

People – Pathogens – Protection

2006 Groundwater Foundation Annual Conference

by Jennifer Wemhoff, The Groundwater Foundation

The efforts of people, the danger of pathogens, and the importance of protection related to groundwater were at the forefront of the discussion at the 2006 Groundwater Foundation Annual Conference and Groundwater Guardian Designation. The Kellogg Hotel and Conference Center on the campus of Michigan State University in East Lansing, Michigan was the setting for the conference, held November 1-3, 2006.

Day one of the conference opened with an overview of waterborne pathogens and their threat to drinking water supplies and human health from Dr. Kristina Mena of the University of Texas School of Public Health. Dr. Mena reported that over half of the documented waterborne disease outbreaks from 1971-2000 were associated in some way with groundwater, and pointed out that “all groundwater is vulnerable to pathogenic contamination.”

A panel discussion about assessing the risks and identifying potential sources of pathogens included Morris Beaton, U.S. Environmental Protection Agency Region V; Jay Beaumont, Orange County, New York Groundwater Guardians; Dr. Ann Marie Gebhart, Underwriters

Laboratories, Inc.; and Dr. Rebecca Head, Monroe County Health Department, Michigan. The group commented on the risks and potential sources of pathogenic contamination such as improperly functioning septic systems, water and food-borne illness, and sewer backups. The panel also addressed the role of source water protection in reducing the impact of waterborne pathogens on drinking water sources, noting that though the goal of source water protection is disease prevention, it often takes an outbreak to spur prevention activities.

Elgar Brown of the Michigan Department of Environmental Quality and David Lusch of Michigan State University spoke about successful strategies for preventing pathogenic contamination. Approaches such as wellhead protection, monitoring, and research and data collection are being implemented in Michigan.

Day one also included an interactive small group session. Participants were divided into groups based on geographic region and asked to develop a pathogenic contamination prevention action plan and report to the larger group. Plans included items such as wellhead protection, public education, integrating potential



▲ Dr. Kristina Mena reported that over half of the documented waterborne disease outbreaks from 1971-2000 were associated in some way with groundwater.

sources of pathogens into a contaminant source inventory, and computer modeling.

The day's program was rounded out with the presentation of various resources and tools to move communities forward in taking action to prevent pathogenic contamination from occurring. Presenters included Susan Seacrest, The Groundwater Foundation, who discussed the forthcoming “Pathogens in Drinking Water Primer,” which will provide general information about pathogens, prevention strategies, and case studies; Jennifer Wemhoff, The Groundwater Foundation, who

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E. coli in Spinach

Is There a Waterborne Link?

by Kelly A. Reynolds, MSPH, PhD

Disease-causing microbes are in the news – again – and this time, linked to produce. As we go to press (*Editor's note: This article was originally published in November 2006*), there have been 192 illnesses, 98 hospitalizations, one confirmed, and two suspected deaths identified in 26 states. The culprit is *Escherichia coli* O157:H7 contamination of spinach. Although spinach is the vehicle of disease transmission, the source of the contamination is currently unknown. Because water is a primary component in the growth, harvesting and production of produce, it cannot be overlooked as a potential source of the outbreak, raising questions as to what controls might be necessary in terms of water quality in the agricultural setting.

A Complex Germ

There are many different types of *E. coli*; many are commonly present in the environment and generally not harmful. Found in the feces of humans and warm-blooded animals, they serve as useful indicators of fecal contamination in drinking water sources. The presence of *E. coli* in drinking water indicates that the water is subject to fecal contamination and that other fecally-transmitted microbes could also be present. On the other hand, several strains of *E. coli* are capable of causing mild to serious and sometimes fatal disease. These are known as enterotoxigenic (ETEC), enteropathogenic (EPEC) or enterohemorrhagic (EHEC)

strains. EHEC strains of *E. coli* cause gastroenteritis with profuse, watery diarrhea accompanied by nausea, abdominal cramps and vomiting. This bacterium is a common cause of travelers' diarrhea. EPEC strains are similar to ETEC isolates but contain toxins that are capable of initiating severe disease. EHEC *E. coli* almost always belong to the single serological type O157:H7. This strain generates a potent group of toxins that produce bloody diarrhea which can be fatal – especially for children and the elderly. *E. coli* O157:H7 is the strain responsible for the recent outbreaks in California-grown spinach but the source of the *E. coli* itself remains a mystery.

Signs of Disease

Early symptoms of the potentially fatal *E. coli* O157:H7 infection are very similar to the flu. Thus diagnosis of the condition may be delayed allowing symptoms to worsen. Many people infected will experience intense cramps and bloody diarrhea four to 10 days after exposure. Although most people recover without antibiotics or other specific treatment in five to 10 days, in a portion of the population, the organism may destroy red blood cells and interfere with kidney function, a condition known as hemolytic uremic syndrome (HUS), possibly leading to organ failure and death.

HUS is a life-threatening condition usually treated in an intensive care unit. Blood transfusions and kidney dialysis are often required. With intensive care, the death rate is between three and five



percent. About one-third of persons with HUS have abnormal kidney function many years later and may require long-term dialysis. Another eight percent of persons with HUS have other lifelong complications, such as high blood pressure, seizures, blindness, paralysis and limited bowel function. In the recent spinach outbreak, an overall 16 percent (30) of the documented cases resulted in advancement to HUS. Children suffered worse than all age groups combined, with an HUS rate of 28 percent.

Infection with *E. coli* O157:H7 is diagnosed by detecting the bacterium in the stool. Persons with mild symptomology rarely seek medical attention and thus researchers believe many more cases of *E. coli* O157:H7 are undocumented. Clinical laboratories do not routinely culture stool for *E. coli* O157:H7, unless the doctor or

patient specifically request the analysis. All persons who suddenly have diarrhea with the presence of blood should have their stool tested for *E. coli* O157:H7.

The ability to immunize against this disease is particularly important, because the infection does not respond well to antibiotics; indeed it is thought that antibiotics may actually increase the incidence of HUS by causing the bacteria to burst and release a toxin into the bloodstream. Scientists working on a vaccine are currently conducting clinical trials to determine effectiveness. Others have suggested that cattle, the primary source of *E. coli* O157:H7 in the environment, be given the vaccine as a means of control.

Why California? Why Spinach?

Foodborne illness in the US is responsible for an

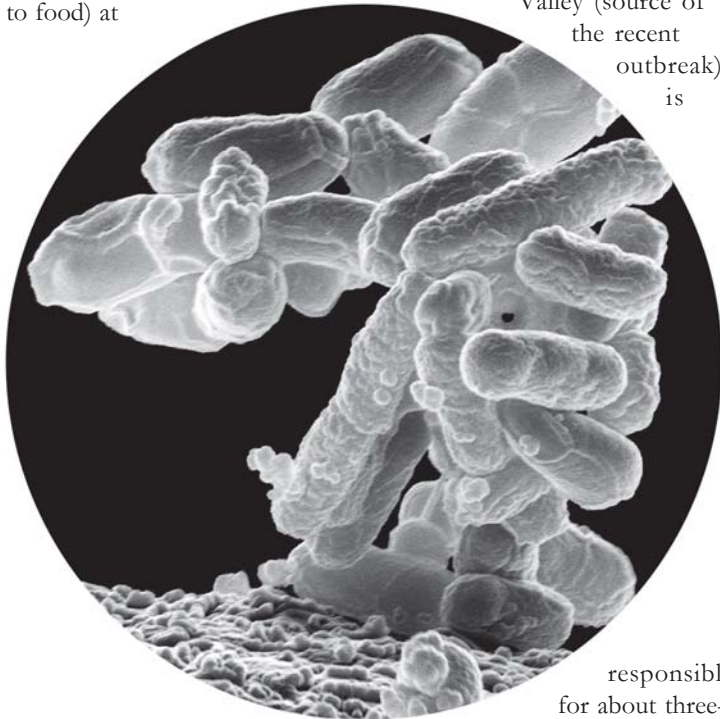
◀ *Even backyard gardens are susceptible to bacteria contamination.*

estimated 76 million cases of disease, 323,000 hospitalizations, and 5,000 deaths per year. Illness from *E. coli* O157:H7 has been caused by a variety of foods including undercooked ground beef, roast beef, raw milk, improperly processed cider, contaminated water, mayonnaise, cantaloupes, vegetables (sprouts, lettuce) and salami. Outbreaks have also started from cross-contamination (contamination from the hands of an infected individual or from contaminated utensils, countertops, etc. to food) at

delicatessens, grocery carryouts and salad bars. Once an outbreak begins, person-to-person transmission in families, schools, daycare facilities, and nursing homes, tends to perpetuate the disease. Historically, the majority of outbreaks are associated with contaminated ground beef, but recently contaminated surface and groundwater have been identified as frequent outbreak sources.

The outbreak in California spinach is not the first of its kind. Many outbreaks have been linked to *E. coli* and fresh lettuce or spinach in the last 13 years. California produces about 75 percent of the US

Valley (source of the recent outbreak) is



▲ *A cluster of E. coli bacteria as viewed through a microscope.*

responsible for about three-quarters of the state's production. Although cattle are the primary source of *E. coli* O157:H7, the organism is transmitted through the environment via stormwater run-off of animal waste operations, sewage

contamination of irrigation waters, contamination from human hands during harvest, packing and processing (also a potential link to water, or lack thereof, in handwashing and hygiene), rinsing, and preparation.

One study found that *E. coli* O157:H7 persisted for five months in soil amended with contaminated composts or irrigation water and for 77 and 177 days on lettuce and parsley, respectively, when planted as seedlings.¹

Some studies have shown that treatment of produce with chlorinated water reduces harmful microbes on the surface but others caution that the surface of produce can be difficult to wash given the varying texture and folds. In addition, plants may be able to internalize the organisms along with water and nutrients or via surface abrasions. Therefore, washing alone may not be effective.

Water Treatment Options in Food Production

The need for clean water and proper waste disposal in produce harvesting applications is a given, as is proper sanitization of processing equipment. Debatable is the feasibility and benefit of advanced water protection and treatment applications related to the production of produce. Should we focus on increased protection of irrigation waters from wild and domestic animals? What is the feasibility of on-site (i.e. POU) treatment of water used in the growth and processing of produce in the

US? What are the risks related to the current procedures? If this *E. coli* outbreak in spinach is related to contaminated water, what options for water treatment at the field production level should be considered?

At press time, the Centers for Disease Control and Prevention (CDC) were focusing on the implicated farms, tracing back from illness cases to the environmental sources such as water, soil and the produce itself. Whether or not water is implicated in this outbreak, the role that contaminated water plays in relation to foodborne outbreaks needs to be considered along with feasible practices for control. For more information about the *E. coli*/spinach outbreak, visit ProMed Mail, International Society for Infectious Diseases at www.promedmail.org.♦

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Reference

¹ Islam, M. et al., 2004. Persistence of enterohemorrhagic *Escherichia coli* O157:H7 in soil and on leaf lettuce and parsley grown in fields treated with contaminated manure or irrigation water. *Journal of Food Protection*. 67: 1365-70.

spoke about an in-development manual to help community groups implement an education and testing program, and a Septic System Lake Community Education Kit; Ruth Kline Robach, Michigan State University, who spoke about the benefits of participating in Groundwater Guardian; and Morris Beaton, who discussed a free software package to track onsite wastewater treatment systems.

Day two of the conference focused on community action to protect groundwater. Mark Lelle, a private evaluation

Lee Drummond, City of Dayton, Ohio Water Department, presented a case study of documenting environmental and economic outcomes. Drummond talked about the difficulty of not only measuring effectiveness in protecting drinking water, but in balancing the environmental and economic factors of protection activities in Dayton's Multi-Jurisdictional Wellfield Protection Program.

Wellhead area management is key to effectively protecting drinking water. Daryl Andersen of the

Little Blue Natural Resources District, Nebraska spoke about a small Nebraska community with nitrate contamination issues and the wellhead protection



▲ Participants work in small groups to develop pathogenic contamination prevention action plans.

► The Groundwater Foundation presented flags to Groundwater Guardian Communities and Affiliates celebrating their tenth year of designation.

consultant, spoke about using the program logic model as a tool in developing, implementing, and evaluating local groundwater protection and education efforts. The model includes factors such as resources, activities, outcomes, and impacts.

Dr. Allen Krizek of Michigan State University Extension discussed documenting and addressing environmental risks. Dr. Krizek focused on Michigan's Turfgrass Program, which works with golf courses in Michigan to assess potential environmental hazards and implement environmentally-friendly practices.

activities being implemented to address the contamination.

The final speaker of day two was Seacrest, who presented the Groundwater Guardian Green Sites (GGGS) program. This new program is currently being developed in connection with The Groundwater Foundation's Growing Groundwater Guardians project. GGGS will offer Groundwater Guardians



the opportunity to work with specific locations within their community on implementing and documenting groundwater-friendly practices.

The conference also included a walking tour of the Red Cedar River on Michigan State University's campus and a presentation about GIS in Michigan's wellhead protection efforts, and the annual National Awards Luncheon (see page 5).

Groundwater Guardians Recognized

The conference again recognized the efforts of Groundwater Guardian Communities and Affiliates for their local groundwater protection and education activities in 2006. Team representatives were honored at the National Groundwater Guardian Designation Ceremony with the presentation of plaques, a

photographic slideshow highlighting team activities, and brief comments from team representatives about their experiences in the program.

Special recognition was given to Communities and Affiliates celebrating their tenth year of designation with

the presentation of a flag with the phrase "10 Years of Groundwater Protection." Communities receiving flags were Orange County Water District, California; Offutt Air Force Base, Nebraska; Hamilton to New Baltimore, Ohio; Springfield, Oregon; and Marshfield Area, Wisconsin. Affiliates recognized were the Northern Illinois Regional

Groundwater Protection Planning Committee, Michigan Groundwater Guardian Affiliate, and U.S. Geological Survey Nebraska Water Science Center.

The fourth annual Groundwater Guardian Silent Auction followed the ceremony and featured items donated by Groundwater Guardian teams and others from across the country. Items such as a breast cancer awareness basket, original photography, Cargill products and logo items, and regional gift baskets helped raise \$1200 to support the Groundwater Guardian program.

The celebration concluded at a banquet, where outgoing members of the Groundwater Guardian Council, the primary advisory group to the Foundation for the program, were recognized for their service to the program with the Phil Peters Groundwater Guardian Service Award. 2006 recipients of the award were Chris Barnett, Indianapolis-Marion County, Indiana; Lisa Corbitt, Mecklenburg County, North Carolina; and Lee Drummond, Dayton Multi-Jurisdictional Wellfield Protection Program, Ohio.

Conference Partners

The 2006 Conference was made possible with support from the Lincoln-Lancaster County Health Department, Michigan Section – American Water Works Association, Nebraska Department of Environmental Quality, U.S. Environmental Protection Agency Office of Ground Water and Drinking Water, U.S. Geological Survey Denver Office, U.S. Geological Survey Michigan Water Science Center, U.S. Geological Survey Nebraska Water Science Center, W.K. Kellogg Foundation, and Water Systems Council. ♦

Honoring Groundwater Stewardship

2006 National Awards

by Zoe McManaman, *The Groundwater Foundation*

On November 2, 2006, a luncheon was held at The Groundwater Foundation's Annual Conference to honor the Foundation's 2006 National Awards recipients. Recognized for their efforts through government service, education, and leadership, these individuals exemplify the importance and impact of local groundwater protection.

Bill Schatz of David City, Nebraska received the E. Benjamin Nelson Government Service Award. Bill's efforts emphasized the relationship of successful groundwater stewardship and the leadership and contributions of those in government. As a city council member, Bill chaired the Wellhead Protection Committee and helped draft and pass the David City Wellhead Protection Plan and Ordinance. He also led efforts to make improvements to the city's water system and worked with city staff to secure funds for fencing around wells and spill containment for storage tanks at the power plant.

Bill was instrumental in educating local leaders on the benefits of using recycled water for golf course irrigation and assisted in securing funding for an irrigation project for the city-owned golf course. The project uses treated and recycled wastewater from the city's wastewater lagoons to irrigate the golf course, saving over seven million gallons of well water annually. Bill was also involved in the creation of a Rural Water project, allowing smaller communities to join with other water systems to comply with federal standards for water quality and maintain public water systems.

Rhonda Artho of Dumas, Texas was selected to receive the Edith Stevens Groundwater Educator Award. Through education, Rhonda has shared her understanding of the importance of groundwater and motivated others to protect groundwater. Rhonda organizes and directs the "Water Wonders" festival attended by over 450 students annually. Rhonda also designed and implemented youth education programs, including the development of a high school social studies unit on groundwater management and the roles of Groundwater Conservation Districts in Texas.

Rhonda educates adults through presentations to professional organizations on becoming more involved in groundwater education and outreach, and collaborates with the Ogallala Commons organization to implement joint teacher training and festivals. She conducts "Water Wise" gardening classes teaching the public about low water use landscaping and drip irrigation. She also produced the "Handbook for Using Water Efficiently in the Texas Panhandle" which is distributed in garden stores and city utility offices in the panhandle.

Dennis Coryell of Burlington, Colorado, received the Vern Haverstick Groundwater Hero Award in honor of his legacy of volunteer service and commitment to groundwater protection. Dennis serves as the President of the Republican River Water Conservation District (RRWCD). He spearheaded RRWCD's sponsorship of Colorado's \$66 million



▲ 2006 National Award winners, from left: Jami Harper, Rhonda Artho, Dennis Coryell, and Bill Schatz.

Republican River Conservation Reserve Enhancement Program which led to the retirement and conservation of 30,000 groundwater-irrigated acres.

Dennis serves as a board member for the Colorado Ground Water Commission, Plains Ground Water Management District, and Kit Carson County Farm Bureau. Through his participation in these organizations, Dennis has contributed to the formulation of groundwater policy throughout the state, assisted in resolving conflicts arising over the use of limited groundwater supplies, and developed management practices for the stewardship of Colorado's groundwater resources. In cooperation with Colorado State University and the Natural Resource Conservation Service, Dennis has undertaken a Conservation Innovation Grant, deficit irrigating 120 of his irrigated acres through crop rotation.

Jami Harper of Grand Island, Nebraska, earned her recognition as the recipient of the Youth Award for Leadership and Excellence in Groundwater through her involvement with water

protection activities over the past 10 years. She began by volunteering at the Nebraska Children's Groundwater Festival as a classroom assistant and class guide. In 2004, Jami created the festival activity H₂OWood Squares—an interactive educational game based on the popular television game show Hollywood Squares. She also developed an interactive Festival exhibit teaching water principles.

With a contribution from Volvo, Jami established two \$5,000 endowments. The first endowment was to the Nebraska Children's Groundwater Festival committee to provide grants for youth to present festival activities. The second endowment is a scholarship fund to assist with college expenses for high school seniors involved in water protection activities. She also developed and oversees the Water Wizard website, featuring daily questions and answers about water protection.

For more information about the National Awards or for a list of past award winners, visit www.groundwater.org/pe/pe.html.

Groundwater Week

Mark your calendars for
Groundwater Awareness Week,
March 11-17, 2007.

For more information, visit
www.wellowner.org.

Rule Addresses Drinking Water Protection

More than 100 million Americans will enjoy greater protection of their drinking water under a new rule issued by the U.S. Environmental Protection Agency. The rule targets utilities that provide water from underground sources and requires greater vigilance for potential contamination by disease-causing microorganisms.

“The Groundwater Rule boosts drinking water purity and public health security,” said Benjamin H. Grumbles, assistant administrator for Water. “These first-ever standards will help communities prevent, detect and correct tainted groundwater problems so citizens continue to have clean and affordable drinking water.”

The strategy incorporated in the rule provides for regular sanitary surveys of public water systems to look for deficiencies in key operational areas, triggered source-water monitoring when a system that does not sufficiently disinfect drinking water identifies a positive sample during its regular monitoring to comply with existing rules, implementation of corrective actions by groundwater systems with a significant deficiency or evidence of source water fecal contamination, and compliance monitoring for systems that are sufficiently treating drinking water to ensure effective removal of pathogens.

A groundwater system is subject to triggered source-water monitoring if its

treatment methods don't already remove 99.99 percent of viruses. Systems must begin to comply with the new requirements by Dec. 1, 2009.

Contaminants in question are pathogenic viruses, such as rotavirus, echoviruses, and noroviruses, and pathogenic bacteria, including *E. coli*, salmonella, and shigella. These contaminants can cause gastroenteritis or, in rare cases, serious illnesses such as meningitis, hepatitis, or myocarditis. Symptoms can range from mild to moderate cases lasting only a few days to more severe infections that can last several weeks and may result in death for those with weakened immune systems.

Fecal contamination can reach groundwater sources, including drinking water wells,

from failed septic systems, leaking sewer lines, and by passing through the soil and large cracks in the ground. Fecal contamination from the surface may also get into a drinking-water well along its casing or through cracks if the well is not properly constructed, protected, or maintained.

The Centers for Disease Control and Prevention reports that between 1991 and 2000, groundwater systems were associated with 68 disease outbreaks that caused 10,926 illnesses. Contaminated source water was the cause of 79 percent of the outbreaks in groundwater systems.

For more information about the Groundwater Rule and drinking water, visit www.epa.gov/safewater/disinfection/gwr.