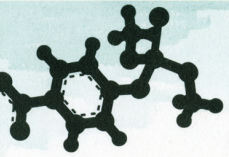
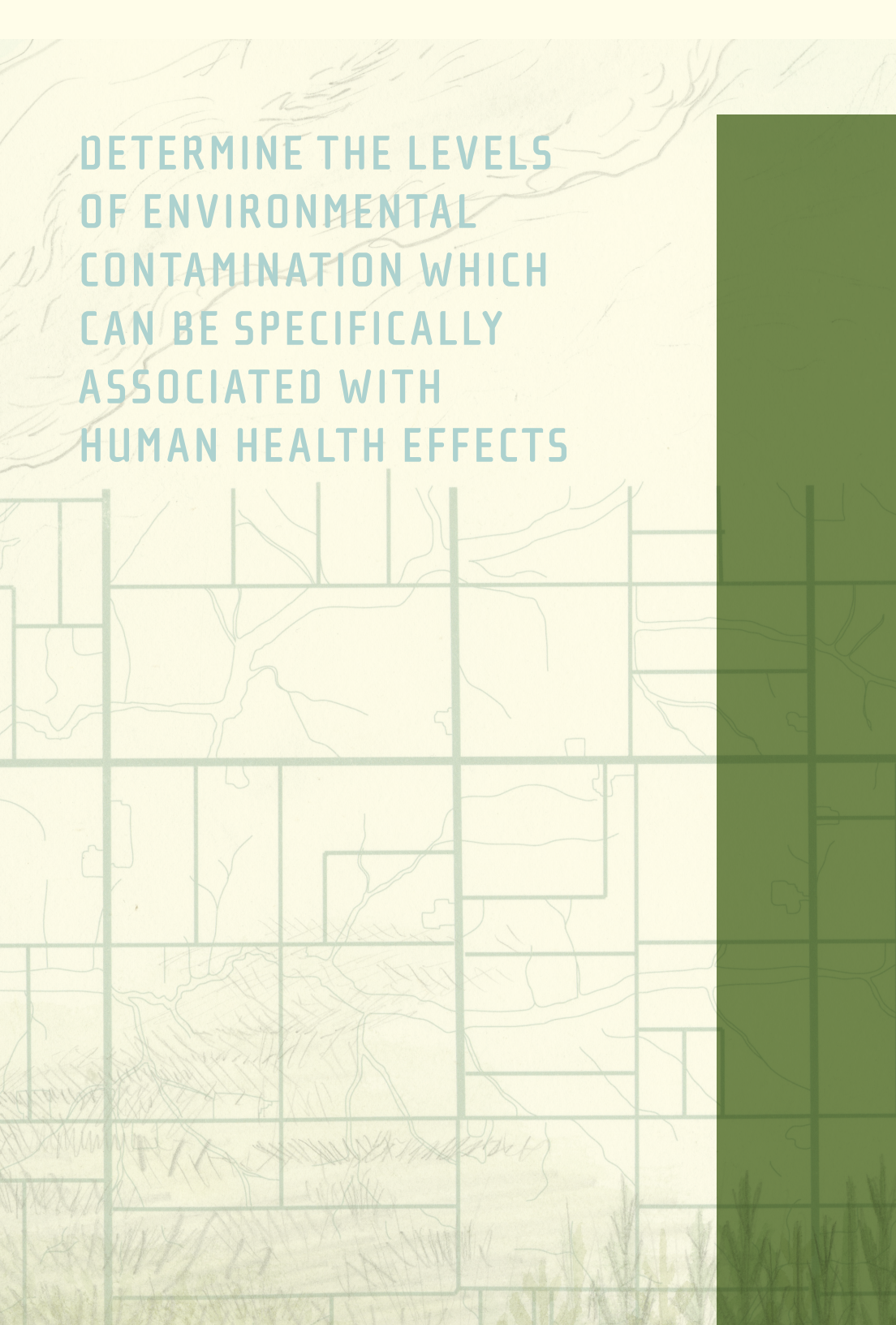


2011-2012
BIENNIAL REPORT

CHEEC CENTER FOR HEALTH EFFECTS OF ENVIRONMENTAL CONTAMINATION

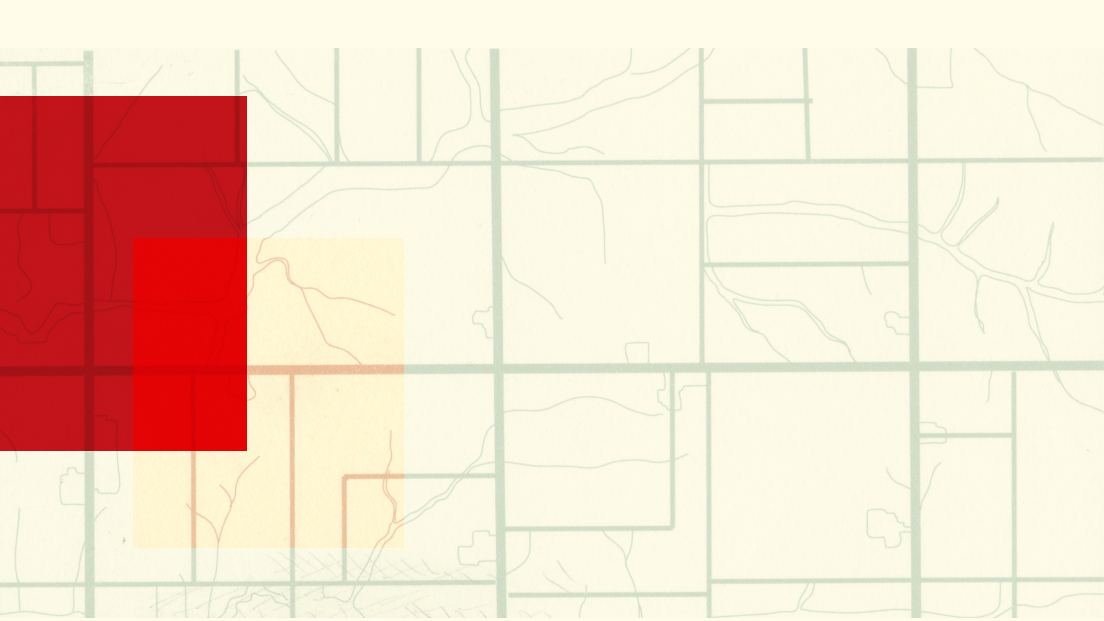


The background features a light green, textured landscape with a grid overlay. The grid consists of thin, dark green lines forming a series of rectangular cells. The landscape includes stylized trees and foliage, particularly in the lower half. A solid dark green vertical bar runs along the right edge of the image. The text is positioned in the upper left quadrant, overlaid on the grid and landscape.

DETERMINE THE LEVELS
OF ENVIRONMENTAL
CONTAMINATION WHICH
CAN BE SPECIFICALLY
ASSOCIATED WITH
HUMAN HEALTH EFFECTS

THE UNIVERSITY OF IOWA (UI) CENTER FOR HEALTH EFFECTS OF ENVIRONMENTAL CONTAMINATION (CHEEC) is a multidisciplinary environmental research center dedicated to supporting and conducting research that investigates possible adverse health outcomes related to exposure to environmental toxins. CHEEC's major activities include 1) developing and maintaining environmental databases to be used in conducting environmental health research, 2) cooperating and collaborating on environmental health research programs and projects, 3) managing a seed grant program to support environmental research, and 4) providing a variety of education and service programs to the citizens of Iowa and the region. CHEEC is comprised of faculty and researchers located in the UI Colleges of Engineering, Public Health, and Liberal Arts and Sciences, and the State Hygienic Laboratory. CHEEC cooperates and collaborates with the Iowa Departments of Public Health (IDPH), Natural Resources (IDNR), and Agriculture and Land Stewardship (IDALS). CHEEC's mission, as described in the 1987 Iowa Groundwater Protection Act, is to *"determine the levels of environmental contamination which can be specifically associated with human health effects."*

This report presents an overview of research activities conducted by or supported by CHEEC, as well as education programs and service functions CHEEC staff participated in during 2011–2012. 2012 was the 25th anniversary of the Iowa Groundwater Protection Act. A summary of the past 25 years of Iowa water quality and health effects research using Iowa municipal water supply data and private well water quality data is also presented.



ENVIRONMENTAL DATABASES

ENVIRONMENTAL CONTAMINANT DATABASES are a central component of CHEEC operations. CHEEC created and maintains databases on Iowa drinking water quality, including the *Iowa Historical Municipal Water Supply Source and Treatment Database*, the *Municipal Analytical Water Quality Database*, and the *Iowa Private Well Water Database*. The municipal supply databases are utilized in conducting drinking water quality and health effects research. The private well databases are used to look at trends in private well water quality, and to collect baseline data on emerging contaminants.

Iowa Municipal (Public) Water Supplies

The CHEEC Municipal Analytical Water Quality Database contains information compiled from numerous sources including state and federal special surveys, regulatory programs (Safe Drinking Water Act), and various academic studies. This database houses information dating from the 1930s and from the 1960s to the present. The Historical Municipal Water Supply Source and Treatment Database contains information dating back through the early 1900s. This database is updated every 5 years by contacting public water utilities across Iowa about changes to their water treatment process and new water sources. The most recent update was completed in 2012.

Iowa Private Drinking Water Wells

CHEEC maintains data from a number of surveys of Iowa private drinking water wells. The Iowa Statewide Rural Well Water Survey (SWRL, 1988–89) was conducted by CHEEC and the Iowa Geological Survey Bureau (IDNR) as part of the implementation of the Iowa Groundwater Protection Act. SWRL provided a statistically valid assessment of the proportion of private rural wells and rural residents affected by various environmental contaminants, and a cross-section of the quality of Iowa groundwater. A total of 686 wells were sampled for coliform bacteria, nitrate, 27 pesticides (and 5 metabolites) and major inorganic ions. A second phase of the SWRL study (SWRL2) was conducted in 2006–08. In this study, 473 private rural drinking water wells were sampled; 116 of the wells were original SWRL study wells; the other wells were randomly selected from the IDNR's Private Well Tracking System. SWRL2 tested for the same contaminants as the original SWRL, with the addition of arsenic. The Iowa Community Private Well Study (2002–03) includes water quality data for 230 private drinking water wells in 50 incorporated Iowa towns not served by a public water supply system.



RESEARCH AND DATA MANAGEMENT

In 2011–2012, CHEEC staff participated in the following projects as Investigators, in developing and maintaining project databases, and in providing applications programming.

Exposure assessment method for disinfection byproducts in drinking water

COLLABORATORS: National Birth Defects Prevention Study centers, U.S. EPA, CHEEC

FUNDING AGENCIES: National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention (CDC)

This project is calculating disinfection byproducts (DBP) exposures in public drinking water systems for participants in the National Birth Defects Prevention Study (NBDPS). The exposure assessment includes linking geocoded maternal addresses to appropriate drinking water utilities, linking relevant DBP water quality data to those residences, and modeling the DBP data to account for possible spatial and temporal variability.

Nitrates, nitrites and nitrosatable drugs and the risk for selected birth defects

COLLABORATORS: Texas A&M University, Iowa Registry for Congenital and Inherited Disorders, NBDPS centers, CHEEC

FUNDING AGENCY: National Institute for Environmental Health Sciences

This study is examining the separate and joint effects of prenatal exposures to nitrates, nitrites and nitrosatable drugs on the risk for selected congenital malformations in children, using data collected by the NBDPS. Texas and Iowa are conducting an exposure assessment for nitrate in public drinking water and in bottled water; Texas is modeling nitrate in private well water.

Iowa Environmental Public Health Tracking (EPHT) Program

COLLABORATORS: IDPH, CHEEC, various Iowa state agencies, UI research units, and County Health Departments

FUNDING AGENCY: CDC

The Iowa EPHT Program is “*the ongoing collection, integration, analysis, interpretation, and dissemination of data on environmental hazards, exposures to those hazards, and health effects that may be related to the exposures. The goal of tracking is to provide information that can be used to plan, apply, and evaluate actions to prevent and control environmentally related diseases.*” CHEEC provides private well water quality data for this Program, and serves in an advisory capacity.

Muscular Dystrophy Surveillance, Tracking and Research network (MDSTARnet)

COLLABORATORS: CDC, Iowa Registry for Congenital and Inherited Disorders, IDPH, research units in Arizona, Colorado, Georgia, and New York.

FUNDING AGENCY: CDC

CDC is working with researchers to set up surveillance/tracking systems for Duchenne/Becker muscular dystrophy (DBMD), the most common muscular dystrophy in children. The goal is to find all DBMD patients in these states by using information from clinic medical records and hospital records. Information about each child’s treatments and medical status will be reviewed to try and answer many questions about DBMD.

Water quality data for private wells for the Agricultural Health Study

COLLABORATORS: National Cancer Institute, CHEEC, State Hygienic Laboratory

FUNDING AGENCY: National Cancer Institute

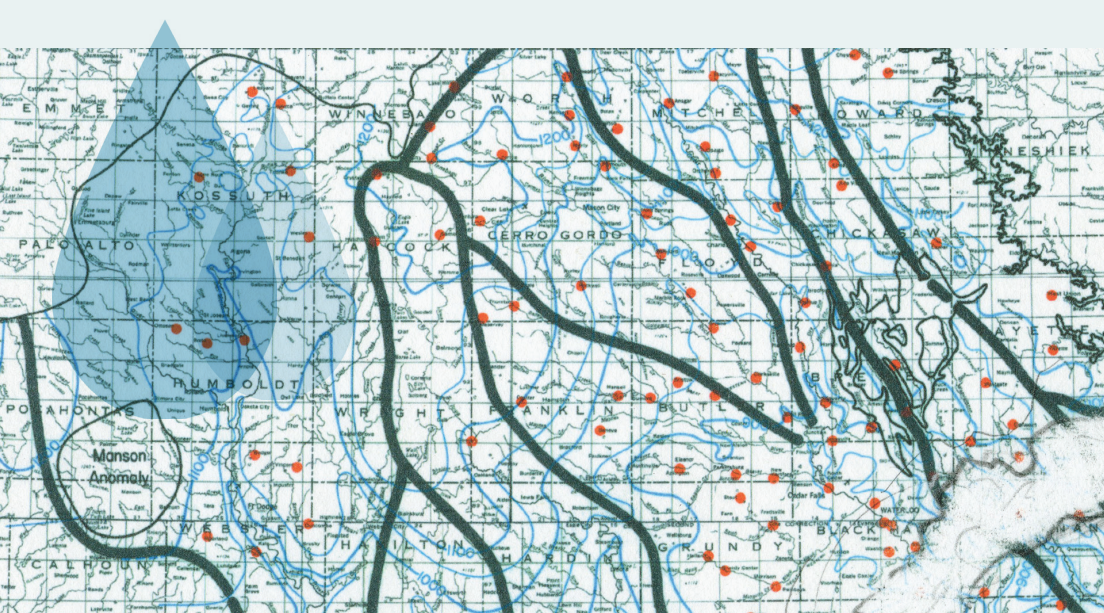
This project provided nitrate, pesticide and other water quality data for private wells and public water utilities across Iowa to use in modeling drinking water exposures for participants in the Agricultural Health Study. Over 89,000 persons are in this Study (Iowa and North Carolina); the goal is to investigate the effects of environmental, occupational, dietary, and genetic factors on the health of the agricultural population.

Epidemiological health survey of DOD contract workers at the Iowa Army Ammunitions Plant in Middletown, IA

COLLABORATORS: U.S. Department of Defense, UI Department of Occupational and Environmental Health

FUNDING AGENCY: U.S. Department of Defense

CHEEC provided database management and applications support for this investigation of worker health at Department of Defense facilities in Iowa.



25 YEARS OF WATER QUALITY RESEARCH

THE IOWA GROUNDWATER PROTECTION ACT specified that CHEEC develop a plan to “...assemble all existing data relating to Iowa drinking water supplies, including characteristics of source, treatment, presence of contaminants, precise location, and usage patterns to facilitate data retrieval and use in research...” The Act also listed numerous activities that CHEEC may engage in, including “...perform epidemiologic studies to relate occurrence of a disease to contaminant exposure and to ensure that other factors known to cause the disease in question can be ruled out...”

In response to these directives, CHEEC has been involved in several studies of possible relationships between drinking water contaminants and adverse health outcomes, particularly cancers and birth defects. Iowa municipal (public) water supply data have been used to conduct exposure assessments to nitrate, pesticides, and disinfection-byproducts in a number of Iowa-based studies. Private drinking water wells have been studied to look at trends in occurrence of emerging contaminants of public health concern. Following is an overview of the Iowa studies that have utilized CHEEC data and staff expertise to investigate drinking water contaminant exposure, recreational water exposure, and health effects. A bibliography of peer reviewed articles and technical reports on those studies is presented at the end of this report.

The Iowa Women's Health Study In 1986, a survey was mailed to 98,030 randomly selected women between the ages of 55–69 years who had a valid Iowa driver's license. The survey was completed by 41,386 women (the Iowa Women's Health Study (IWHS) cohort). Information on drinking water use was collected in a 1989 follow-up questionnaire, in which participants were asked the main source of their drinking water at their current residence (municipal water system, private well water, bottled water or water from other sources) and how long they had been drinking the type of water indicated. A total of 27,811 women drank the same type of water for more than 10 years. Of this group, 16,541 women (from 396 communities) were included in analyses of nitrate and risk for various cancers. Historical data (1955–88) on Iowa municipal water supplies (from the CHEEC Municipal Analytical Water Quality Database) were used to estimate exposure to nitrate in drinking water. The IWHS is traced annually for cancer incidence by linkage to the State Health Registry of Iowa's cancer database. Drinking water nitrate and risk for bladder, thyroid, ovarian, breast and other cancers has been studied in the IWHS. Currently, work is being conducted on examining exposures to drinking water disinfection byproducts in the IWHS.

The Iowa Cancer Case-Control Study Participants in the Iowa Cancer Case-Control Study were Iowa residents 40–85 years of age, who were newly diagnosed with a cancer (colon, rectum, bladder, kidney, pancreas, or brain) between 1986–89; cases were identified by the State Health Registry of Iowa. A common set of 2434 controls was identified from Iowa driver's license records and Health Care Financing Administration listings. Controls were frequency-matched to the overall case group (all types of cancers combined) by age (in 5-year age groups) and sex. Nitrate data from Iowa municipal water supplies from 1960–88 (from the CHEEC database) were used to calculate individual exposure levels, which were examined for their relationship to risk for cancers of the bladder, colon and rectum, and pancreas in Iowa Cancer Case-Control Study participants.

The National Birth Defects Prevention Study The NBDPS is a population-based study that began in 1997 to investigate genetic and environmental risk factors for 31 major birth defects. The NBDPS is being conducted by birth defects registries in 8 states, including the Iowa Registry for Congenital and Inherited Disorders. Women with pregnancies affected by birth defects and women with unaffected pregnancies are interviewed about their health, diet and lifestyle during their pregnancies; the interview includes questions about personal water use (source of water, use of filters, quantity of water consumed at work and home, and changes in consumption). NBDPS studies of Iowa populations and drinking water contaminants include *Exposure assessment method for disinfection byproducts in drinking water* and

Nitrates, nitrites and nitrosatable drugs and the risk for selected birth defects. Work continues on drinking water contaminants (atrazine, arsenic, heavy metals) and risk for birth defects in the NBDPS.

The Agricultural Health Study The Agricultural Health Study is a prospective study of licensed pesticide applicators from North Carolina and Iowa recruited in 1993-1997 at the time of license renewal. The cohort includes 4,916 commercial applicators from Iowa and 52,395 private applicators, mostly farmers, from both states. Drinking water nitrate (from both municipal water supplies and private drinking water wells) is being studied as a possible risk factor for a variety of cancers in the cohort.

The Iowa Beach Study A study of beach users from three Iowa beaches was conducted in the summer of 2005 to determine the number of self-reported GI illness symptoms and skin irritation /rash symptoms in swimmers and non-swimmers, and to correlate those numbers with bacterial levels in beach water. 1039 people were recruited for the study; 261 people participated on-line in a web-based system to collect baseline information, and completed follow-up surveys about water activities, time spent at the beach, and occurrence of GI illness or skin irritation. Water samples were collected daily and analyzed for *E.coli*, enterococci, and total microcystin toxin. Associations between bacteria and reported illness included enterococci level and diarrhea, enterococci level and skin irritation/rash symptoms, and microcystin toxin level (<1 µg/L) and skin irritation/rash. The results of this study indicate that more research is needed to determine if these associations exist on a larger scale at other inland beaches and to further explore the positive correlation between low levels of microcystin toxin and skin irritation/rash.



AN ESTIMATED 450,000 IOWANS RELY ON PRIVATE WELLS FOR THEIR DRINKING WATER.

Private well water quality surveillance activities

While public water supplies are regulated under the federal Safe Drinking Water Act, maintaining good water quality in private wells is the responsibility of the well owner. An estimated 450,000 Iowans rely on private wells for their drinking water. CHEEC has been involved in a number of surveillance projects looking at private well water quality and well contamination issues in Iowa.

The Iowa Statewide Rural Well Water Survey (SWRL: 1988–89)

This study, mandated by the Iowa Groundwater Protection Act, was a one-time random systematic sampling of 686 private rural wells, which was designed to estimate both the proportion of rural wells that were affected by various environmental contaminants and the proportion of rural Iowa residents using contaminated private well water supplies. SWRL documented widespread nitrate and bacteria contamination and, to a lesser extent, herbicide contamination of wells. Ten percent of SWRL wells were re-sampled in 1990–91.

The Iowa Community Private Well Study (2002–03) This study sampled water from private drinking water wells in incorporated Iowa towns not served by a public water supply system. Water samples were analyzed for common use pesticides, nitrogen compounds, inorganics, bacteria, and VOCs. The study had two components: 1) 103 drinking water wells from a total of 50 towns that did not have a public water supply were randomly selected for sampling, and 2) existing databases of potential contamination sources were used to intensively sample 15 communities (total of 133 wells) with private septic systems, underground storage tanks, agricultural grain and chemical storage dealerships, active and closed landfills, feedlots, railroad systems, and industries in violation of wastewater permit applications. Important findings from the study were the detection of arsenic in about 25% of the wells sampled, and the atrazine degradate DEA detected in 18% of the wells.

The Carroll County Well Water Study (2007–08) Private drinking water wells in Carroll County (IA) were sampled as part of the Comprehensive Assessment of Rural Health in Iowa project. Fifty wells were tested for nutrients, bacteria, metals, pesticides and herbicide degradates for potential seasonal variation in a confined geographic area (county), and possible risk factors related to well characteristics/proximate sources of contaminants. An additional 100 wells were sampled for total coliform bacteria, *E. coli*, enterococci, somatic coliphage, and chloride, as part of a special microbial monitoring study. Study objectives were to determine 1) enterovirus incidence,

2) the occurrence of traditional and non-traditional fecal indicators in groundwater (e.g. somatic coliphage, chloride, and enterococci), and 3) whether the source of fecal pollution was human. The two indicators found in the highest number of impacted wells were total coliform bacteria (67%) and total enterococci (61%).

The Iowa Statewide Rural Well Water Survey Phase 2

(SWRL2: 2006–08) This study was conducted as a follow-up study to the original SWRL. SWRL2 objectives were to examine trends in water quality since 1988–89 and collect baseline data for emerging contaminants. A total of 473 private wells were sampled; 116 of the wells were original SWRL wells, the other 357 wells were randomly selected from the IDNR’s Private Well Tracking System. Findings include: 43% of the wells had total coliform bacteria, 19% had enterococci, and 11% had *E. coli*. Almost half of the wells had nitrate, with 12% having ≥ 10 mg/L nitrate-N (EPA MCL for public water supplies). 48% of wells had arsenic; 8% had arsenic ≥ 0.01 mg/L (EPA MCL). 8% of wells had atrazine at very low concentrations. Herbicide degradates were fairly common in wells: 11% had desethylatrazine, 11% had acetochlor ESA (ethane sulfonic acid), 27% had alachlor ESA, 33% had metolachlor ESA, and 8% had metolachlor OXA (oxanilic acid).

Emerging water quality issues

Arsenic occurs naturally in geologic deposits and can become concentrated in groundwater, depending on subsurface chemical conditions and other factors. While arsenic is regulated in public water systems, private well users may be at risk for exposure to arsenic. The Iowa Community Private Well Study and SWRL2 documented arsenic contamination of private wells in several areas of the state. Efforts are underway to conduct pilot research on drinking water arsenic exposure and risk for adverse reproductive outcomes in Iowa.

Human enteric viruses have recently been detected in groundwater that supplies municipal wells in Wisconsin. A seed grant project looking at viruses in an alluvial aquifer in central Iowa is described in the next section under Seed Grants; a surveillance effort will be getting underway in 2013 to sample a network of municipal wells in Iowa (see study overview under Cooperative Research Grants).



SEED GRANTS

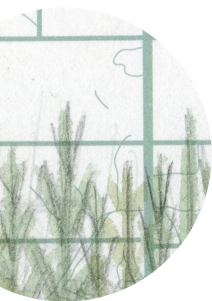
CHEEC AWARDS APPROXIMATELY ONE-THIRD of its annual state allocation to pilot-scale research. Since the inception of the CHEEC Seed Grant Program in 1988, 125 projects have been funded. To date, the return from federal, state and private sector grants and contracts for larger research efforts has been over \$11 for every \$1 invested by CHEEC. More importantly, seed grant projects create a valuable learning environment for undergraduate and graduate level students, with the vast majority of projects resulting in either Masters or PhD theses for the student investigators. Dozens of technical reports and over 80 articles in peer-reviewed journals have been published to date on CHEEC seed grant research projects. A bibliography of peer reviewed articles published on seed grant projects on environmental chemistry and engineering studies of Iowa water quality is presented at the end of this report.

CHEEC awarded the following seed grants in FY 2011 and FY 2012.

Pesticide exposure and risk of endometriosis

INVESTIGATORS: E. Smith, L. Rubenstein, UI Dept. of Epidemiology; B. Stegmann, UI Dept. of Obstetrics and Gynecology; L. Fuortes, UI Dept. of Occupational and Environmental Health; D. Sandler, J. Hoppin, National Institute of Environmental Health Sciences

SUMMARY: Endometriosis is a chronic disease affecting ~15% of U.S. reproductive-aged women, and is a significant cause of infertility. A possible risk factor is exposure to organochlorines (OCs). Diagnosed cases of endometriosis have been detected with longer exposure or higher serum concentrations than controls for OCs; however, study results have been inconsistent due partly to small numbers of cases/controls and limited exposure history. Analyses using the Agricultural Health Study will provide a significantly larger sample size for a case-control study and detailed measures of pesticide and environmental exposure to common agricultural pesticides and to OCs.



Using human enteric viruses to track groundwater contaminants to a municipal drinking water supply in an alluvial aquifer

INVESTIGATOR: W. Simpkins, Dept. of Geological and Atmospheric Sciences, Iowa State University (ISU)

SUMMARY: Alluvial aquifers are a widely used source of drinking water in Iowa. They are vulnerable to contamination due to shallow water tables, hydraulic interchange with streams, and flooding potential. The Ames (IA) aquifer is one such aquifer. The hypothesis that human enteric viruses enter the Ames aquifer from the South Skunk River and are transported to the municipal well field that supplies the Ames drinking water will be tested by analyzing river water and groundwater in piezometers and wells for viruses and stable isotopes along a groundwater flow path. This study will provide data on the extent and temporal variability of human enteric viruses in drinking water and demonstrate an innovative method to assess groundwater under the direct influence of surface water in alluvial aquifers.

Enantiospecific disposition of chlordane in a mouse model lacking NADPH-dependent Cytochrome P450 Reductase

INVESTIGATORS: E.D. Oldham, I. Kania-Korwel, H.J. Lehmler, UI Dept. of Occupational and Environmental Health

SUMMARY: The pesticide chlordane is a persistent environmental contaminant linked to a range of adverse health effects in animals. Chlordane's chiral isomers may be metabolized in an enantiospecific manner (similar to other chiral pollutants) by cytochrome P450 enzymes. This study will take advantage of a knockout mouse model lacking the NADPH-dependent cytochrome P450 reductase, a critical enzyme in the catalytic cycle of P450 oxidation, and measure levels

and enantiomeric fractions of chlordane and its metabolites in tissue from wild-type and knockout mice. This will provide key mechanistic information about enantiospecific metabolism of chlordane, and can be extended to other pesticides commonly found in Iowa.

Establishing a methodology for the detection of silica particles in lung cancer tissue using computer-controlled scanning electron microscopy

INVESTIGATORS: K. Coleman, R.W. Field, UI Dept. of Occupational and Environmental Health

SUMMARY: Crystalline silica is an occupational hazard of the dusty trades; exposures resulting in silicosis. IARC categorizes respirable crystalline silica as a Grade 1 human carcinogen; silica may be implicated in the development of lung cancer. Silica may also be an environmental hazard; patients with no known exposure may show measurable quantities of silica within cancerous tissue samples. This study will develop methods using Computer-Controlled Scanning Electron Microscopy to examine silica content in lung cancer tissue. Showing that silica is not evenly distributed within the tissue will establish the need to use automated full scanning techniques to guarantee analysis is not subject to random sampling/researcher error, which may show random sampling of zones for analysis under-representative of silica levels in the tissue.

Sequence analysis of transferable genes encoding bacterial attachment and multi-drug resistance

INVESTIGATORS: L. Jarboe, ISU Dept. of Chemical and Biological Engineering; M. Soupir, ISU Dept. of Agricultural and Biosystems Engineering; C. Logue, L. Nolan, ISU Dept. of Veterinary Microbiology and Preventive Medicine

SUMMARY: The attachment of agricultural *E coli* to environmental particles is associated with multi-drug resistance; the genes responsible for bacterial attachment may be encoded on a mobile genetic element that also encodes resistance and virulence. These genetic elements are transferable genes that can pass from one bacterium to another; plasmids are the most common form. These genes are possible environmental contaminants that could threaten human health. This study will attempt to confirm that the genes encoding resistance and attachment can be co-transferred between bacteria, validating these genes as environmental contaminants. Investigators will sequence plasmids transferred between bacteria, which would identify virulence-associated genes, providing information about the threat that these plasmids present to human health.

Functionalized magnetic mesoporous silica for adsorption of arsenic from water

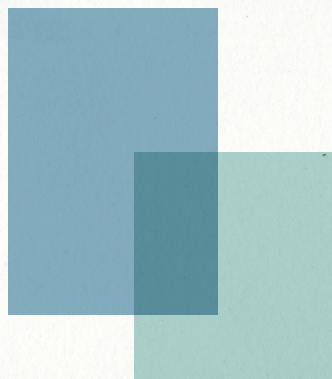
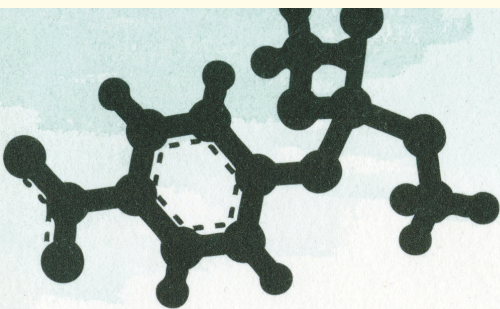
INVESTIGATOR: S. Larsen, UI Dept. of Chemistry

SUMMARY: Human exposure to arsenic in drinking water has been linked to cancer, neurological, cardiovascular and pulmonary health problems. Arsenic levels in 8% of Iowa private wells were determined to be greater than the EPA drinking water standard of 10 ppb (0.01 mg/L). It is critical, both globally and locally, to develop improved methods for removing and analyzing arsenic in water. Mesoporous silica, which has well-defined pores of 1.5-10 nm and very high surface areas, can be readily modified through surface functionalization. In this study, mesoporous silica will be functionalized with thiol and/or amine functional groups which are expected to selectively adsorb As(III) or As(V) species. Magnetic iron oxide nanoparticles will be incorporated into the mesoporous silica to facilitate magnetic recovery from solution.

An investigation of carbon nanotube exposure assessment methods

INVESTIGATORS: P. O'Shaughnessy, R. Altmaier, A. Horne, UI Dept. of Occupation and Environmental Health

SUMMARY: Carbon nanotubes (CNTs) are engineered nanoparticles that have been shown to cause adverse pulmonary outcomes in test animals. The National Institute for Occupational Safety and Health is considering a recommended exposure level (REL) for CNTs of 7 $\mu\text{g}/\text{m}^3$, which is the limit of quantification (LOQ) of a method used to measure elemental carbon (EC) in diesel particles. This limit presents either an under- or over-exposure scenario with no information to determine actual conditions when below the LOQ. This study will seek to establish a relationship between CNT particle count concentrations given known size distributions and EC mass concentrations to guide the interpretation of environments that may become contaminated with CNTs below the LOQ.



COOPERATIVE RESEARCH PROJECTS

THE CHEEC COOPERATIVE RESEARCH PROGRAM seeks to leverage research monies from university, state, and federal entities to conduct research in areas of mutual interest. The collaboration requires matching funds from participating entities; the program seeks to establish innovative lines of environmental health research leading to preliminary results that may be used in seeking larger grant funding from federal and private sources. Since the Program began in 1999, 10 projects have been funded. Cooperators have included the U.S. Geological Survey, the U.S. Department of Agriculture, IDNR, IDPH, the Leopold Center for Sustainable Agriculture at ISU, and various Departments in the UI Colleges of Public Health, Engineering, Medicine, and Liberal Arts and Sciences.

CHEEC awarded the following cooperative research grants in FY 2011 and FY 2012.

Occurrence of viruses and unregulated contaminants in Iowa public water supply groundwater

INVESTIGATORS: R. Libra, Iowa Geological and Water Survey;
M. Wichman, State Hygienic Laboratory

Cooperators: IDNR, U.S. Geological Survey, UI
Department of Geosciences, U.S. Department of Agriculture

SUMMARY: Groundwater supplies drinking water to about 80% of Iowa's population; most Iowans obtain water from public water

supplies (PWS), which are required by EPA to monitor finished water for various chemical, physical, and biological contaminants; raw source water monitoring is infrequently required. EPA publishes a Drinking Water Contaminant Candidate List detailing contaminants that may require standards and monitoring in the future. A strategy to assess future drinking water regulatory needs, and to guide source water protection activities for both public and domestic wells is targeted sampling and analysis of raw PWS groundwater for currently unregulated contaminants with public health and environmental concerns. This project will sample 66 Iowa PWS wells with known construction and hydrogeologic vulnerability for a number of contaminants. Funding for this project comes from EPA and Iowa DNR Drinking Water and Source-Water Protection programs. CHEEC funds will be used for sampling and analysis of PWS wells for human enteric viruses. The upcoming federal Unregulated Contaminant Monitoring Rule will have an emphasis on groundwater contaminants; this project will complement the national plan and establish Iowa as a leader in monitoring groundwater quality for contaminants with public health implications.

Evaluation of a web-based approach to data collection in molecular environmental epidemiological investigations of adverse pregnancy outcomes

INVESTIGATORS: P. Romitti, K. Caspers, UI Dept. of Epidemiology; G. Ludewig, UI Dept. of Occupational and Environmental Health; M. Wichman, State Hygienic Laboratory; P. Weyer, CHEEC

COOPERATORS: Iowa Registry for Congenital and Inherited Disorders, UI Reproductive Molecular Epidemiology Research and Education Program

SUMMARY: Wireless telephone use, caller ID, and call blocking pose challenges to telephone-based data collection for epidemiological studies; smartphones, tablets, and increased access to the internet have removed both time and place demands of home-based communications. Telephone-based data collection in Iowa for the NBDPS has indicated a steady decline in participation rates. This case-control study will evaluate a web-based approach for molecular environmental epidemiological studies of adverse pregnancy outcomes. 240 infants with selected birth defects and 240 infants without defects will be selected and equally assigned to a web-based or a telephone-based group. They will be administered a questionnaire for maternal environmental exposures; mothers in the web-based group will electronically sign a consent form to use residual newborn bloodspots for biomonitoring; for the telephone-based group, the U.S. Postal Service will be used for hand-signed informed consents. Participation rates, sample representativeness, exposure reporting, and costs between the

web-based and telephone-based groups will be compared. Investigators hypothesize that improved participation rates will be seen in the web-based group, which will permit increased generalization of study results and increased statistical power for studies.

Influence of redox fluctuations on arsenic dynamics in Iowa aquifer materials

INVESTIGATORS: M. Scherer, G. Parkin, D. Schnoebelen, UI Dept. of Civil and Environmental Engineering; P. Weyer, CHEEC

COOPERATOR: Cerro Gordo County (IA) Department of Public Health

SUMMARY: Arsenic is an emerging water quality issue in Iowa's groundwater. According to the IDNR, there are 69 public water supplies that utilize groundwater with arsenic concentrations greater than the recommended limit and in a recent survey of 473 private wells in Iowa, 48% were found to contain arsenic. This study will help address the issue of arsenic in groundwater by conducting laboratory experiments to better understand the geochemical processes controlling the release of arsenic from soils to groundwater. This project will build on previous work that developed analytical methods for measuring arsenic and investigating the reduction of arsenic by common soil minerals. The objectives of this study are to 1) determine the extent of arsenic incorporation and release from iron minerals commonly found in Iowa aquifers, and 2) measure the release of iron and arsenic from Iowa aquifer materials where arsenic has been identified in the groundwater.





EDUCATION AND SERVICE ACTIVITIES

CHEEC sponsors a continuing seminar series on environmental health and environmental research issues (<http://www.cheec.uiowa.edu/outreach/seminars.html>). The following seminars were given on the UI campus in 2011–2012:

Dr. Marc Schenker, Department of Public Health Sciences, University of California, Davis

“Occupational health among immigrant workers” and *“Inorganic dust exposure and lung disease”* co-sponsored by the UI Environmental Health Sciences Research Center

Dr. William Simpkins, Dept. of Geological and Atmospheric Sciences, Iowa State University

“Tracking human enteric viruses in municipal drinking water from an alluvial aquifer”

Ken Cook, President, Environmental Working Group

“Ten Americans”

co-sponsored by the UI College of Public Health, and the UI Center for Global and Regional Environmental Research

CHEEC sponsors, co-sponsors and hosts conferences and workshops on a variety of issues related to environmental health (<http://www.cheec.uiowa.edu/outreach/conference.html>). Two conferences were conducted during 2011–2012.

Conference on Arsenic in Iowa's Water Sources: Surveillance, Research, Education and Policy

(Des Moines, November 9, 2011)

Recent Iowa studies have documented the widespread occurrence of arsenic in private drinking water wells. A 2006-08 survey of 473 wells showed that almost half of the water samples contained arsenic; about 8% of those had arsenic concentrations at or above 10 parts per billion, the EPA drinking water standard for public water supplies. This conference presented overviews of the possible health effects related to drinking water arsenic, Iowa surveillance efforts on arsenic in groundwater, current Iowa-based research on the fate and transport of arsenic in the environment, treatment options for arsenic removal/reduction in small systems, and current water quality education programs in Iowa. Researchers from Minnesota and Wisconsin discussed efforts to address arsenic concerns in those states, and a panel of experts responded to audience questions on what approaches might be taken in Iowa to develop public education programs on arsenic and efforts to prevent or limit arsenic contamination of drinking water supplies. Conference attendees had the opportunity to discuss this emerging public health issue with academic and agency researchers and with policy makers from state government. The conference was co-sponsored by the Iowa Geological and Water Survey (IDNR), IDPH, the State Hygienic Laboratory, and CHEEC. Full Proceedings are available in audio and power point presentation at: http://www.cheec.uiowa.edu/outreach/arsenic_presentations.html

Continuing Medical Education Conference on Pediatric Environmental Health

(Iowa City, September 14, 2012)

The Pediatric Education Conference is presented by members of the faculty of the UI Department of Pediatrics as well as by selected guest faculty. The program was designed to provide pediatricians, family physicians, nurses, and other child health care providers with an overview of recent developments in areas of current interest, concern and controversy. The 2012 conference focused on pediatric environmental health issues relevant for the general pediatrician, family practitioner and other healthcare professionals who work with children and adolescents.

Staff gave research presentations at a number of state and national meetings in 2011 and 2012, including the Iowa Water Conference, the Iowa Environmental Health Association annual meeting, the NBDPS annual meeting, the Society for Epidemiologic Research annual meeting, and the RCN Conference on Impacts of Excess Nitrogen in the Environment on Human Health. Center staff served on the IDPH Advisory Committee for the Environmental Public Health Tracking Program, the State Hygienic Laboratory Board of External Advisors, and the Iowa Children's Health Environmental Health Working Group.

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