

# **NATIONAL WATER RESEARCH INSTITUTE**

## **Proposed Panel Members**

### **Expert Panel for the California Department of Public Health**

#### **Development of Water Recycling Criteria for Indirect Potable Reuse through Surface Water Augmentation and the Feasibility of Developing Criteria for Direct Potable Reuse**

*Prepared for:*

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## ABOUT NWRI

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A 501c3 nonprofit organization, the National Water Research Institute (NWRI) was founded in 1991 by a group of California water agencies in partnership with the Joan Irvine Smith and Athalie R. Clarke Foundation to promote the protection, maintenance, and restoration of water supplies and to protect public health and improve the environment. NWRI's member agencies include Inland Empire Utilities Agency, Irvine Ranch Water District, Los Angeles Department of Water and Power, Orange County Sanitation District, Orange County Water District, and West Basin Municipal Water District.

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David L. Sedlak, Ph.D.	
Timothy J. Wade, Ph.D.	

## 1. INTRODUCTION

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The National Water Research Institute (NWRI), a 501c3 nonprofit research and education organization, proposes to form an independent, third-party Expert Panel to provide expert peer advice to the State of California on the following:

- Development of Water Recycling Criteria for indirect potable reuse (IPR) through surface water augmentation; and
- Feasibility of developing criteria for direct potable reuse (DPR), including a review of current DPR research efforts.

The Expert Panel will be held on behalf of the California Department of Public Health (CDPH) and administered by NWRI.

This proposal presents and summarizes NWRI's efforts to identify and recruit a 10-member Expert Panel to assist the State of California.

## 2. DESCRIPTION OF THE PANEL

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Brief descriptions of the role, activities, and end-products of the NWRI Expert Panel process are provided in this section.

### 2.1 Panel Role

The purpose of the Expert Panel is to provide an independent review, identify knowledge gaps, and make recommendations based on the current state-of-the-science for the following:

- **Development of Water Recycling Criteria for IPR through surface water augmentation.**

Specifically, the Panel's role involves the evaluation of proposed California criteria and making a finding, based on their expert opinion, whether the proposed criteria would adequately protect public health. Water Code Section 13564 provides a list of items CDPH must consider when developing the criteria. The items comprising that list should be considered by the Panel.

- **Feasibility of developing criteria for DPR, including a review of current DPR research efforts.**

Specifically, the Panel's role involves investigating the feasibility of developing California Water Recycling Criteria for DPR. Water Code Section 13566 provides a list of items CDPH must consider when investigating the feasibility of developing uniform water recycling criteria for DPR. The items comprising that list should be considered by the Panel. In addition, the Panel will have the opportunity to review the DPR research plans of water organizations early in their deliberations.

### 2.2 Panel Activities

As detailed below, NWRI proposes organizing a Panel of 10 independent, third-party experts in the field who would meet five times in person, as follows:

**Meeting 1:** Review with the Panel CDPH's views on the Panel's charge and goals for the process. Investigate the research needs necessary to draft DPR regulations that are adequately protective of public health.

**Meeting 2:** Complete investigation of research needs necessary to draft DPR regulations that are adequately protective of public health. Complete draft of a report that details what those research needs are and recommendations for how they can be accomplished.

**Meeting 3:** Begin the review and discussion of the initial draft of CDPH's criteria for IPR through surface water augmentation. Provide feedback to CDPH on changes

necessary for the Panel to determine that the criteria are adequately protective of public health.

**Meeting 4:** Review and discuss the revised draft of CDPH's criteria for IPR through surface water augmentation. Provide feedback to CDPH on changes necessary for the Panel to find the criteria are adequately protective of public health.

**Meeting 5:** Review and discuss the final draft of CDPH's criteria for IPR through surface water augmentation. Make a determination as to whether the criteria are adequately protective of public health. Produce a report documenting the Panel's determination.

### **2.3 Final Products of the Panel Review**

The final products of the Expert Panel review process will be reports that address the following:

- An assessment of what, if any, additional areas of research are needed to be able to establish uniform regulatory criteria for DPR and a recommended approach for accomplishing any additional needed research regarding uniform criteria for DPR in a timely manner.
- A finding regarding the adequacy of proposed criteria for IPR through surface water augmentation to protect public health.

### **3. DESCRIPTION OF THE PANEL MEMBER SELECTION PROCESS**

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NWRI has a well-established Expert Panel process, which includes the selection of Panel members. A brief description of the Panel member selection process is included in this section.

#### **3.1 Panel Member Characteristics**

The goal of the selection process is to determine the most qualified experts to serve on the Panel. These experts include academics, utility staff members, retired regulators, current or retired federal agency staff, and independent consultants with professional knowledge, experience, and standing in areas relevant to surface water augmentation and potable reuse.

#### **3.2 Objectives of the Selection Process**

Because the selection of experts to serve as Panel members is critical to the success of the Panel review, the selection process has to achieve the following objectives:

- Panel members must be viewed as experts in their field.
- The expertise of Panel members must cover the appropriate areas of review.
- Panel members must be viewed as credible and independent, without the appearance of conflicts of interest.
- The Panel must be able to work together to carry out its assigned tasks and develop consensus findings and recommendations.

#### **3.3 Role of the Panel Chair**

The Expert Panel will be led by a Panel Chair, who is selected based on a number of factors, including: expertise, leadership capabilities, and ability to assist NWRI in managing the Panel.

The Chair is typically involved with Panel activities related to:

- Developing Panel meeting materials.
- Facilitating Panel meetings.
- Facilitating the preparation of Panel reports.
- QA/QC of Panel reports and other deliverables.
- Engaging in additional project activities or meetings, such as public meetings or dialogue with CDPH staff.

### **3.4 Process to Identify and Select Panel Members**

The process used by NWRI to identify and select Expert Panel members involves the following steps:

- NWRI ensures its understanding of the CDPH Panel effort by reviewing overall goals and objectives with CDPH.
- Based on Panel needs, a list of disciplines required for Panel membership is reviewed with CDPH.
- Based on identified disciplines, potential candidates for the Panel are assembled using suggestions from CDPH, NWRI staff experience, a review of available publications, and recommendations based on interviews with known experts. Three to five candidates are typically identified for each Panel discipline.
- NWRI contacts each potential candidate via telephone to determine if the candidate has the appropriate background for the Panel. If so, NWRI assesses the interest, availability, and potential conflicts for each candidate.
- NWRI develops a summary matrix of potential candidates, including name, affiliation, position, a brief background summary, and any potential conflicts of interest.
- NWRI identifies preferred candidates based on their background and other information. In addition, NWRI assembles their vitas, biographies, or resumes.
- NWRI reviews the matrix of potential candidates with CDPH. Note that CDPH will convene an advisory committee that will be consulted on the proposed Panel members.
- NWRI selects Panel members based on input from CDPH.
- NWRI formally invites the selected individuals to serve on the Panel. NWRI also collects written statements regarding conflicts of interests from Panel members, if necessary, for review by CDPH.

Altogether, the selection effort is designed to be an open and collaborative process between NWRI and CDPH.

## 4. DESCRIPTION OF PROPOSED PANEL MEMBERS

Included in this section is a list of 10 proposed Expert Panel members for this effort and their areas of expertise.

### 4.1 Panel Requirements

Specific to this effort, the California Water Code (Section 13565) requires that the “expert panel shall be comprised, at a minimum, of a toxicologist, an engineer licensed in the state with at least three years’ experience in wastewater treatment, an engineer licensed in the state with at least three years’ experience in treatment of drinking water supplies and knowledge of drinking water standards, an epidemiologist, a limnologist, a microbiologist, and a chemist.”

### 4.2 List of Proposed Panel Members

A list of proposed Panel members and their areas of expertise is included in Table 1. For more information, please refer to candidate’s resume or CV, which can be found in the Appendix.

**Table 1: Names, Areas of Expertise, and Background of Proposed Panel Members**

Candidate	Area	Background
<b>R. Rhodes Trussell, Ph.D., P.E., BCEE</b> Chairman & CEO, Trussell Technologies (Pasadena, CA)	Panel Chair	<ul style="list-style-type: none"> <li>Ph.D. in Sanitary Engineering, UC Berkeley</li> <li>Experienced in methods and criteria for water quality and in the development of advanced processes for treating water or wastewater</li> </ul>
<b>Charles N. Haas, Ph.D.</b> Dept. Head & L.D. Betz Prof., Env. Eng., Drexel Univ. (Philadelphia, PA)	Microbial Risk Assessment	<ul style="list-style-type: none"> <li>Ph.D. in Environmental Engineering, University of Illinois at Urbana-Champaign</li> <li>Specializes in water treatment, risk assessment, environmental modeling and statistics, microbiology, and environmental health</li> </ul>
<b>Michael A. Anderson, Ph.D.</b> Chair & Prof., Applied Limnology & Env. Chem., UC Riverside (Riverside, CA)	Limnology	<ul style="list-style-type: none"> <li>Ph.D. in Environmental Chemistry, Virginia Tech</li> <li>Research includes water and soil sciences, with particular emphasis in applied limnology and lake/reservoir management; surface water quality and modeling; fate of contaminants in waters, soils, and sediments; and environmental chemistry</li> </ul>
<b>David L. Sedlak, Ph.D.</b> Prof., Civil & Env. Eng., UC Berkeley (Berkeley, CA)	Chemistry	<ul style="list-style-type: none"> <li>Ph.D. in Water Chemistry, University of Wisconsin</li> <li>Research focus is on the fate of chemical contaminants, with the long-term goal of developing cost-effective, safe, and sustainable systems to manage water resources</li> </ul>
<b>Walter Jakubowski</b> Consultant, U.S. EPA (retired) (Spokane, WA)	Microbiology	<ul style="list-style-type: none"> <li>M.S. in Microbiology, Oregon State University</li> <li>More than 48 years of experience on public health significance and effects of waterborne pathogens in drinking water, wastewater, and municipal sewage sludge</li> </ul>

Candidate	Area	Background
<p><b>Professor Dr.-Ing. Jörg Drewes</b> Chair &amp; Prof., Urban Water Systems Eng., Technische Universität München (Germany)</p>	Water Treatment Engineering	<ul style="list-style-type: none"> <li>• Dr. Ing. (Ph.D.) in Environmental Engineering, Technical University of Berlin, Germany</li> <li>• Research includes treatment technologies leading to IPR and the fate and transport of persistent organic compounds in these systems</li> </ul>
<p><b>Perry L. McCarty, Sc.D.</b> Silas H. Palmer Prof. of Civil &amp; Env. Eng. Emeritus, Stanford University (Stanford, CA)</p>	Wastewater Treatment Engineering	<ul style="list-style-type: none"> <li>• M.S. and Sc.D., Massachusetts Institute of Technology</li> <li>• Recognized for his research on understanding contaminant behavior in groundwater aquifers and sediments</li> </ul>
<p><b>Richard J. Bull, Ph.D.</b> Consultant, U.S. EPA (retired) (Richland, WA)</p>	Toxicology	<ul style="list-style-type: none"> <li>• Ph.D., Pharmacology, UC San Francisco</li> <li>• Research interests include central nervous system effects of heavy metals, the carcinogenic and toxicological effects of disinfectants and disinfection by-products, halogenated solvents, acrylamide, and other contaminants of drinking water</li> </ul>
<p><b>Adam W. Olivieri, Dr.PH, P.E.</b> Vice President, EOA, Inc. (Oakland, CA)</p>	Multi-Barrier System Reliability	<ul style="list-style-type: none"> <li>• M.P.H. and Dr. P.H. in Environmental Health Sciences, UC Berkeley</li> <li>• Experience in the technical and regulatory aspects of water recycling, groundwater contamination by hazardous materials, water quality and public health risk assessments, water quality planning, wastewater facility planning, urban runoff management, and on-site waste treatment systems</li> </ul>
<p><b>Timothy J. Wade, Ph.D.</b> Branch Chief, Epidemiology Branch, U.S. EPA (Chapel Hill, NC)</p>	Epidemiology	<ul style="list-style-type: none"> <li>• M.P.H., Epidemiology/Biostatistics and Ph.D., Epidemiology, UC Berkeley</li> <li>• Research activities focus on waterborne disease and epidemiologic studies to evaluate the health effects of arsenic exposure in well water</li> </ul>

## **APPENDIX: Curricula Vitae (CVs) of Panel Members**

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The curricula vitae (CVs) for the proposed Expert Panel members are provided in the following pages. Proposed Expert Panel members include:

- R. Rhodes Trussell, Ph.D., P.E., BCEE (Panel Chair)
- Michael A. Anderson, Ph.D.
- Richard J. Bull, Ph.D.
- Professor Dr.-Ing. Jörg Drewes
- Charles N. Haas, Ph.D.
- Walter Jakubowski
- Perry L. McCarty, Sc.D.
- Adam W. Olivieri, Dr.PH, P.E.
- David L. Sedlak, Ph.D.
- Timothy J. Wade, Ph.D.

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- R. Rhodes Trussell, Ph.D., P.E., BCEE (Panel Chair)



**R. Rhodes Trussell, Ph.D., P.E.,  
BCEE**

**EDUCATION:**

Ph.D., Sanitary Engineering, *University of California, Berkeley*  
M.S., Sanitary Engineering, *University of California, Berkeley*  
B.S., Civil Engineering, *University of California, Berkeley*  
Graduate, *Stanford Executive Program*

**REGISTRATION:**

Civil Engineer, State of California - No. 25107  
Corrosion Engineer, State of California - No. 745

**CERTIFICATION:**

Board Certified Environmental Engineer,  
American Academy of Environmental Engineers

**HONORS**

1995 National Academy of Engineering  
2001 AAMWA Boyd Award  
2005 AEESP/AEE Pohland Medal  
2010 AWWA Black Award  
2012 IWA's Global Water Award

**SUMMARY:**

Dr. Trussell is recognized, worldwide, as an authority in methods and criteria for water quality and in the development of advanced processes for treating water and wastewater to achieve the highest standards. He is often called upon to help utilities effectively

manage critical projects involving regulatory authorities and public health. Dr. Trussell has also for more than 40 years maintained an active practice in the corrosion of materials in water systems, having conducted more than a dozen pipe-loop tests. He is sought nation wide as a consultant on water problems having advised the Cities of San Diego, Los Angeles, San Francisco, Oakland (EBMUD), Concord (CCWD), Portland, OR; Tacoma and Seattle, WA, Boston, MA; New York; and Washington DC and many others. Recent projects include: Advice on post treatment to the Monterey Regional Desalination Project; Development of water quality and treatment documents for the Woodland Davis Water Supply Project; Expert Testimony on contamination/corrosion of a liquid chlorine system at a major water treatment plant (Archer Western Contractors, Ltd. v. The City of Austin); Consulting with the Korean Water Corporation on the design of ozonation and GAC facilities for their Sunnam water treatment plant (207 mgd); Review of the design of a 30 mgd membrane filtration ozonation facility for the Clark County Reclamation District; Lead and Copper treatment for the Camp Pendleton Marine Corps Base; Participation in the DEC Review for USBR's proposed facilities for the San Luis Drain (\$2.3 billion); Report on Compliance with the Lead and Copper Rule for the San Francisco Public Utilities Department (300 mgd); evaluating Desalting for the City of Carlsbad, CA.; assisting the San Diego County Water Authority in a Design/Build/Operate effort for a 100 mgd membrane/ozonation/GAC plant; and reviewing the lead problem in Washington, D.C. for USEPA Office of Water. Dr. Trussell is available to review and advise on any complex water quality problem. He has special interest in reuse, desalting, membrane filtration, disinfection and corrosion.

Dr. Trussell served as Member and Chair of the Water Science and Technology Board for the National Academies from 1988 to 2007 and as a member of the EPA Science Advisory Board from 1998 through 2005. He was also the Vice Chair of the NRC Committees on Indicators of Pathogens and Drinking Water Contaminant Candidates. For the International Water Association, Dr. Trussell serves as a member of the Scientific and Technical Council, and was also a member of the Program Committees for the Convocations in Berlin 2001, Melbourne 2002, Marrakech 2004, Beijing 2006, and World Congress in Vienna, 2008. Dr. Trussell is a Board Certified Environmental Engineer in the American Academy of Environmental Engineers and is a member of the Academy's Committee for Certification by Eminence. Dr. Trussell served as the Chair of the Research Advisory Committee and is now a member of the Board of Directors for the WaterReuse Foundation. He also serves on the Board of Directors of the Water Environment Research Foundation. Dr. Trussell was elected to the National Academy of Engineering in 1995, served as a member of the Academy's Peer Committee for Civil Engineers for 2001-2003, served on the selection committee for the Academy's "\$1 million" Grainger Prize for 2006-2007, on the presently on the Academy's Membership Committee (2006-2009) and on the Membership Policy Committee (2010-2012).

## EMPLOYMENT HISTORY

### **TRUSSELL TECHNOLOGIES, INC. PASADENA, CA (2003-Present)**

Chairman, CEO and founder of the company. Technology in the water world is rapidly changing. Many in the industry see choosing among the many technical opportunities as fraught with risk. Change takes place so quickly and there are so many things going on that it's difficult to make good choices.

Yet new technologies and new regulations are forcing change. Trussell Technologies seeks to be the trusted advisor that understands new technologies; how to test them, how to understand and predict their behavior, and how to reduce the risks associated with embarking on a new way of doing things.

### **UNIVERSITY OF CALIFORNIA, IRVINE (2003-Present)**

Adjunct Professor of Environmental Health, Science, and Policy, School of Social Ecology, University of California, Irvine

### **MWH, INC. INTERLOCKEN, CO. (2001-2003)**

Senior Vice President, Manager of Global Water Knowledge Center 2001-2002. Led Company's effort to author new textbook, *Water Treatment: Principles and Design*, published by John Wiley & Sons in 2005.

### **MONTGOMERY WATSON, INC. PASADENA, CA (1992-2001)**

Senior Vice President, Director of Corporate Development, Board Member and Member of the firm's Executive Committee from when the firm was created in 1992 until merger with Harza in 2001. Participated in 13 mergers/acquisitions during that time.

### **JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC. PASADENA, CA (1972-1992)**

Entered as Senior engineer in Pasadena Water Department, became Vice President Head of Environmental Sciences Department, became head of Specialized Resources Group, founded both the company's laboratory and research group, became Corporate Director of Water, became Senior Vice President and Director of Applied Technology for the firm, 1972-1991. Director of Corporate Development, charged with strategic planning and mergers

and acquisitions, 1992. Member of the firm's Board of Directors 1983, 1985-1992. Member of the Firm's Executive Committee from 1985-1992.

### **UNIVERSITY OF CALIFORNIA (1966-1972)**

Ph.D. Research: Dr. Trussell developed a methodology for making predictions in water chemistry. The method is in use in the Environmental Engineering field.

### **CONSULTING WHILE AT U.C. (1966-1972)**

While in school, Dr. Trussell worked as a consultant with Dr. Jerome F. Thomas, the firm of Pomeroy, Johnston and Bailey, and James M. Montgomery, Consulting Engineers, Inc. Studies included internal and external corrosion of private, municipal, and industrial iron, copper and stainless steel piping; corrosion of buried iron and steel piping and other equipment; industrial water treatment; design, operation, and maintenance of cooling towers; proper operation of boilers and associated condensate return systems; the preliminary design of chlorination facilities for a large municipality; solid waste management; design of individual home waste disposal systems; demineralization; and advanced wastewater treatment.

### **PROJECT EXPERIENCE (Selected projects):**

#### **Santa Margarita Water District**

Title: Copper Tubing Corrosion

Year: 2011-2012

Homeowners in the SMWD service area have reported copper pitting of consumer plumbing as a problem occurring in new construction built in the early 2000s. Trussell Tech was retained to write a Technical Memorandum to provide a brief background on the copper pitting issue; briefly summarize the claims made and the technical reports filed; look at the existing water quality of the treated water from Metropolitan Water District of Southern California's (MWD) Diemer Water Treatment Plant (WTP) that feeds the SMWD's

water distribution system; provide a visual evaluation of existing pipe materials through photographic evidence including discussion of evaluation techniques planned for pipe materials sent to EPA's lab in Cincinnati, Ohio; and provide recommendations, schedule, and budget of next steps including a twelve-month test with a pipe loop setup at SMWD's pump station to evaluate treatment alternatives including phosphate addition and disinfection.

Role: *Technical Director*

#### **Monterey Regional Water Pollution Control Agency (MRWPCA)**

Title: Groundwater Replenishment Project

Year: 2012-present

MRWPCA is planning to develop and implement a Groundwater Replenishment Project in the Seaside Groundwater Basin. It is planned to percolate into the basin either advanced treated water from the Salinas Valley Water Reclamation Plant and/or agricultural drainage from Blanco Drain. The estimated amount of water that could be provided by the project is approximately 2,800 acre-feet per year (AFY), which will supplement the natural recharge to the basin by approximately a factor of two. Trussell Tech was retained to assist with source water characterization, to evaluate Membrane Bioreactor (MBR) technology as an alternative secondary treatment approach to the existing trickling filters, and to evaluate post treatment stabilization and dual purpose pipeline considerations.

Role: Technical Advisor

#### **Water Reuse Research Foundation (WRRF)**

Title: Equivalency of Advanced Treatment Trains for Potable Reuse

Year: 2012-present

Trussell Technologies is lead firm on WRRF 11-02 potable reuse project in partnership with Carollo, University of Arizona, and numerous utilities. This important project serves to bridge the gap from indirect potable reuse projects in place today to future direct potable reuse projects that reduce the role of the environmental buffer. The project involves three overarching tasks: (1) background research and criteria development including literature review with focus on health

criteria and regulations, process models, and alternative treatment trains; review of available public health criteria including international, federal, state, and local regulations and guidance; development of criteria for direct potable reuse that are protective of public health through an Independent Advisory Panel and workshop; development of additional criteria to compare unit processes and treatment trains; and culminating in a State-of-the-Science report; (2) Toolbox for integrated treatment trains, a computer model that provides information on integrated water reuse treatment trains for DPR; and (3) Treatment Train Development and Validation, involving validation of the relevant treatment trains at the pilot-, near-full-scale, and full-scale including testing with reclaimed water from the LACSD's San Jose Creek WRP with advanced treatment processes including ozonation and biological filtration, among other technologies.

**Role:** Principal Investigator (PI)

### **Upper San Gabriel Valley Municipal Water District**

**Title:** Groundwater Recharge project

**Year:** 2012-present

Trussell Technologies is serving as Technical Advisor for Upper District's Indirect Reuse Action Plan (IRAP). This involves identifying and assisting the District in tasks required to permit, construct, operate, and pay for advanced treatment facilities to produce highly treated recycled water for groundwater recharge in the Main San Gabriel Basin. This involves interactions with CDPH and the RWQCB on regulatory considerations including the CDPH's draft groundwater recharge reuse requirements. It also involves identification and piloting of advanced treatment technologies including ozone/biological filtration.

**Role:** Technical Advisor

### **PACE Engineers, Inc. (for SMWD)**

**Title:** Treatment for Corrosion Control

**Year:** 2012

Working as a sub for PACE, Trussell Tech developed a TM for SMWD for evaluation of treatment technologies for corrosion control treatment to resolve excessive copper

concentrations in consumer plumbing exposed to groundwater serving Nichols Institute in SMWD's service area. Treatment evaluated included air stripping, caustic addition and/or orthophosphate addition. Orthophosphate ended up being the best choice based on previous experience at nearby Camp Pendleton.

**Role:** Technical Director

### **Santa Ana Watershed Project Authority**

**Title:** Inland Empire Brine Line Solids Control

**Date:** 2011 – Present

The Santa Ana Watershed Project Authority (SAWPA) operates the Inland Empire Brine Line, a brine line used to convey wastes (desalter discharge, domestic and industrial wastewater) to Orange County for treatment, prior to discharge. Trussell Technologies has been retained by SAWPA to investigate the formation and composition of solids within the brine line, as well as sampling procedures and potential mitigation strategies, given that Orange County uses solids loading as a parameter for billing SAWPA. Dr. Trussell has overseen these efforts in the capacity of Technical Advisor, providing critical insight into the characterization of the solids and the implications of non-representative sampling on the solids loading.

**Role:** *Technical Advisor*

### **Santa Margarita Water District**

**Title:** Copper Tubing Corrosion

**Year:** 2011-2012

Homeowners in the SMWD service area have reported copper pitting of consumer plumbing as a problem occurring in new construction built in the early 2000s. Trussell Tech was retained to write a Technical Memorandum to provide a brief background on the copper pitting issue; briefly summarize the claims made and the technical reports filed; look at the existing water quality of the treated water from Metropolitan Water District of Southern California's (MWD) Diemer Water Treatment Plant (WTP) that feeds the SMWD's water distribution system; provide a visual evaluation of existing pipe materials through photographic evidence including discussion of evaluation techniques planned for pipe materials sent to EPA's lab in Cincinnati, Ohio; and

provide recommendations, schedule, and budget of next steps including a twelve-month test with a pipe loop setup at SMWD's pump station to evaluate treatment alternatives including phosphate addition and disinfection.

**Role:** Technical Director

### **Rancho California Water District District/RMC Water and Environment**

**Title:** Indirect Potable Reuse Conceptual Design Study

**Year:** 2011 to present

The Rancho California Water District (District) is evaluating alternatives and the viability of indirect potable reuse for augmenting their water supply. Indirect potable reuse alternatives cover a wide-range of possibilities from reservoir augmentation to surface spreading. The project aims to maximize the District's beneficial use of recycled water while meeting salt and nutrient plan objectives for the groundwater basin. Trussell Technologies, Inc. evaluated the various recycled water source water alternatives, developed treatment alternatives to minimize brine, and assisted with the evaluation of advanced water treatment process alternatives.

**Role:** Technical Advisor

### **Rancho California Water District**

**Title:** Rancho California Alternative Secondary Treatment Evaluation

**Year:** 2011- present

The Rancho California Water District (District) owns and operates the Santa Rosa Water Reclamation Facility (SRWRF) in Murrieta, CA. Almost all of the wastewater treated at the SRWRF is reclaimed and reused locally for land irrigation. The heart of the treatment process at SRWRF is sequencing batch reactors (SBRs) that have historically performed poorly and struggle to handle peak flows. Trussell Tech is currently working with the District to assess the current performance of each process, document the current conditions of the facility, develop alternatives for either replacing or upgrading the secondary process, and evaluate and estimate these alternatives to provide the district with the best overall upgrade approach to reliably and

efficiently produce reclaimed water for the next 20-30 years.

Analyses of the past two years of data and communication with plant operators about treatment challenges form the basis for the recommendations. Focus has been placed on process targets and possible changes to reach optimal efficiency and performance with respect to coagulation, filtration, chlorination, and solids handling. Recommendations will be categorized based on immediate, short, and long-term time scales to enable the City to comprehensively plan capital improvements.

**Role:** Technical Advisor

### **Search Dog Foundation**

**Title:** National Training Center Water Treatment Design

**Year:** 2010 to present

Search Dog Foundation (SDF) is currently planning and constructing their National Training Center (NTC) in the foothills of Santa Paula, CA to consolidate its canine kennels, search training sites, and offices. The NTC is located in a quiet, rural area, and their projected water demand of 4000 gallons per day must be met with an onsite groundwater well. Testing has shown this water quality to be challenging, containing elevated levels of total dissolved solids, sulfates, boron, iron, manganese, and potentially hydrogen sulfide. Also challenging is the client's request to have minimal trucking associated with water treatment and an impacted watershed (i.e., no conventional place to discharge the waste stream produced by water treatment). Trussell Technologies has evaluated multiple whole-system treatment technologies for the NTC, including solar distillation, thermal distillation, and reverse osmosis (RO) with pretreatment for producing drinking water; and thermal distillation and evaporative beds for brine minimization and treatment. Upon Trussell Technologies' recommendation, SDF has selected RO with pretreatment and evaporative brine beds for their overall water treatment system, and retained Trussell Technologies for the process design. To ensure successful RO performance, pretreatment involves tray aeration to oxidize iron, manganese, and hydrogen sulfide and greensand filtration. Post-treatment of the RO

permeate will involve boron ion exchange, calcite filtration for stabilization, and disinfection. RO brine and filter backwash water will be sent to the evaporative beds, where only solids will be retained, making this overall system essentially zero-liquid discharge. Trussell Technologies will continue to participate in final process design, as well as start-up testing and evaluation of the new water treatment system, enabling the NTC to have a safe and reliable drinking water supply.

**Role:** Technical Advisor

### **MWH / City of Tacoma Dept. of Public Utilities (Tacoma Water)**

Engineering Analysis and Technical Review Services for The Green River Filtration Facility  
Year: 2010-2012

MWH Americas, Inc. (MWH) provided design consultant services to the City of Tacoma, Department of Public Utilities, Water Division (Tacoma Water) for design and construction of a new filtration facility for the Green River supply to meet the requirements of the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). Successful implementation of this project will provide significant benefits to Tacoma Water, its Regional Water Supply System Partners (Partners) and other wholesale customers.

The Green River Filtration Facility (GRFF) will be constructed on the site of the existing Green River Headworks Facilities. It will treat water supplied from the Green River downstream of Howard Hanson Dam and from the North Fork Well Field (NFW). The initial maximum filtration capacity of the new facilities will be 150 mgd with an ultimate filtration capacity of 168 mgd. Planned capacity will be 90 mgd when operating in conventional mode (with pretreatment preceding the filters). Currently, maximum and annual average treatment flows are approximately 110 mgd and 60 mgd, respectively, but are anticipated to increase after construction of the GRFF. Trussell Tech provided engineering analysis, oversight and technical review services as a subconsultant to MWH.

**Role:** Technical Director

### **West Basin Municipal Water District**

Title: SWRO Demonstration  
Year: 2008-present

Trussell Technology assisted WBMWD in the design and now the operation of their full-scale seawater desalination facility in Redondo Beach, CA. Operational assistance includes management of the system for manufacturing preformed chloramines, monitoring and control of water quality in the seawater, the product water, and the seawater discharge. The firm also manages the quality control on the bench-scale unit for post treatment.

**Role:** Technical Advisor

### **West Yost Associates**

Title: Davis-Woodland Water Supply Project  
Year: 2009-present

Trussell Technologies has provided water quality and treatment support to West Yost Associates in the development of the Davis-Woodland Water Supply Project, a 52 mgd project which will take water from the Sacramento River, treat it and supply it to these two Central Valley Communities. The project is utilizing a design-build-operate method of delivery and Trussell supervised extensive water quality monitoring, coordinated with the California Department of Health, prepared white papers on key water quality issues, conducted bench testing on treatment, prepared a 15% design of the benchmark process train, including process flow sheet, design criteria, hydraulic profile, and site layout, equipment selection. The firm has also prepared major portions of the RP and draft service contract.

**Role:** Technical Director

### **RMC Environment/ Marina Coast Water District**

Title: Marina Coast Regional Desalination Project  
Year: 2009-2012

The Marina Coast Water District was working with Cal Am and Monterey County to develop a 10 mgd regional desalination project. Trussell Technologies did the preliminary process design including flow sheet, design criteria, process modeling, water quality goals, and equipment selection and interaction with the California Department of Health. The effort included extensive evaluation of GWUIDI criteria, alternatives for disinfection and an extensive

examination of alternatives for corrosion control, including a preliminary design.

**Role:** Technical Director

#### **Private Client**

**Title:** Water Filtration Development

**Year:** 2009

Developing advanced water filtration technology for a private client via market and regulatory investigation, experimentation, design and collaboration with academic and manufacturing partners, including comparisons of various attributes with multicriteria decision making tools (e.g., Target Plot-/Spider Diagram) and development of a technology roadmap.

**Role:** Technical Director

#### **RMC Environment/ Marina Coast Water District**

**Title:** Marina Coast Salinas River Surface Water Treatment Plant Conceptual Design and Permitting

**Year:** 2009

The Marina Coast Water District is developing new water supply options including a surface water treatment plant on the Salinas River in Monterey County. The project consists of seasonal diversion of excess Salinas River surface water and treating it at a surface water treatment plant to provide a potable water supply directly to urban users. Trussell Technologies, Inc was hired by RMC Environment to prepare a conceptual design of the plant, assist with the process selection, and the Department of Public Health permitting, including the preparation of the sampling plan. The primary treatment processes proposed for this facility are high rate sedimentation (Actiflo) followed by microfiltration (MF) membranes. These processes were selected for their ability to meet water quality goals, large turndown requirements, and in the case of Actiflo, ability to handle rapid changes in turbidity.

**Role:** *Project Advisor*

#### **City of San Diego**

**Title:** Innovative Brine Minimization Treatment Train

**Year:** 2009

In order to diversify its potable water supply portfolio, the City of San Diego is conducting a 12 month San Pasqual Brackish Groundwater Desalination Demonstration Project. In addition to investigating the efficacy of various wells to extract sustained production volumes from the shallow aquifer, the Demonstration Project is aimed at determining the operational parameters that will be necessary for sustained operation of a reverse osmosis plant. This project will investigate precipitative softening processes using two of the most promising technologies (i.e. tubular membrane filtered lime slurry reactor and a pellet reactor) and a biological reducing process to eliminate oxyanions (i.e. sulfate, nitrate). The overall treatment train objectives are to minimize the total brine volume and the mass of salt contained in this brine without using any cost-prohibitive thermal processes currently incorporated in treatment schemes that approach the recoveries described here (i.e. zero liquid discharge (ZLD) at 97%).

**Role:** *Project Advisor*

#### **Sunnyslope County Water District**

**Title:** Treatment of Groundwater Using Precipitation Softening

**Year:** 2008-2009

The District faces increasingly stricter regulations on its wastewater discharge, which limits the concentrations of sodium, chloride, and total dissolved solids that are allowed. Unfortunately, the groundwater available to the District is hard and self-regenerating water softeners (SRWS) are in common use throughout the service area, which increases all three constituents of concern. RMC retained the services of Trussell Technologies to evaluate treatment alternatives that could reduce the water hardness and the total dissolved solids concentration without using complex or expensive treatment processes. Trussell Technologies evaluated softening treatment alternatives using a 'Softie Model' to compare a pellet reactor, to a high rate solids contactor with lime, along with a high rate solids contactor with lime and potassium soda ash. In addition to evaluating lime softening of the groundwater, Trussell Tech was tasked with modeling softening processes to treat the brine from a primary reverse osmosis operating on the

groundwater. Modeling the operation of a secondary RO system treating the softened RO brine is also part of this project. Trussell Tech will participate in an evaluation of additional brine minimization alternatives such as: evaporation ponds, VSEP and thermal processes.

**Role:** *Technical Director*

### **West Basin Municipal Water District**

**Pilot Operation Of Novel High-Rate Granular Media Filtration As Pre-Strainer To Microfiltration On Open- Intake Seawater Source**

**Year:** 2009

West Basin MWD's El Segundo, CA pilot test site, have successfully employed a 100-micron disc filter for this application. The District has now investigated an alternate approach to pre-straining, using a high- rate granular media filter (GMF) in place of the disc filter. The goal is a more robust pretreatment process that can accomplish the straining requirements at a reduced total water cost.

To evaluate the GMF concept, two pilot trains were operated with identical microfiltration (MF) systems operating downstream of the pre-straining processes. The high rate GMF and disc filter processes were operated in parallel on the raw ocean water that was pre-screened with a 1.6 mm basket strainer. This enabled the performance of the GMF / MF combination to be compared to the disc filter / MF combination. Data was generated for typical seawater conditions as well as impaired seawater conditions that occurred as a result of algal blooms and storm events. West Basin MWD plans to continue to evaluate the process benefits and the economics of these two pre-strainer technologies to determine the most cost-effective and robust pretreatment system (pre-strainer + MF).

**Role:** *Technical Advisor*

### **City of Austin, Texas**

**Title:** Chlorine contamination

**Date:** 2008-2009

The City of Austin substantially expanded the city's water treatment plant and, as part of the process, it constructed facilities to receive, store, evaporate and deliver liquid chlorine. Storage facilities are sufficient for 48 tons of liquid

chlorine. During the start-up of the facilities, contamination began to appear in the chlorine and a dispute has arisen between the City and the contactor as to the cause of the contamination. The City has retained Dr. Trussell to serve as an expert witness on its behalf.

**Role:** *Expert Witness*

### **MWH/West Basin Municipal Water District**

**Title:** West Basin Red Tide Project

**Year:** 2007 – 2008

Working with MWH, Trussell Tech has been retained along with the University of Southern California to develop and conduct a comprehensive monitoring program for stormwater impacts on the SWRO treatment process and resulting permeate water quality, and marine phytoplankton and biotoxin production impacts on the SWRO process and resulting permeate water quality. The monitoring program will develop real-time monitoring surrogates and utilize state-of-the-art technologies to demonstrate the public health and operational significance of these events. The algal toxin information generate by the project is novel both in the context of seawater desalination, as well as in the context of fundamental research in marine biology and oceanography. Trussell Tech has developed the stormwater monitoring program and is coordinating the RO testing related to the algal toxins identified for study by USC.

**Role:** *Project Manager*

### **West Yost/ Davis-Woodland JPA**

**Project Title:** Davis-Woodland's Sacramento River Surface Water Treatment Plant Conceptual Design and Permitting

**Year:** 2009-Present

The Cities of Davis (Davis) and Woodland (Woodland) and the University of California at Davis (UC Davis) are working in partnership to develop a regional water supply. The Davis-Woodland Water Supply Project (DWWSWP) is intended to divert and treat Sacramento River water and convey the resulting potable water to the project partners. Trussell Technologies, Inc was hired by West Yost to assist with the Department of Public Health permitting, including

the preparation of the sampling plan. In subsequent phases of the work Trussell Technologies, Inc will be involved in the following tasks: preparation of water quality performance specification, process selection, conceptual design, and bid package preparation.

**Role:** *Technical Advisor*

### **Camarillo Water Division/CDM**

#### **Pilot Plant Design and Operation of Camarillo's Groundwater Treatment Facility**

Working with CDM, Trussell Technologies was retained by the City of Camarillo on a project to expand the groundwater supply for the City to reduce its dependence on imported water, while improving the quality of water ultimately discharged to the Calleguas Creek watershed. They are developing a groundwater treatment system that is capable of addressing current water quality concerns and also flexible enough to adjust to potential future water quality changes as they occur in the aquifer. Trussell Technologies evaluated emerging contaminants for the project including but not limited to hexavalent chromium and the issues considered for the City of Camarillo's wells are directly applicable to water quality issues that need to be evaluated for the SFB wells. The purpose of the pilot study is to demonstrate and select the most cost-effective treatment approach, providing specific information on operating performance, water quality, and projected treatment costs for the proposed treatment processes. Trussell Technologies is also involved in optimization of the desalination process and is evaluating a wide range of "new-era" low energy NF/RO membranes for the treatment of contaminated groundwater.

**Role:** *Technical Advisor*

### **Boyle/City of Huntington Beach**

#### **Title: Huntington Beach Desalter**

**Date:** 2008

Working with Boyle, Trussell Technologies was retained by the City of Huntington Beach to provide expert technical advice on the implications for water quality and disinfection of introducing a seawater desalination source into its distribution system alongside its existing

sources. Dr. Rhodes Trussell and Dr. Hokanson advised the City on the matter.

**Role:** *Technical Advisor*

### **Boyle Engineering**

#### **Title: Water Quality Facilities for the Upper Chiquita Reservoir**

**Date:** 2008

Boyle was retained by the Santa Margarita as the lead for a team to design the Upper Chiquita reservoir, a new, 2,700 Ac-ft treated water reservoir to provide emergency storage for agencies in South Orange County. Trussell Tech. was included as part of the team, responsible for portions of the design addressing water quality. The work included developing projections of chloramine decay over long periods of time, examination of DPB formation, including the potential formation of NDMA, examination of alternatives for maintaining a residual and/or controlling the presence of ammonia oxidizing bacteria (AOBs) in the reservoir effluent. The ultimate design makes provision for dissipation of the residual in the reservoir, rechloramination and UV disinfection to ensure the removal of AOBs that would proliferate therein. Trussell Tech analyzed the problem, examined alternatives, and developed P&IDs, design criteria, preliminary layouts and equipment selection.

**Role:** *Project Manager.*

### **Sydney Water Corporation**

#### **Title: Taste and Odour Management: Project report**

**Date:** 2008

In February 2003, a serious taste and odor incident (MIB & Geosmin) occurred in the Prospect Reservoir, the location of Sydney's largest water treatment plant. Using high rate direct filtration (10 gpm/sf) and chlorination/chloramination, the plant has only limited taste and odor removal capability, particularly where MIB & geosmin are concerned. Three years later in January 2006 Sydney experienced another troublesome T&O incident in their Cascade System. Again MIB & Geosmin were implicated. In April of that same year, another serious T&O incident occurred in the Prospect system, this one more widespread than

the first. MWH-Australia was contracted by the Sydney Water Corporation to conduct a comprehensive review of taste and odor management in the Sydney water catchments. Dr. Trussell was retained to do an independent peer review of the draft report.

**Role:** *Peer Reviewer*

### **U.S. Department of Justice**

Title: Expert Witness on BNR in the U.S. v. Eastern MWD et al

Date: 2007 - 2008

DOJ is representing Camp Pendleton MCB in lawsuit with Eastern MWD and Rancho California WD in connection with a 1990 Agreement between the Four Parties. Dr. Trussell prepared an expert witness report on the definition of best available treatment for nitrogen and phosphorous, on the cost of treatment to meet BAT and on the reasonableness of the cost of said treatment.

**Role:** *Expert Witness*

### **Beverage Company**

Title: Assessment of the Risks of Recovery RO Systems Implemented to Improve Water Use Ratio in the Production of Beverage Products

Date: 2007-2008

Trussell Technologies was retained by a major beverage company to assess the risks to water quality of implementing a secondary stage of RO to increase recovery in the production of its products. Trussell Tech also developed strategies and guidelines for to provide to bottlers to minimize the risk of introducing secondary RO into the treatment train.

**Role:** *Project Manager*

### **Downey Brand Attorneys, LLP**

Title: Expert Witness on BNR in the U.S. v. Eastern MWD et al

Date: 2007 - 2008

Downey Brand is representing Fallbrook PUD in lawsuit with Eastern MWD and Rancho California WD in connection with a 1990 Agreement between the Four Parties. Dr. Trussell prepared an expert witness report on the definition of best available treatment for nitrogen and phosphorous, on the cost of treatment to meet

BAT and on the reasonableness of the cost of said treatment.

**Role:** *Expert Witness*

### **City of San Juan Capistrano**

Title: Testing, Evaluation, and Recommendations Relating to Colored Water

Date: 2007-2008

The City of San Juan Capistrano has retained the services of Trussell Technologies to provide troubleshooting and resolution of its colored water issues. Trussell Technologies, Inc. scope has entailed development of sampling plan to monitor the raw water quality, the water quality throughout the treatment plant as well as in the distribution system; performing data analysis and pretreatment/treatment alternatives evaluation including analysis of alternative oxidants and filtration technologies; performing colored water bench scale study and full-scale filter evaluation; and providing recommendations to enhance treatment process and distribution system operations based upon the sampling results.

**Role:** *Project Advisor*

### **Carollo Engineers**

Title: Workshop on Silica removal

Date: 2007

Carollo has several projects where silica is the limiting constituent in concentrating the brine from RO facilities. Trussell Tech organized a workshop to discuss possible solutions to the issue.

**Role:** *Organizer, Expert*

### **CDM/Los Angeles Department of Water and Power (LADWP)**

Title: Scattergood Generating Station Seawater Desalination Pilot Project

Date: 2007 - 2009

Trussell Technologies, Inc. is part of CDM's team for the Scattergood Desalination pilot project. This project is the next step for LADWP in their evaluation of the feasibility of seawater desalination to augment their available drinking water supply. Trussell Technologies, Inc. is tasked with developing the technical memorandum to identify the process trains that will be pilot tested in the upcoming years along with water quality goals for each treatment

process and a final treated water quality goal for distribution. This TM included the selection of an appropriate desalination process, pretreatment and coarse screening process. Trussell Technologies, Inc. is also tasked to perform an analysis on how LT2 SWTR would be applied to the selected treatment train.

**Role:** *Project Manager*

### **Boyle/City of Poway**

**Title:** Bergland Water Treatment Plant Upgrade

**Date:** 2007-present

Working with Boyle, Trussell Technologies, Inc. was retained by the City of Poway to evaluate key water quality and treatment issues related to its Bergland Water Treatment Plant upgrade. Issues examined included investigating the levels of DBPs in the water, costing and ozonation alternative and determining whether it is needed based on the DBP levels in the water, and evaluating ancillary issues like the presence of quagga mussels in the source water.

**Role:** *Project Manager*

### **MWH/West Basin Municipal Water District**

**Title:** Critical Raw Water Quality Issues

Unique to Seawater: Marine Phytoplankton Blooms, their Associated Biotoxins, and Transient Urban Stormwater Inputs

**Date:** 2007-present

Working with MWH, Trussell Tech has been retained along with the University of Southern California to develop and conduct a comprehensive monitoring program for stormwater impacts on the SWRO treatment process and resulting permeate water quality, and marine phytoplankton and biotoxin production impacts on the SWRO process and resulting permeate water quality. The monitoring program will develop real-time monitoring surrogates and utilize state-of-the-art technologies to demonstrate the public health and operational significance of these events. The algal toxin information generated by the project is novel both in the context of seawater desalination, as well as in the context of fundamental research in marine biology and oceanography. Trussell Tech is developing the stormwater monitoring program and coordinating

the RO testing related to the algal toxins identified for study by USC.

**Role:** *Project Reviewer*

### **Provost & Pritchard**

**Title:** Peer Review of Impacts of Delta Water on Friant Kern Users

**Date:** 2007

Users of the Friant-Kern canal have been approached by the MWD of SC to consider an arrangement where MWD would use Friant-Kern Canal water during certain periods in return for providing State Project water during periods when Friant-Kern water is not so readily available. Provost & Pritchard was retained to review the impacts of the exchange on Friant-Kern users and Trussell Tech was retained to conduct a peer review of that study.

**Role:** *Peer Reviewer*

### **Los Angeles County Sanitation Districts**

**Title:** Santa Clarita Valley Chloride Study

**Date:** 2007

The Los Angeles Regional Water Quality Control Board has issued a TMDL for chloride the Santa Clara River and, as a result, is considering limitations on the chloride on the wastewater discharged from the Saugus and Valencia water reclamation plants, operated by the Los Angeles County Sanitation Districts. The Districts retained Trussell Tech to determine the appropriate desalination technology, the amount of flow to be treated at each facility and to do a preliminary design of the required facilities.

**Role:** *Project Manager*

### **ECO Resources, Inc.**

**Title:** San Juan Capistrano Water Recovery Facility

**Date:** 2007

ECO Resources, Inc., a division of Southern Water, Inc., operates a 4 mgd groundwater desalination facility in San Juan Capistrano, CA. Since its inception the facility has had difficulties meeting its production goals and its membranes have required excessive cleanings. Trussell Tech was retained to review the problem and examine possible remedies.

**Role:** *Technical Director*

**West Basin Municipal District- Separation Processes, Inc.**

Title: General Consulting on Desalination

Date: 2007

Trussell Technologies was part of the SPI team selected to provide consulting services to WBWD. Project involved review and comment on water quality data. Advice on use of pre-formed chloramines. Advice on the use of high rate coarse media filtration.

**Role:** *Project Advisor***Clark County Water Reclamation District**

Title: The Addition of Membrane Filtration and Ozonation to CCSD's advanced wastewater Treatment Plant

Date: 2007

Clark County Water Reclamation District retained the services of Trussell Technologies to prepare review and advise on the preparation of contract documents for constructing a 30 mgd tertiary facility using membrane filtration and ozonation at their Advanced Wastewater Treatment Plant. The review included an assessment of the necessary ozone dose as well as extensive discussions on the best approach for getting useful bids from competing membrane manufacturers.

**Role:** *Project Advisor***Beverage Company**

Title: Technical Advisory Committee

Date: 2007

A major beverage company established a technical advisory panel of five national experts and met with the panel to review their water treatment standards and practices and suggest possible weaknesses or changes.

**Role:** *Advisory Committee Member***Southwest Water Company Optimization of the San Juan Capistrano Groundwater Recovery Plant**

Date: 2006-2008

The Southwest Water Company (SWC) owns and operates a desalting facility to treat up to 5 mgd of highly mineralized groundwater for the City of San Juan Capistrano. The groundwater is also contaminated with iron and manganese. Trussell Technologies, Inc. assisted the SWC in

a project to rehabilitate the desalter. Trussell Tech diagnosed the cause of membrane fouling, identified changes in chemical feed methods to prevent clogging of pipelines with calcium carbonate, recommended changes in pretreatment to prevent future fouling, selected new membranes to replace old membranes which had ceased to meet requirements, met with CDPH and Southwest Water to discuss CDPH requirements and provided support to Southwest during implementation.

**Role:** *Technical Director***Coachella WD - MWH**

Title: Ion Exchange to Remove Arsenic

Date: 2006

MWH had designed ion exchange facilities to remove arsenic from drinking water. The specification included limitations on the Langelier Index of the water produced in order to ensure that old, arsenic-containing, pipe scales in the distribution system would not be compromised. Some of the IX facilities were having difficulty meeting this requirement. Trussell Technologies was asked to analyze the cause of the problem.

**Role:** *Technical Advisor***West Basin Municipal District-MWH**

Title: Scoping Study for the Design of a 0.5 mgd Ocean Desalination Demonstration Facility

Date: 2006

Trussell Technologies was part of the MWH team selected to do a comprehensive scoping study for the design of a 0.5 mgd ocean desalination demonstration facility. Trussell Tech did the Water Assessment, looking at all water quality questions, both for the permeate and for environmental discharges. Trussell Tech also did assessments of pretreatment alternatives as well as reviewing the remainder of the preliminary design.

**Role:** *Project Advisor***Hankuk Engineering Company**

Title: Sungnam Water Treatment Plant

Date: 2006-2007

Hankuk Engineering Company (HEC) had been retained by the KOWACO, the largest water utility in So. Korea to upgrade KOWACO's largest water treatment plant. Trussell

Technologies traveled to Korea to review the project and provided advice on the design of systems for ozonation and granular activated carbon for removing the unusually high levels of 2-methyl iso borneol and geosmin in the raw water supply.

**Role:** *Project Manager*

### **Hankuk Engineering Company**

Title: Seoul Water Treatment Plant

Date: 2006

Hankuk Engineering Company (HEC) had been retained by the City of Seoul, So. Korea to design a new, large water treatment plant. Trussell Technologies provided advice to HEC regarding the design of deep bed granular media filters.

**Role:** *Project Manager*

### **MWD- Geopentech**

Title: Review of Perchlorate Treatment near Las Vegas Wash

Date: 2006-2007

Geopentech was conducting a study for MWDSC on the contamination of Lake Mead with perchlorate being discharged by former rocket fuel manufacturers whose wastes are tributary to the Las Vegas Wash. Trussell Tech was retained, together with Black and Veatch to review treatment processes being used or proposed by those industries to remove perchlorate and to advise MWDSC s to their efficacy.

**Role:** *Project Manager*

### **Sydney Water Corporation – SKM - Reiss Env.**

Title: Sydney Water Reuse Program

Date: 2006

Trussell Technologies was a member of the team examining reuse alternatives for Sydney Water. The work includes an extensive review of existing use of advanced treatment for reuse.

**Role:** *Project Manager*

### **Castaic MWD - Carollo Engineers**

Title: AwwaRF Project 3182 – An Electrochemical Reactor to Minimize Brominated DBPs: Impact on Coagulation and Ozonation

Date: 2006

Along with Castaic MWD, Carollo Engineers is conducting bench and pilot studies examining a

new innovative electrochemical reactor to minimize the formation of brominated DBPs during disinfection.

**Role:** *Technical Adviser*

### **MWH-ARD**

Title: WERF Pharmaceuticals Study

Date: 2006

Under the auspices of an unsolicited proposal to WERF, the MWH Applied Research Department conducted a study examining the effectiveness of alternative biological process on the removal of pharmaceuticals and personal care products. Among other things the study demonstrated that an SRT of over 10 days ensures much greater removal. Dr. Trussell is an adviser on the project

**Role:** *Technical Adviser*

### **LACSD- Kennedy-Jenks Engineers**

Title: WERF Disinfection Study

Date: 2006

Working in conjunction with the Los Angeles County Sanitation Districts, Kennedy-Jenks Engineers is conducting a WERF on alternatives for the disinfection of wastewater. The study includes an extensive survey of existing practice. Dr. Trussell is an adviser on the project

**Role:** *Technical Adviser*

### **Tucson Water- Malcolm Pirnie**

Title: Tucson Water, Water Quality and Implementation Program

Date: 2006 - 2007

MPI was retained by Tucson Water to conduct an extensive study of alternatives for augmenting the City's water supply. Part of the program includes review by a panel of six independent outside experts. Dr. Trussell was a member of that panel

**Role:** *Panel Member*

### **Clark County Water Reclamation District**

Title: Cost Estimate for the Addition of Membrane Filtration to CCSD's advanced wastewater Treatment Plant

Date: 2006

Clark County Water Reclamation District retained the services of Trussell Technologies to prepare an independent estimate of the cost of constructing a 30 mgd tertiary membrane facility

at their Advanced Wastewater Treatment Plant. The estimate included the cost of several alternatives, including two alternative Greenfield facilities, as well as a possible retrofit to existing alum flocculation basins.

**Role:** *Technical Advisor*

### **Water Replenishment District of Southern California**

**Facility Evaluation and Resolving Membrane Fouling at the Leo Vander Lans Water Treatment Facility**

**Year:** 2008

Trussell Technologies, Inc. has been retained by the District as a membrane and process consultant to optimize the performance of a 3 MGD MF/RO reclamation plant. Trussell Tech is tasked with analyzing the performance and condition of the MF and RO membranes, probing the causes of membrane fouling, and identifying the key foulants causing the sub-optimal plant performance. The task also includes development of a cleaning protocol so that foulants from the full-scale RO trains can be removed. In addition, Trussell Tech will provide recommendations on how best to operate the LVL Facility to minimize future membrane fouling rates

**Role:** *Technical Advisor*

### **Separation Processes, Inc.**

**Title:** Treatment Alternatives for Removing Barium from CAP Water

**Date:** 2006

SPI was doing a study on the alternatives for desalinating CAP water and the precipitation of barium sulfate had been identified as limiting water recovery. Trussell Technologies explored treatment alternatives, including lime softening and ion exchange. The outcome of the project was a unique ion exchange strategy that cuts costs by taking advantage of the higher preference of most cation resins for barium ion.

**Role:** *Technical Director*

### **Metropolitan Water District and Participating Water Agencies**

**Title:** Cost Alternatives for Reducing Contaminants of Concern from the Discharge of

the Sacramento Regional Wastewater Treatment Plant

**Date:** 2006

MWD So. Cal., on behalf of a group of fifteen water agencies using water drawn from the Sacramento-San Joaquin Delta, retained Trussell Technologies, Inc. to develop an estimate of the cost of meeting five alternative levels of four contaminants of concern (orthophosphate, total inorganic nitrogen, total organic carbon and C. parvum) from the discharge of the Sacramento Regional Wastewater Treatment Plant. The estimate included the cost of converting all, or portions of the existing HPOAS facility, to more modern nutrient removal processes ranging from the Modified Ludzack-Ettinger process to a modified Bardenpho process.

**Role:** *Principal-in-Charge*

### **Rick Brady & Associates – Camp Pendleton Marine Corps Base (MCBCP)**

**Title:** Investigation of Copper Mitigation Measures for the North System

**Date:** 2006 - present

Through Rick Brady & Associates, MCBCP retained the services of Trussell Technologies to provide assistance in troubleshooting and resolving the recent copper problems in the groundwater supply of the Northern system on the base.

**Role:** *Project Manager*

### **Los Angeles Superior Court**

**Title:** Appraiser, LASC Case No. BC 315186 City of Santa Monica v. Baron & Budd P.C. et al.

**Date:** 2005 - 2007

Dr. Trussell was appointed by Superior Court Judge David Minning as the Appraiser in a suit between Santa Monica and a group of attorneys that had represented the City in an earlier suit. The Appraiser's assignment was to determine the value of the Settlement in that earlier suit. The Appraisal involved estimating the cost to design, permit, build and operate a water treatment plant to remove methyl tertiary butyl ether and tertiary butyl alcohol from groundwater until the groundwater was no longer contaminated. The project involved the 10% design of a \$60M UV/H<sub>2</sub>O<sub>2</sub> advanced oxidation facility followed by GAC adsorption. Dr. Trussell

organized an extensive team of outside consultants to accomplish the effort.

**Role:** *The Appraiser*

**Rick Brady & Associates – Camp Pendleton Marine Corps Base (MCBCP)**

Title: Investigation of Copper Mitigation Measures for the North System

Date: 2006-2007

Rick Brady & Associates retained the services of Trussell Technologies to provide assistance in troubleshooting and resolving the operational problems experienced with the new iron and manganese removal facility in the Southern water system at Camp Pendleton.

**Role:** *Project Manager*

**Bureau of Reclamation**

Title: Review of Bureau Plans for a System to Treat Agricultural Runoff

Date: 2005 - 2006

When the Bureau of Reclamation committed to build aqueducts to serve farms in the San Joaquin Valley, it also committed to construct a drain to remove salt-laden agricultural runoff. The so called “San Joaquin Drain” ran into serious environmental opposition and was never completed. Nevertheless, the courts maintained that the USBR continued to have the responsibility to provide for disposal of the agricultural drainage. To resolve the issue, the Bureau has undertaken an extensive program of treatment research. Trussell Technologies has been retained to review the output from that program.

**Role:** *Project Manager*

**Rick Brady & Associates – Camp Pendleton Marine Corps Base (MCBCP)**

Title: Investigation of Lead Mitigation Measures for the South System

Date: 2005 - 2006

Through Rick Brady and Associates, MCBCP retained the services of Trussell Technologies to provide assistance in troubleshooting and resolving the recent lead problems in the groundwater supply of the Southern system on the base.

**Role:** *Project Manager*

**MWH – San Francisco Public Utilities Department**

Title: Comprehensive Report on Lead and Copper Rule Compliance

Date: 2005 - 2006

Working with MWH, Trussell Technologies was retained to prepare a comprehensive report on the implementation of the lead and copper rule in the San Francisco Water System, and in the Regional Water Systems also served by SFPUC. The study addressed past and current practice, compared it to the practices of several other U.S. cities treating similar water supplies and recommended pH adjustment as corrosion control treatment. The study also included an extensive assessment of the impact of this strategy on the protection of cement-based assets in the system and made recommendations to maximize their protection. Finally the study examined the rationale for water quality parameters in the system to address copper and lead rule requirements. In the end all the recommendations of the study were approved by CDHS. At the present time SFPUC is conducting monitoring of consumer plumbing to confirm the success of the program.

**Role:** *Project Manager*

**Desalination and Water Reuse Task Force**

Title: State-of-the-Science Report on Membranes

Date: 2005

Trussell Technologies has been retained by the D&WRTF to develop a state of the science report on membranes in desalination and reuse. This report is one of three reports to be used by the group to identify information gaps to be supported by its research monies.

**Role:** *Project Manager*

**City of Carlsbad, CA**

Title: Assessing Boron and Chloride in Desalted Seawater

Date: 2005

The City of Carlsbad, CA., is evaluating a proposal where Poseidon Resources, Inc. would provide desalted water to the City. Trussell Technologies has been retained to assist the City in understanding alternatives for improving the removal of boron and chloride, and in conducting investigations to understand the impact of future

boron and chloride levels on the plant life in the City.

**Role:** *Project Manager*

### **Metropolitan Water District of Southern California**

Title: Review Panel on Recreation in Lake Perris

Date: 2005

MWD retained a panel of specialists, to review a study it conducted examining the impact of recreation on the microbiological quality of the water in Lake Perris, and the alternatives for reducing its impact. Dr. Trussell was a member of that panel.

**Role:** *Consultant*

### **City of Carlsbad, CA**

Title: Assessing Corrosiveness of Desalted Seawater

Date: 2005

The City of Carlsbad is evaluating a proposal where Poseidon Resources, Inc. would provide desalted water to the City. Trussell Technologies was retained to assist the City in understanding and reviewing the plans for and conduct of studies to assess the corrosiveness of the desalted water.

**Role:** *Project Manager*

### **MWD-Geopentech**

Title: Perchlorate and the Colorado Aqueduct

Date: 2005

Geopentech has been retained by the Metropolitan Water District of Southern California to examine several issues related to gaining a better understanding of the history and fate of perchlorate in the Colorado River Aqueduct. Dr. Trussell serves as a project consultant on questions of treatment and water chemistry

**Role:** *Consultant*

### **EPA Office of Water**

Title: Estimate of National Occurrence of waterborne Disease Associated with Community Water system Drinking Water

Date: 2005

In September 2005, the EPA prepared a paper entitled, *Estimating the National Occurrence of Waterborne Disease Associated with Community Water System Drinking Water*". The report was a

preliminary estimate of GI illness attributable to drinking water. Dr. Trussell was retained by the U.S. EPA as an independent reviewer to comment on the analysis in the paper and on its conclusions.

**Role:** *Independent Reviewer*

### **MWH Constructors**

Title: Northeast Water Purification Plant

Date: 2004

MWH Constructors built a 40 mgd water purification plant to treat water from Lake Houston and serve portions of the City of Houston. Dr. Trussell was retained to provide consulting services on the treatment process during startup.

**Role:** *Project Consultant*

### **MWRA**

Title: Lead and Copper Rule/Corrosion Strategy for the Greater Boston Area

Date: 2004

For more than 20 years, MWRA has been struggling to find the water treatment necessary to control the corrosion of lead to levels that will allow it to comfortably meet the EPA Lead and Copper Rule. In the Fall of 2004, the utility faced a particularly important milestone where it must meet the lead action level. MWRA staff organized a five-member Panel of nationally recognized experts to review their past actions and to provide advice on future actions that might be taken. Dr. Trussell was a member of that panel.

**Role:** *Panelist*

### **San Diego Water Authority**

Title: Twin Oaks Valley DBO

Date: 2004

Dr. Trussell was a member of a five-member Board of Senior Consultants retained by the San Diego Water Authority to act as an independent expert body to support the Water Authority during its effort to proceed with a design-build-operate procurement for a 50 to 100 mgd water treatment plant in northern San Diego County.

**Role:** *Board Member*

### **Carollo Engineering**

Title: Water Treatment Consulting

Date: 2004-present

The firm of Carollo Engineering established a general contract for the services of Dr. Trussell to assist the firm in its water treatment efforts.

**Role:** *Consultant*

### **McGuire and Associates**

Title: Reservoir Augmentation in San Diego, CA

Date: 2004

Teamed with PBS&J, McGuire and Associates was retained to review alternatives for recycling in the City, specifically reservoir augmentation. Dr. Trussell was part of the technical team that will provide technical analysis of treatment alternatives and assessment of potential contaminants.

**Role:** *Consultant*

### **EPA-Environomics**

Title: Review of Washington D.C. Lead Problem

Date: 2004

In July 2002, and in two subsequent samplings, the lead levels in Washington, D.C. tap water have suddenly increased. On behalf of the EPA Office of Water, the firm of Environomics retained Dr. Trussell and three additional national experts to review the efforts being made to address the problem.

**Role:** *Consultant*

### **City of Carlsbad, CA**

Title: Poseidon Agreement

Date: 2004

The City of Carlsbad is evaluating a proposal where Poseidon Resources, Inc. would provide desalted water to the City. Trussell Technologies, Inc. was retained by the City to provide advice on the technical aspects of the agreement between Poseidon and the City.

**Role:** *Consultant*

### **City of Carlsbad, CA**

Title: Impact of Desalting on Cost of Water

Date: 2003-2004

The City of Carlsbad evaluated a proposal where Poseidon Resources, Inc. would provide desalted water to the City. Trussell conducted an analysis which compared the cost of desalted water to the cost of imported water over a 20-year horizon.

**Role:** *Consultant*

### **Portland Water Bureau - Murray, Smith and Associates, Inc.**

Title: Portland, OR. Blending and Operations Study

Date: 2003-2004

The Portland Water Bureau is considering augmenting the Bull Run Water Supply with local water near the Bull Run Headworks. Through MWH and Murray, Smith and Associates, Dr. Trussell was retained to provide technical review on the effort.

**Role:** *Consultant*

### **Brown and Caldwell**

Title: Water Treatment Consulting

Date: 2003-2004

The firm of Brown and Caldwell established a general contract for the services of Dr. Trussell to assist the firm in its water treatment efforts.

**Role:** *Consultant*

### **Chino Basin Watermaster - Black and Veatch**

Title: Removal of Perchlorate, Nitrate, Arsenic and Synthetic Organics in Chino Basin Groundwater

Date: 2003-2004

The firm of Black and Veatch retained Dr. Trussell to assist the firm in a review of approaches to the removal of nitrate, perchlorate, arsenic, and selected synthetic organics from groundwater in the Chino Basin.

**Role:** *Consultant*

### **Denver Water Board - MWH**

Title: Denver Water Moffat Water Supply Project Indirect Potable Recycling White Paper

Date: 2003-2004

The City of Denver is experiencing extreme water shortages and has retained the Denver office of MWH, Inc. to assist them in developing an indirect potable reuse project for the water supply for the Moffat water treatment plant. Dr. Trussell was retained as a member of an Advisory Panel to review a white paper for the project.

**Role:** *Consultant*

### **Arapahoe County Water and Wastewater Authority - Richard P. Arber and Associates**

Title: TAC, Water Purification Project for Arapahoe County Water and Wastewater Authority

Date: 2003

The Arapahoe County Water and Wastewater Authority (ACWWA) and the Cottonwood Water Sanitation District (CWSD) are located in a part of Colorado near Denver that is experiencing extreme water shortages. The two utilities have retained Richard Arber and Associates to assist them in developing an indirect potable reuse project using the alluvium adjacent to Cherry Creek. Dr. Trussell was retained as a member of an Advisory Panel for the project.

**Role:** *Consultant*

#### **MHW, Inc. Applied Research Department**

Title: USBR MBR Pilot Study

Date: 2003

MWH's ARD group has been conducting a long-term pilot-scale study of four Commercial MBR technologies for possible application for water reclamation at the Point Loma WWTP for the City of San Diego. Dr. Trussell was retained as a member of an Advisory Panel for the project.

**Role:** *Consultant*

#### **City of Torrance**

Title: Remediation of the Madronna Marsh

Date: 2003

The City of Torrance maintains the Madrona Marsh as one of the last remaining examples of the vernal marshes that once dotted the Pacific Flyway. The Marsh had been subjected to significant pollution and had been substantially impacted. Dr. Trussell was retained to review the situation and advise on possible remediation alternatives.

**Role:** *Consultant*

#### **MWH, Inc. Las Vegas**

Title: Application of Membrane Filtration and MBR to phosphate reduction

Date: 2003

MWH retained Dr. Trussell to assist in the review of alternatives using membrane filtration and MBR for phosphate reduction at the Clark County Sanitation District. The review included detailed discussions with four manufacturers about the cost of MBR.

**Role:** *Consultant*

#### **Metropolitan Water District of Southern California**

Title: Chlorine/Chlorine Dioxide Alternatives Study

Date: 2002-2003

At the request of several of its member agencies, the Metropolitan Water District of Southern California conducted bench, pilot and full-scale studies examining alternatives to ozonation as a treatment strategy for the three plants it operates which blend Colorado Water and State Project Water. The District assembled a panel of experts to review the progress of that study.

**Role:** *Panel Member*

#### **Portland Water Bureau/US EPA**

Title: Panel to Review Methods Copper Lead Rule Compliance

Date: 2002

Portland, Oregon has been having difficulties meeting the lead rule; in spite of changes made in chemical treatment. With the U.S. EPA, the Water Bureau convened a blue ribbon panel of experts to review recent treatment practices and recent lead sampling data and to help the Bureau consider alternatives for addressing the issue

**Role:** *Panel Member*

#### **AWWARF/EPA/MWH**

Title: Treatability of Perchlorate in Groundwater Using MfBR Technology--Phase III

Date: 2002-2003

The pilot-scale design from the earlier study was revised and improved. They continued to remove perchlorate and showed considerably more promise for scale-up. Nevertheless, significant scale-up issues remain. The process was also shown to be capable of removing perchlorate and nitrate from ion exchange brine

**Role:** *Technical Advisor*

#### **City of San Diego**

Title: Membrane Bioreactor Study

Date: 2001-2003

In a U.S.B.R funded study, the City examined four different alternative OEMs for MBR that might be applied at the City's Point Loma WWTP. The evaluation included application of these

technologies, both before and after enhanced primary treatment. Costs were also prepared for a 1, 5, and 10 mgd reclamation facility using the technology.

**Role:** *Technical Advisor*

#### **AWWARF/EPA/MWH**

Title: Treatability of Perchlorate in Groundwater Using MfBR Technology--Phase II

Date: 2002-2003

The pilot scale design for a membrane fiber biological reactor (MfBR) to remove both nitrate and perchlorate from groundwater was built and operated at a La Puente well site. The study established the feasibility of the process, but raised some significant scale-up issues.

**Role:** *Technical Advisor*

#### **City of San Diego**

Title: Upgrading the Otay Water Treatment Plant

Date: 2002

The City was considering several alternatives for remodeling their Otay Water Treatment Plant, so that it could comply with upcoming regulations. The City's budget had been severely cut and a special study was conducted to examine alternatives. Issues included meeting the requirements of the interim enhanced surface water treatment rule and upcoming requirement on disinfection byproducts.

**Role:** *Chair of Technical Advisory Group*

#### **IONICS, INC.-MWH**

Title: Pretreatment for 36 mgd desalter at Point Lisas, Trinidad

Date: 2001-2002

Ionics, Inc. prepared the successful bid for the desalter to provide drinking-quality water for the Trinidad and Tobago Water and Sewage Authority. The desalter was constructed with an ultimate capacity of 30 mgd. MWH Inc. was charged with design of the system to pretreat the water for the seawater reverse osmosis (SWRO) as well as certain other support facilities. Based on Ionic's experience with projects at other locations, the bid was prepared to include coagulation, sedimentation, and two-stage, dual-media filtration. After the Ionics team was selected, Dr. Trussell led a more detailed evaluation of pretreatment options,

recommending coagulation and sedimentation followed by a single-stage, deep-bed, dual media filter. Pilot tests conducted in parallel with construction demonstrated the validity of the improved filter design, allowing for the elimination of the second stage of filtration.

**Role:** *Technical Consultant*

#### **AWWARF/EPA/MWH**

Title: Treatability of Perchlorate in Groundwater Using MfBR Technology--Phase I

Date: 2001-2002

Northwestern University had developed and patented a biological process for the removal of perchlorate and nitrate using only hydrogen gas. This study was to further develop the process at bench scale and to design the reactor for a further pilot-scale study.

**Role:** *Technical Advisor*

#### **East Bay Municipal Utilities District**

Title: Treatment alternatives to meet emerging regulations

Date: 2002

The Districts asked Dr. Trussell to review an alternatives analysis that District Staff had prepared with the assistance of consultants, to address emerging contaminants.

**Role:** *Peer Reviewer*

#### **AWWARF/EPA/MWH**

Title: Treatability of Perchlorate in Groundwater Using Ion Exchange Technology--Phase II

Date: 2001-2003

Studying an optimized ion exchange process at pilot scale to assess its performance in treating low concentration perchlorate contamination of groundwater.

**Role:** *Technical Advisor*

#### **AWWARF/University of Houston/MW**

Title: Treatability of Perchlorate in Groundwater by Ion Exchange Technology—Phase I

Date: 2000-2002

Evaluated, through proof-of-concept laboratory studies, the feasibility of an optimized ion exchange process for treating low concentration perchlorate contamination of groundwater. Further research will be conducted in project

**Role:** *Technical Advisor*

### **Aerojet General**

Title: GET/E/F Treatment Study on Perchlorate Removal

Date: 2001-2002

Aerojet ran a three-year study developing and testing a biological process for Perchlorate Removal at pilot and full-scale. Dr. Trussell served as a member of a Blue Ribbon Panel that reviewed the progress of the study

**Role:** *Panel Member*

### **Los Angeles Department of Water and Power**

Title: Conversion to Chloramines for Residual Maintenance

Date: 2000- 2002

In seeking to meet upcoming changes in the regulation of disinfection byproducts, Department staff had written a white paper recommending converting the system to chloramines for residual maintenance. Implementing the decision is complicated by the sheer size of the system and by the number of large open, finished water reservoirs. MW was retained to do a comprehensive study examining the feasibility of conversion to chloramines and identifying the key projects that would be required to make implementation possible.

**Role:** *Technical Advisor*

### **Northwestern University/Montgomery Watson**

Title: Application of Bioreactor Systems to Low-Concentration Perchlorate-Contaminated Water

Date: 1999-2001

Evaluated the efficiency of a biological process to reduce perchlorate concentrations of up to 1,000 micrograms per liter to levels of 4 - 18 micrograms per liter. Evaluated the impact of co-contaminants on process performance, characterize process effluents, and define post treatment requirements. Included pilot-scale testing. Process received a U.S. Patent.

**Role:** *Technical Advisor*

### **Portland Water Bureau**

Title: Conduct of Bench Studies with Medium and Low Pressure UV

Date: 1999-2001

The Portland Water Bureau, as a conduit for a group of several of the largest unfiltered water agencies has asked MW to conduct bench

studies to confirm the inactivation of Cryptosporidium with medium pressure UV, to establish if infectivity studies will show that same inactivation with low pressure UV, and to determine if these technologies will also cost effectively address Giardia and viruses.

**Role:** *Technical Director*

### **Los Angeles Department of Water and Power**

Title: Conduct of Bench and Pilot Studies with Medium Pressure UV

Date: 1999-2001

The Los Angeles Department of Water and Power is under the process of applying for a permit to avoid filtration at the Encino and Stone Canyon Reservoirs. A critical part of the City's long-term plan is the use of medium pressure UV for control of Cryptosporidium. In order to get a permit under the SWTR, the technology must be approved by the State and EPA for its effectiveness in removing Giardia and enteric viruses as well. The project will include bench studies to develop survival curves for Cryptosporidium, Giardia and enteric viruses; the development of a public-domain model to calculate the UV dose for a given full-scale reactor; pilot studies to confirm the model and bench-scale results and the development of a technique to confirm the RTD in the reactor meets standards.

**Role:** *Technical Director*

### **Los Angeles Department of Water and Power**

Title: Filtration Avoidance Criteria

Date: 1998-2001

The Los Angeles Department of Water and Power is under direct order from the California Department of Health Services to filter the water at Stone Canyon Reservoir. Local citizens hired an outside consultant that recommended that medium pressure UV be used in place of filtration. MW was retained to review the consultant's recommendation and later, to help the Department pursue an application for avoiding the filtration requirement.

**Role:** *Technical Director*

### **City of San Diego**

Title: Repurification

Date: 1998-1999

The repurification project was proposed implementation of indirect potable reuse and involved extensive study. Managing operations, coordinating sampling, organizing/ordering lab supplies, performing seeding experiments, data collection and data analysis were routine tasks performed during this project.

**Role:** *Technical Director*

### **Australian Water Services**

**Title:** Cryptosporidium Crisis

**Date:** 1998

Early in the 1990's MW was part of a four-firm consortium that designed the Prospect Water Filtration plant, a 3,800 mL/day water treatment plant that is the largest of three plants serving the Metropolitan Area of Greater Sydney. In July 1998, a local laboratory reported levels of Cryptosporidium in the distribution system as being unusually high. Recognizing that its client may be at risk, MW appointed Dr. Trussell to follow up. Dr. Trussell followed the issue through the crisis and, in consultation with the client, sent two specialists to Sydney; one, a nationally recognized expert in treatment for cryptosporidium removal worked in the client's offices for three months, helping them deal with the crisis. The other, MW's principle engineer with the most recent experience in designing a large scale ozone system, went to Sydney and worked with the local office to produce a predesign and cost estimate for this important treatment alternative. By assisting the client to stay ahead of the problem, MW was able to help them stay out of trouble during the crisis.

**Role:** *Appointed MW Representative*

### **The San Benito County Water District**

**Title:** Membrane Feasibility Studies

**Date:** 1998

The San Benito County Water District is interested in examining aquifer storage and recovery as a means for augmenting their water supply in areas where recharge through surface spreading is not possible. Studies will examine the feasibility of membrane filtration as a pretreatment for the injection process.

**Role:** *Technical Director*

### **The North Holland Water Authority (PWN) Amsterdam, Netherlands**

**Title:** The PWN Hermskeerk WTP,

**Date:** 1993-1995

Dutch water utilities are facing increasingly strict standards for the drinking water. Meanwhile, the quality of the River Rhine, their principle supply, continues to decline due to municipal, industrial and agricultural discharges from countries upstream, particular France and Germany. PWN, a drinking water utility that serves a part of Amsterdam, draws an increasing portion of its supply indirectly from the Rhine and faces increased mineralization, more organics, and more microbiological contaminants. Meanwhile new Dutch drinking water standards have been established. Dr. Trussell served the technical reviewer for a scoping study MW and it's Dutch partner, Witeeven + Bos, recently completed. Two basic alternatives were chosen for further study, conventional treatment followed by reverse osmosis, post ozonation, and GAC and conventional treatment followed by ultrafiltration and reverse osmosis. As a result of that effort, the MW/W+B team is now embarked on a predesign study for a 75 mgd plant that includes choosing among these processes. Dr. Trussell assembled a unique team from MW's operations in the U.S., Australia, Holland, and England to complete the project.

**Role:** *Technical Advisor*

### **Portland Water Bureau, Portland, OR**

**Title:** Corrosion Study

**Date:** 1993/95

The Portland Water Bureau retained MW to conduct an evaluation of treatment and non-treatment alternatives for optimizing the reduction of lead and copper corrosion byproducts in consumer plumbing. The study involved pilot studies of elevating the pH, elevating the pH and the alkalinity, adding orthophosphate, and adding silicates as well as an extensive evaluation of non-chemical options.

**Role:** *Technical Advisor*

### **East Bay Municipal Utilities District, Oakland, CA**

**Title:** Blue Water Project

**Date:** 1991-1993

Black Hawk, CA: A mysterious corrosion problem developed in the copper plumbing of approximately one thousand homes in some of the most expensive developments in the EBMUD service area. The problem manifested itself when water with a deep blue color sporadically emanated from taps in these homes. It took three years and substantial resources to solve the problem in a cooperative effort between, EBMUD, the developers, the plumbers, the manufacturers of building materials, various City and County building authorities, and the Alameda County Department of Health Services. A large number of corrosion specialists were involved and a number of public meetings, press conferences and TV interviews were also held. At one point a local talk show host came on site and made it his mission to solve the problem. As the lead technical advisor to EBMUD, Dr. Trussell provided guidance for the technical investigation and helped the District represent itself to citizens, to other outside experts, to the developers, and to the Health Department.

**Role:** *Technical Director*

#### **The Rotterdam Water Authority, Rotterdam, Netherlands – Witeven+Bos**

**Title:** The Berenplaat Expansion

**Date:** 1993/95

The Berenplaat, the largest water treatment plant in Holland (155 mgd) and the place where the THMs were originally discovered, takes water from the River Rhine, treats it, and serves it to the City of Rotterdam. The water is currently treated with conventional lime softening, filtration and chlorine disinfection. Dutch citizens are very concerned about the unpleasant chlorine taste in their water and about the potential health risk associated with the by-products of chlorination. As a result, Rotterdam has set a goal of treating River Rhine water so thoroughly that no chlorine residual is necessary in the distribution system. Dr. Trussell was a key technical reviewer on a MW/W+B team from three countries that worked with staff at the Berenplaat as well as KIWA, the Dutch Water Research Center, to develop the process for the plant. The proposed process, which includes ozonation, biologically active carbon, aeration, a second stage of physiochemical carbon adsorption, and

disinfection with ultraviolet light has been verified with large scale pilot studies.

**Role:** *Technical Advisor*

#### **Melbourne Water Board, Melbourne, Australia**

**Title:** Workshop on Nutrient removal in Municipal Wastewater Treatment

**Date:** 1994

The Melbourne Water Board was having problems with stimulation of algal growths in the waterways for which it had jurisdiction and nutrients being discharged from municipal wastewater treatment plants had been implicated. The Water Board retained Montgomery Watson to convene a workshop with technical experts on the subject and to produce a state of the art report on technologies for nitrogen and phosphorus removal from municipal effluents. As lead technologist for the project, Dr. Trussell served as convenor for the workshop and editor of the report.

**Role:** *Convenor/Editor*

#### **Sydney Water Board, Sydney Australia**

**Title:** Sydney Water Board Drinking Water Program

**Date:** 1990-1994

At the present time virtually all the water supplying the City of Sydney, Australia receives chloramination as its only treatment. As a result of more restrictive regulations as well as rising consumer standards, a decision was made to treat the water supply. Ultimately Sydney plans on building four new water plants ranging from 60 to 950 mgd in capacity. The Sydney Water Board is self-regulating and Dr. Trussell, as part of The Prospect Group, a venture involving MW, CDM and two Australian engineering firms, worked with the Board to help resolve certain key elements of their water quality standards and to conduct pilot, prototype studies and a predesign work for two of the four plants - including the 950 mgd Prospect Plant. Eventually it became clear that Sydney would privatize the construction and operation of these plants. Dr. Trussell was instrumental in bringing together members of Australian Water Services (AWS), the company that won the contract for the largest of the four plants. At the present time the Prospect Group is

working for AWS, completing the design of the plant

**Role:** *Technical Advisor*

### **Portland Water Bureau, Portland, OR**

**Title:** Filtration Study

**Date:** 1989-1992

Following the passage of the EPA Surface Water Treatment Rule, the Portland Water Bureau retained MW to do pilot and predesign studies of the Bureau's Bull Run Supply. Extensive pilot and predesign studies were conducted, including extensive work establishing the effectiveness of free chlorine, combined chlorine and ozone on the disinfection of *Giardia lamblia*. Dr. Trussell was a regular technical advisor on this effort which involved interaction with two blue ribbon panels composed of technical experts from around North America (one on water treatment and one on disinfection of *Giardia lamblia*). Both of the technical panels had representatives from the Oregon State Department of Health Services and the EPA. Public input was also important and included workshops and focus groups with stakeholders as well as ordinary citizens.

**Role:** *Technical Advisor*

***Palm Beach County Utilities District:*** MW was retained by PBCUD to operate as the District's engineer for two five year periods. During that period Dr. Trussell served as a key technical advisor in an evaluation of methods for enabling the system to meet the new coliform rule, in pilot studies evaluating ozonation as an alternative for color removal, in the design of full scale ozonation facilities, and in the conduct of pilot studies to deal with biodegradable carbon resulting from the ozonation process.

***Coalition of West Coast Suppliers: The EPA Lead Rule:*** During the period when the EPA was developing the Lead and Copper Rule, Dr. Trussell worked with an informal consortium of water suppliers (Portland, OR, Seattle and Tacoma, WA, San Francisco, CA, East Bay Municipal Utilities District, Oakland, CA, American Water Works Service Co., Paramus, NJ, and New York City, NY) to ensure that the EPA had the best possible data for making decisions on the lead rule. The effort included

helping to organize the utilities, several meetings with the group and with the EPA, collecting, compiling and organizing data for EPA's consideration and informal meetings with EPA to help ascertain the meaning of the data. These efforts helped the EPA to balance some practical considerations as well as the concerns of Congress in their decision making.

### ***Contra Costa Water District - Randall-Bold WTP***

The Contra Costa Water District was searching for a way to reduce the cost and increase the appeal of a project involving a water plant that would serve the Eastern zone of their District. Working with staff, Dr. Trussell developed a new process that reduced capital cost while also improving the flavor of the water, providing a barrier against pesticide spills from Delta agriculture, and eliminating the byproducts of chlorination almost entirely. Because the process was new, extensive pilot and prototype studies were required, both to verify the technical performance of the process and to allow the Health Department to review evaluate it. Today Contra Costa has one of the most advanced water treatment plants in the country, producing unusually low turbidities, THMs below 10 g/L, and a water of excellent taste.

***Portland Water Bureau - Corrosion Study:*** In the early 1980's the Portland Water Bureau was challenged by the Citizens for a Lead-Free Environment who asserted that the Portland water supply resulted in excessive lead levels in consumer plumbing. After extensive interviews, the Water Bureau retained MW with Dr. Trussell in charge to conduct a study to examine the question. The progress of the effort, that included extensive sampling in consumer's homes, was reviewed by a Panel of local Citizens convened for that purpose. As a result of the study, 50/50 lead solder was banned in the State of Oregon. MW is still working with the Water Bureau on the corrosion issues today.

***Coalition of U.S. Unfiltered Supplies,*** During the period when the EPA was developing the Surface Water Treatment Rule, Dr. Trussell worked with the City of Portland in assembling a consortium of unfiltered water supplies (Portland,

OR, Seattle and Tacoma, WA, San Francisco, CA, Casitas, CA, and New York City, NY) and in ensuring that the EPA had the best possible understanding of the practices and circumstances that made these water supplies safe. As a result of these efforts, the EPA visited the watersheds of most of these utilities and incorporated provisions in the final rule that allowed them to maximum potential to continue operation.

**East Bay Municipal Utilities District /Contra Cost Water District- Water Supply Quality Study:** MW was retained by the East Bay MUD and the Contra Costa WD to organize and evaluate a comprehensive water program to assess water quality in the current sources of supply for these utilities as well as alternate sources of water that both were considering throughout the Sacramento/San Joaquin River System. This survey included extensive sampling and analysis of raw waters throughout the northern California area and preparation of a report that addressed treatment of these supplies under a variety of conditions and mixes. Dr. Trussell was Project Manager.

**Beaver Creek Water District:** MW was retained to do a master plan, conduct pilot studies and for the design and construction supervision of a new water treatment plant for the District. Dr. Trussell served as a key technical advisor for the project.

**Valley County Water District/EPA - Air Stripper:** The VCWD retained MW to conduct extensive pilot studies for determining design criteria for removing organic solvents from their groundwater supply. These studies were then used in the design of an air stripper on one of the most heavily contaminated wells in the San Gabriel Valley. Dr. Trussell was Project Manager.

**Portland Water Bureau - pH Adjustment Study:** MW was retained by the Portland Water Bureau to conduct a pilot study of alternatives for adjusting the pH of Portland water. A number of options were considered and a pilot plant was constructed and operated to observe the stability of the water quality that resulted. Dr. Trussell was the principle investigator for this project.

**Kaiser Steel – Groundwater Plume Characterization:** MW was retained by the Kaiser to drill monitoring wells and produce a groundwater model describing the scope of the plume of contaminated water due to several decades of discharge of pickle liquor on the steel-mill site. The study resulted in one of the first models of the travel of contaminant plume in Southern California Groundwater. Dr. Trussell was Principle-in-Charge

**Kaiser Steel – Hazardous Waste Evaluation:** MW was retained by the Kaiser to conduct a survey of the Fontana Site to determine the actions required to comply with new Federal Law. The survey identified a number of issues, in particular the potential for a large plume of contaminated water drifting off-site. Dr. Trussell was the principle investigator for this project.

**La Habra - Air Stripper:** MW was retained by the City of La Habra to examine the means for removing organic solvents from the water in a new well the City had recently developed. Pilot studies demonstrated that air stripping would do the job and the first full-scale airstripper in So. California was designed and commissioned as a result. Dr. Trussell was Project Manager.

**Pembroke Pines, FL - Air Stripping Study:** The effluent from the Pembroke Pines WTP had THM levels approaching 1.0 mg/L, 10 times the proposed EPA MCL. Pilot studies demonstrated that air stripping could be effectively employed to remove these THM's after they were formed without removing a chloramine residual. Studies also demonstrated that the remaining TOX was unaffected. Dr. Trussell was principle investigator.

**Contra Costa WD - Air Stripping Study:** MW was retained by the Contra Costa Water District to conduct a pilot study of air stripping as a means for removing THM's from the treated water in the Bollman WTP. These were the first pilot studies that successfully demonstrated effective removal of bromoform from drinking water via air stripping. Dr. Trussell was principle investigator.

**Four Agency Delta Study:** Four major agencies using Delta water retained MW to develop a comprehensive assessment of Delta water using information gathered in the Contra Costa Study as well as additional information gathered by the California Department of Water Resources and the U.S. Bureau of Reclamation. This study compiled the most comprehensive assessment of Delta water quality assembled up to that time. Dr. Trussell was project manager.

**Portland Water Bureau - Corrosion Study;** MW was retained by the Portland Water Bureau to conduct a study of the corrosiveness of the Bull Run Water Supply. The study included a review of that statistics of consumer complaints, collection and analysis of standing and running water samples in consumer plumbing, examination of piping material from the Distribution system, pilot testing simulating consumer plumbing (copper and galvanized), certain pilot scale testing by the Water Bureau on lead release from lead pigtailed and frequent interaction with a panel of citizens. One of the principle outcomes was that Oregon was one of the first states to outlaw the use of 50/50 solder for copper tubing in residences. Dr. Trussell was project manager

**Potomac Estuary Experimental Prototype:** The Baltimore District of the U.S. Army Corps of Engineers is responsible for providing the water supply for the City of Washington, D.C. In the early 1980's, the COE proposed to consider taking water from the lower Potomac Estuary. As most of the water in the estuary would be wastewater during low flow periods, the District was required to conduct a full-scale investigation on the treatment of reclaimed wastewater for potable reuse. A full-scale, 1 mgd treatment facility was constructed and MW was retained to operate the facility and study the quality over a 30 month period. Dr. Trussell was heavily involved in the technical direction of the project, which involved the most extensive chemical analysis and health-effects testing that had ever been done up to that time. Along with the rest of the project team, Dr. Trussell helped present the results of the study to a special Committee of the National Academy of Sciences which had been

assembled to review the conduct of the study and its results. The Committee spoke positively about the MW effort.

**Contra Costa Water Quality Study:** MW was retained by the Contra Costa Water District to do a comprehensive assessment of the quality of the water in the Contra Costa Canal as well as other sources of supply in the Delta of interest to the District. This was the first comprehensive assessment of waters in the Delta and included extensive organics assays, virus assays, microbiological assays, asbestos, heavy metals and corrosivity. Dr. Trussell was the Project Manager.

**MWD/EPA Study of Copper-Induced Pitting of Galvanized Pipe:** MW was retained by the Metropolitan Water District of Southern California to conduct a large scale, EPA supported, pilot study on the pitting of galvanized pipe as a result of copper in the water supply. The study not only addressed the copper-induced pitting problem, but also addressed the problem of pipe quality as well. Dr. Trussell was Project Manager for the study.

**The Contra Costa Water District - THMs:** While the THM regulations were under development, Dr. Trussell worked extensively with the Contra Costa Water District to develop alternatives to meet the new regulations. These studies, which included examination of chloramination, ozonation, enhanced coagulation, GAC adsorption, and air stripping, were among the first to demonstrate the cost-effectiveness of chloramination in controlling THM formation. Working with the California Department of Health Services, an agreement was reached to allow the District to use chloramines for residual maintenance provided certain standards of treatment were met and that a short time of disinfection with free chlorine was also provided. This agreement served as a model that Cal DHS followed with numerous other utilities throughout California and which was eventually duplicated in nearly one third of the water supplies in the nation.

**Pitting of Galvanized Pipe in Agoura:** MW was retained to examine the cause of failure of

new galvanized pipe in several hundred homes in a development in the Agoura area. The cause was determined to be copper-induced pitting of the new galvanized pipe. Dr. Trussell was the project Manager.

**EPA Selenium Analysis Study:** EPA retained MW to evaluate alternative methods for differentiating between the principle forms of selenium found in drinking waters. Fluorometric and ion chromatographic methods were evaluated. Dr. Trussell was technical advisor.

**Ramona Water District/EPA - Selenium Removal Study:** MW was retained by the Ramona Water District to conduct a study on methods for removal of selenium from drinking water. Bench and pilot studies demonstrated that activated alumina would be effective but that the oxidation state of the selenium was also important. Dr. Trussell was principle investigator.

**Aguadora de Nicaragua:** The principle water supply for the City of Managua was Lake Asosoca, a collapsed volcanic feature between the City and Lake Managua. A large industrial complex had been constructed between the two lakes and the City was concerned about the potential for contamination being transported in the groundwater from the industries to the City's supply. Dr. Trussell did extensive surveys of the industries as well as chemical testing that demonstrated that small amounts of the organic chemicals being discharged by the industries were already showing up in the drinking water supply.

**Water Factory 21:** Once the Water Factory's R.O. plant was built and began groundwater injection, the California Department of Health Services required that the Orange County Water District, conduct extensive studies demonstrating that the process effectively removed viruses. Dr. Trussell worked with staff at the Water Factory, the California Department of Health Services, the Health Services research laboratory, Montgomery Laboratories, and the University of California Department of Health to develop and manage a five year program that confirmed the high quality of the Water Factory's product where viruses are concerned.

**Sinotech Pingtung Industrial Waste Design:** Sinotech was retained to design systems to collect and treat the wastes for a large industrial complex being built in Ping Tung. Dr. Trussell served as a technical expert advising Sinotech on the concept of the design, in negotiations with the Taiwan EPA, and in reviewing the detailed design of the facilities.

**C & H Sugar Refinery Heat Dissipation Study:** MW was retained by the C&H refinery in Crockett, California to evaluate the refinery's hot water discharges to the Sacramento River, and to develop alternative means for controlling the problems. The principle source of heat was the barometric condensers. Remedies considered included cooling towers and an outfall that dissipated the hot water in during periods of high tidal flux. Dr. Trussell served as technical director on the Project.

**Dominguez Water Company:** The Dominguez Water Co. retained MW to examine the cause of pitting-type failure of galvanized pipe in some 60 to 80 homes in a development in their water system. Though the cause could not be absolutely determined, copper-induced pitting was the principle suspected cause. Dr. Trussell was the principle investigator.

**California Office of Water Recycling - Reuse in Cooling Towers:** MW did a study of reuse of municipal effluents in cooling towers throughout the United States and as a result of the study, developed criteria for wastewater reuse in cooling towers in California.

**Kenniwick WTP:** The City of Kennewick wished to construct a new WTP drawing water from the Columbia River. MW conducted extensive pilot studies for the City that resulted the design of the first direct filtration plant with pre-ozonation in the United States. Dr. Trussell was the Project Manager

**Casitas Municipal Water District:** The Casitas Municipal Water District was considering the installation of a 20 mgd water treatment plant for Lake Casitas. Dr. Trussell managed a pilot study which demonstrated that direct filtration would be suitable treatment. The study also addressed the

potential impact of unscheduled shutdowns and sudden demand changes on water quality.

**The Los Angeles Aqueduct Plant:** Dr. Trussell was the technical director for the predesign pilot studies for the Los Angeles Aqueduct Plant. These extensive pilot and full-scale studies were conducted by MW staff as well as the staff of LADWP and resulted in the development of the advanced high-rate, deep-bed filtration process with ozonation which the plant uses today. Because of the importance of the Owens River supply and because of the innovative nature of the process, satisfying the concerns of the California Department of Health Services was a key element in the effort.

**Water Factory 21:** After the Water Factory was built and it became clear that the sea water desalination portion of the project would not be cost effective, MW was retained to help the District explore design alternatives that involved the desalination of the tertiary effluent produced by the Water Factory. The firm developed bid documents for the desalination process (a 5 mgd reverse osmosis plant) and designed the support facilities for the same. Dr. Trussell was involved in evaluating desalination process and assisted in the preparation of bid documents.

**The City of San Diego - Alvarado/Miramar WTP Study:** Once it became clear that the City would be receiving State Project water, MW was retained to do a comprehensive evaluation of both the Alvarado and Miramar WTPs. Dr. Trussell was did much of the process work for both projects. During the effort Trussell demonstrated an inexpensive interim modification of the filter control systems that allowed the plant to successfully operate at a capacity increase of 20%.

**Chino Basin Municipal Water District, Plant No. 2:** Trussell organized and executed a pilot and prototype scale program for evaluating ozonation/direct filtration as a technology for ensuring virus removal from the CBMWD secondary effluent. The process was demonstrated to produce more than 5 logs of

reduction of Polio virus and an effluent that was free of native viruses as well.

**The Contra Costa Water Reuse Project:** Dr. Trussell was technical director and project manager for the Contra Costa Industrial Reuse Project. The project included full-scale testing of reclaimed water in industrial cooling towers, an extensive industrial user cost study, a two year pilot scale study of softened water in cooling towers and the design of a 15 mgd system to further polish the effluent and serve it to several Contra Costa industries. The project required coordination with six major industries; the California Department of Health Services, the Central Contra Costa Sanitary District, the Contra Costa Water District, and the San Francisco Regional Water Quality Control Board.

#### **Contra Costa Water District**

**Title:** Design of 10 mgd Ion Exchange Softening Plant

**Date:** 1978

Dr. Trussell designed a 10 mgd ion exchange plant to soften reclaimed water produced by the Central Contra Costa Sanitation District to be used for cooling towers operated by the Shell and Phillips Petroleum Refineries and by PG&E. The plant used a counter-flow ion exchange process and achieved regeneration efficiencies of less than 1.15.

**The San Diego Water Authority:** The Water Authority was considering the construction of a water treatment plant to treat water imported from Northern California. Dr. Trussell conducted an evaluation of technologies appropriate for treating that supply.

**Reedy Creek Improvement District:** Dr. Trussell was retained by the Reedy Creek Improvement District, over a period of several years, to advise its operational staff on the operation of the District's activated sludge treatment plant. Trussell used innovative computer technology to communicate with the treatment plant operators and assist them in managing the plants operating conditions

**Circus World Waste Study** - MW was retained by Circus World Inc., to do a comprehensive study of all the solid and liquid waste treatment systems to emanate from the new amusement park in Orlando, FL. The project involved extensive characterization of a variety of animal wastes as well as designing a treatment system that addressed all the appropriate special quarantines and other regulations that apply to animal collections. Mr. Trussell was the project engineer.

**The Seaworld Ozonation Study:** Seaworld had a number of installations where recirculated water was used for the habitat for sea-going mammals such as killer whales and porpoises. Practice had been to disinfect these systems with chlorine, occasionally using breakpoint chlorination as a means for controlling the eye-irritation that stems from extensive exposure to chlorine. Dr. Trussell was hired to evaluate alternatives and, using field and pilot data developed the design criteria that are now used for ozonation in such recirculated seawater system throughout the industry.

**Hollywood Presbyterian Hospital Waste Study** - MW was retained by the Hollywood Presbyterian Hospital to review the problems in disposing of wastes from their new expansion. The timing of the expansion was unfortunate because, at the time, State Law required that all hospital wastes be incinerated, but the Southern California Air Quality Management District had recently set air quality limits that no such incinerator could meet. Mr. Trussell organized the bulk of the study and the issue was only resolved when members of all the relevant regulatory agencies were brought into one room so a compromise could be struck.

**Rancho California On-Site Treatment Study** - MW was retained by Rancho California, Inc. to conduct a study of on-site wastewater treatment for large rural lots in the development in an area with shallow soil and poor percolation rates. A manual was developed for use in site-by-site design of an evapotranspiration system to serve development in the area.

**Power Plant in Needles, CA** - A private utility was considering construction of a large power plant near Needles, CA. and was considering discharge of the waste brine to a deep aquifer via deep-well injection. Dr. Trussell conducted an evaluation of the interaction of the injection water and the deep aquifer water, demonstrating that significant scaling could be expected.

**Rancho California Vail Lake Masterplan** - MW was retained by Rancho California, Inc. to develop a water and sewer masterplan for the Vail Lake area. The effort included studies of land use, population estimates, and preliminary layouts of both sewers and water mains. Mr. Trussell conducted much of the work.

**Corona Corrosion Study** - MW was retained by Home Savings and Loan to find the cause, and recommend action, for the pitting failure of copper tubing in a number of homes in the vicinity of Corona, California. The homes, which were served by groundwater exhibited Type I pitting in the coldwater plumbing. Chemical treatment was recommended. Dr. Trussell conducted the investigation.

**Crummer Ranch Study** - Home Savings and Loan, owner of Crummer Ranch retained MW to basis for sizing the new sewer system being installed by the Triunfo Sanitation District in a service area that included the Crummer Ranch. New population estimates were developed and the size and cost of the sewer system was reviewed. Mr. Trussell did the larger share of the technical work

#### **ORGANIZATIONS:**

- American Association of Environmental Engineering Professors (Associate)
- American Chemical Society
- American Society of Civil Engineers
- American Institute of Chemical Engineers
- American Water Works Association (Life Member)
- California Water Pollution Control Association
- International Water Association
- National Association of Corrosion Engineers

- Sigma Xi - The Scientific Research Society of North America
- Water Environment Federation

## PROFESSIONAL ACTIVITIES:

### AAEE

Nominated to AAEE by AWWA  
Cover person in Environmental Engineer, January 1997  
Kappe Lecturer for Fall of 1999  
Member, Certification by Eminence Committee, 2005-2007  
Frederick G. Pohland Medal, For outstanding contributions to bridging environmental engineering research, education, and practice, 2005 (jointly awarded by AAEE & AAEEESP)

### AAEESP

Invited Speaker to AAEEESP forum at AWWA, 1989.  
Invited member of Asilomar Panel on the New Frontiers in Environmental Engineering and Science, 1997p  
Frederick George Pholand Medal, 2005, (jointly awarded by AAEE & AAEEESP)

### AWWA

Vice Chair Water Treatment Committee, California Section 1977-1980.  
Co-chair National Research Committee on Particulates, 1978-1982  
AWWA Representative to the Editorial Advisory Board of **Standard Methods for Examination of Water and Wastewater**, 1982-1989.  
Member Editorial Board of **American Water Works Association Journal**, 1988-1994.  
AWWA Representative to International Water Supply Association's Standing Committee on Water Quality and Treatment, 1990-1994  
Member of AWWA International Committee 1990-present  
Best Paper Award, Distribution Division, 2000  
Best Paper Award, Distribution & Operations Division, 2001  
Best Paper Award, Water Resources Division, 2001

AP Black Award, 2010

### AWWARF

AWWARF - US/Holland Committee on Volatile Organic Compounds in Ground Water, 1982-1983  
AWWARF - US/German Committee on Corrosion, 1983-1985  
AWWARF - US/USSR Committee on Drinking Water Research, 1985-1987  
AWWARF - US/French Committee on Mixing in Water Treatment 1988-1990  
AWWARF - US/European Committee on Corrosion, 1991-1994

### ASCE

Civil Engineering Research Foundation, CERF  
Consultant Advisory Board, Civil Engineering Research Foundation, 1991-1998, Chairman Environmental Committee, 1993  
Executive Committee, 1994.

### ACS

Member Editorial Board of **Environmental Science and Technology**, 1978-1983  
Member of magazine Editorial Board of **Environmental Science and Technology**, 2000-2005.

### IWA

Member of Standing Committee on Water Quality and Treatment, 1990-1994  
Member of Scientific and Technical Council, 1994-present  
Chair, Committee on Disinfection, 1994-2002  
Member, Programme Committee, 2000-2008

### National Academy of Engineering

Peer Committee 2001-2003  
Membership Committee 2005-2007  
Grainger Prize Committee 2006-2007

National Research Council - Division on Earth and Life Studies Water Science and Technology Board  
Chair 2002-2008

National Water Research Institute

Member of Clarke Prize Selection Committee  
2006-2012  
Member of Davis Water Supply Panel  
Member of OCWD GWRS Panel

WaterReuse Association  
Chairman of Research Advisory Committee,  
2005-2007

Water Environment Research Foundation  
Member, Board of Directors, 2007-2010

### **EPA ADVISORY ACTIVITIES**

Science Advisory Board  
Consultant to Sub Committee on  
Drinking Water, 1988-1990  
Member Committee on Drinking  
Water, 1990-1992  
Consultant to Committee on Drinking  
Water, 1992-1994  
Member, Committee on Drinking  
Water, 1994 - 2005  
Chair, Committee on Drinking Water,  
2000-2004  
Member, Executive Committee and  
Board, 2000-2005

EPA Board of Scientific Counselors  
Member of Committee on Arsenic in  
Water, 1997

Other EPA Activities  
Invited Speaker EPA Seminar Series  
on Treatment Technology for Meeting  
the NIPDWR 1976  
Invited Speaker EPA Seminar Series  
on Operation of Activated Sludge,  
1977  
Invited Speaker EPA Seminar on  
Defluoridation of Drinking Water,  
Dallas, Texas, 1978  
Invited Speaker EPA  
Seminar/Workshop on Corrosion in  
Consumer Plumbing, Cincinnati,  
Ohio, 1979  
Invited Speaker EPA Seminar Series  
on Treatment Technology for  
Removing Organics in Drinking

Water, San Francisco and Dallas,  
1979  
Member EPA Arlie Conference on  
Potable Reuse Criteria, Washington,  
D.C., 1980  
Member EPA Panel on Re-evaluation  
of National Water Quality Criteria; The  
Johns Hopkins University, 1983  
Member of Consulting Panel to EPA  
to Write Report to Congress on the  
Relative Risks of Disinfection and  
Disinfection By-products, 1987-88  
Member of Panel appointed to review  
office of pesticide program  
regulations, 2000.

### **NATIONAL RESEARCH COUNCIL**

Member National Academy of Sciences  
Committee on Drinking Water  
Chemicals CODEX, 1980-1982  
Member National Academy of Sciences  
Committee on 3rd Party Certification  
of Drinking Water Chemicals, 1983-  
1984  
Member National Academy of Sciences  
Committee on Irrigation Induced  
Water Quality Problems, 1985-1989  
*Elected to National Academy of  
Engineering, Class of 1995*  
Member of National Academy of Sciences  
Committee on Viability of Potable  
Reuse, 1996-1998.  
Vice-Chair of National Academy of  
Sciences Committee on Setting  
Priorities for Drinking Water  
Contaminants, 1998-1999  
Member of Water Science and  
Technology Board, 1999-2007,  
Incoming Chair 2004-2007  
Vice-Chair of National Academy of  
Sciences Committee on Identifying  
Future Drinking Water Contaminants,  
1999  
Vice-Chair of National Academy of  
Sciences Committee on Categorizing  
Drinking Water Contaminants for  
Purposes of Regulation, 2000-2001.  
Vice-Chair of National Academy of  
Sciences Committee on Microbial  
Indicators in Water

Member of Peer Committee for Section 4,  
Civil Engineering, 2001-2004

### OTHER ADVISORY PANELS

Member, Scholars Committee on Perchlorate,  
Urban Water Research Center, Irvine, CA  
2003-2004

### HONORS:

1985 Who's Who in the West  
1987 Who's Who in America  
1989 Who's Who in Engineering  
1990 American Academy of Environmental  
Engineering (nominated by AWWA)  
1995 National Academy of Engineering  
1997 American Academy of Environmental  
Engineering, Featured Cover Story  
1998-1999 American Water Works Association,  
Distribution & Plant Operations Division, Best  
Paper Award  
1999 American Academy of Environmental  
Engineering: Kappe Lecturer  
2000 American Water Works Association,  
Distribution Division, Best Paper Award;  
2001 Water Resources Division, Best Paper  
Award  
2001 American Water Works Association,  
Distribution & Operations Division, Best  
Paper Award;  
2001 American Association of Municipal Water  
Agencies Donald R. Boyd Award for  
leadership and contributions to the drinking  
water community  
2003 American Water Works Association, Life  
Member  
2003 American Chemical Society, Life Member  
2005 Association of Environmental Engineering  
and Science Professors/American Academy  
of Environmental Engineering – Frederick G.  
Pohland Medal for outstanding contributions  
to bridging environmental engineering  
research, education and practice  
2010 American Water Works Association, A.P.  
Black Award  
2012 International Water Association, Global  
Water Award

### PUBLICATIONS IN REVIEWED BOOKS AND JOURNALS

1. Thomas, J. F. and Trussell, R. R., "The Influence of Henry's Law on Bicarbonate Equilibria," **JAWWA V62(3)**:195 (March 1970).
2. Thomas, J. F. and Trussell, R. R., "Computer Application to Water Conditioning Calculations," **JAWWA V62(3)**:245 (April 1970); also published in *British Water Supply*, p. 22 (December, 1970), by request.
3. Trussell, R. R. and Thomas, J.F., "A Discussion of the Chemical Character of Water Mixtures" **JAWWA**, V63(4):40 (January 1971).
4. Trussell, R. R., and Tate, C. H., "Water Borne Viruses, Their Characteristics and Possible Methods for Removal," **J. National Water Supply Improvement Association**, V2(1):15 (January 1975).
5. **EPA Process Control Manual for Aerobic Biological Treatment Facilities**. Dr. Trussell was one of three principal authors (March 1977).
6. Trussell, R. R., and Chao, J. L., "Rational Design of Chlorine Contact Tanks," **JWPCF**, P. 659 (April, 1977).
7. Tate, C., and Trussell, R. R., "Developing Drinking Water Standards," **JAWWA** V69(9):pp486-498, (September 1977), Erratum, **JAWWA**, V70 No. 3, p44.(March 1978).
8. Trussell, R. R., "Predesign Studies" in **Water Treatment Plant Design**, Ed. R. Sanks, Ann Arbor Publ., Ann Arbor, Michigan, P. 37 (1978).
9. Trussell, A., Umphres, M., Leong, L., and Trussell, R. R., "Optimizing Trihalomethane Analysis," **Water Chlorination: Environmental Impact and Health Effects, Vol. 2**, Ed. Junk, Ann Arbor Sci., Michigan, p543-553, (1978).

10. Trussell, R. R., Umphres, M., "Formation of Trihalomethanes," **JAWWA** V70(11):604 (November 1978).
11. Tate, C.H., and Trussell, R. R., "The Use of Particle Counting in Developing Plant Design Criteria," **JAWWA**, V70(12): P. 691 (December 1978).
12. Trussell, A., Umphres, M., Leong, L., and Trussell, R. R., "Precise Analysis of Trihalomethanes," **JAWWA**, V72(7):pp385-389, (July 1979).
13. Trussell, R. R. Selleck, R., E., and Chao, J. L., *Discussion of Hydraulic Analysis of Model Treatment Units* by F. Hart and S. Gupta, **ASCE Vol. 105**, No. EE4, Aug 1979, p 796-798.
14. Kavanaugh, M., Trussell, A., Tate, C., Trussell, R. R., and Treweek, G., "Particle Size Distributions in Water Treatment Processes," **Particles in Water**, Ed. M. Kavanaugh, ACS Adv. in Chem. Series No. 189, P. 305 (1980).
15. Tate, C., & Trussell, R., "Recent Developments in Direct Filtration", **JAWWA**, V71(3), pp165-169, March 1980.
16. Chao, J. and Trussell, R. R., Hydraulic Design of Flow Distribution Channels," **Journal of Environmental Engineering Division**, ASCE, P. 331-334 (April 1980)
17. Trussell, R. R., and Trussell, A., "Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies," **JAWWA**, V72(8):pp458-470, (August 1980).
18. Trussell, R., Trussell, A., Kreft, P., **Selenium Removal for Ground Water Using Activated Alumina**, EPA-600/2-80-153, 147p. August 1980.
19. Kavanaugh, M. C., Trussell, A., Trussell, R. R., and Cromer, J., "Empirical Kinetic Model of Trihalomethane (THM) Formation: Applications to Meet the Proposed THM Standard," **JAWWA**, V72(12), pp684-692, December 1980.
20. Trussell, R. R., Trussell, A., Lang, J., and Tate, C., "Recent Developments in Filtration System Design," **JAWWA**, V72(12):pp705-710, December 1980.
21. Kavanaugh, M. C., and Trussell, R. R., "Design of Air Stripping Towers to Remove Volatile Contaminants from Drinking Water," **JAWWA**, V74(12):pp684-692, (December 1980). Erratum, **JAWWA**, V75(5), p 42., May 1981, (Etude des tours de stripping en vue d'eliminer les contaminants volatils de l'eau potable), **Aqua**, No. 6, June 1980, pp118-125.
22. Kreft, P., Trussell, A., Lang, J., Kavanaugh, K., and Trussell, R. R., "Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglas Pilot Plant," **JAWWA**, V75(10):558 (October 1981)
23. NAS, **Water Chemicals Codex**, [member of Committee] National Research Council, W.D.C., 1982
24. Leong, L., Argo, D., Trussell, R., "Enterovirus Removal by a Full-Scdale Tertiary Treatment Plant", **JAWWA**, V75, No. 4, pp199-204, April 1983.
25. Saunier, B., Selleck, R., Trussell, R., "Preozonation as a Coagulant Aid in Drinking Water Treatment", **JAWWA**, V75, No.5, pp239-246, May 1983.
26. Umphres, M., Tate, C., Kavanaugh, M., Trussell, R., "Trihalomethane Removal by Packed-Tower Aeration", **JAWWA**, V75, No. 8, pp414-418, August 1983.
27. Kreft, P., Umphres, M., Hand, J., Tate, C., McGuire, M., Trussell, R., "Converting From Chlorine to Chloramines: a Case Study", **JAWWA**, V77, No. 1, pp38-45, January 1985.
28. Kuch, A., Snoeyink, V., Trussell, R. R., and Wagner, I., "Experimental and Investigation

- Techniques," in ***Internal Corrosion of Water Distribution Systems***; AWWARF, Denver, CO, P. 657 (June 1985).
29. Trussell, R. R., and Wagner, I., "Corrosion of Galvanized Pipe," in ***Internal Corrosion of Water Distribution Systems***, AWWARF Denver, CO, P. 337 (June 1985).
30. APHA, AWWA, WPCF, ***Standard Methods for the Examination of Water and Wastewater***, Joint Editorial Board; Greenberg, A. (APHA) Chmn, Trussell, R. R., (AWWA) and Clesceri, L. (WPCF); publ. APHA, Washington, D.C. (1985).
31. ***Selected Physical and Chemical Standard Methods for Students***, APHA, AWWA, WPCF, Ed. A. Greenberg, R.R. Trussell, and L. Clesceri, APHA (1986).
32. Kreft, P., and Trussell, R. R., "Removal of Inorganic Selenium from Drinking Water Using Activated Alumina," ***Proceedings of Symposium on Selenium in the Environment***, California Agricultural Institute, California State University, Fresno, CAT 1/960201, Feb 1986, p 97-101.
33. Fox, K., Tate, C., Treweek, G., Trussell, R., Bowers, G., McGuire, M., and Newkirk, D., ***Copper-Induced Corrosion of Galvanized Steel Pipe***, EPA 600/S2-82/056 Sep 1986.
34. APHA, AWWA, WPCF, ***Standard Methods for the Examination of Water and Wastewater***, Joint Editorial Board; Greenberg, A. (APHA) Chmn, Trussell, R. R., (AWWA) and Clesceri, L. (WPCF); publ. APHA, Washington, D.C. (1989).
35. NAS, ***Irrigation-Induced Water Quality Problems*** [member of Committee] National Research Council, W.D.C., 1989
36. Bull, R., Gerba, R., and Trussell, R., "Evaluation of Health Risks Associated with Disinfection" in ***Critical Reviews in Environmental Control*** V20(2)77-114, 1990.
37. Amirtharajah, A., Clark, M., and Trussell, R., editors, ***Mixing in Coagulation and Flocculation***, AWWARF, Denver, CO, 1991
38. Oldshue, J., and Trussell, R., "Design of Impellers for Mixing", in ***Mixing in Coagulation and Flocculation***, ed. Amirtharajah, et.al., AWWARF, Denver, CO, 1991
39. Monk, R., and Trussell, R., "Design of Mixers for Water Treatment Plants: rapid Mixing and Flocculators", in ***Mixing in Coagulation and Flocculation***, ed. Amirtharajah, et.al., AWWARF, Denver, CO, 1991
40. Kawamura, S., and Trussell, R., "Main Features of Large Water Treatment Plants in Japan", ***JAWWA***, V83(6)p 56-62, 1991.
41. Trussell, R., "Treatment for Control of Disinfectant Residuals and Disinfectant By-Products" in ***Safety of Water Disinfection: Balancing Chemical & Microbiological Risk***, ILSI Press, Washington, D.C., p319-343. 1993.
42. Lang, J., Giron, J., Hansen, A., Trussell, R., and Hodges, W., "Investigating Filter Performance as a Function of the Ratio of Filter Size and Media Size", ***JAWWA*** V85(10)122-130 October 1993.
43. Clark, M., Srivastava, R., Lang, J., Trussell, R., McCollum, L., Bailey, D., Christie, J., Stolarik, G., ***Selection and Design of Mixing Processes for Coagulation.***, AWWARF, Denver, CO, 1994.
44. Mau, R., Boulos, P., Clark, R., Grayman, W., TeKippe, R., Trussell, R., "Explicit Models of Distribution Storage Water Quality" ***ASCE J. Hydr. Engr., HY08744, Vol. 121***, pp1-11, Oct. 1995.
45. Trussell, R., and Wagner, I., "Corrosion of Galvanized Pipe", ***Internal Corrosion of Water Distribution Systems, 2nd Edition***, in press by AWWARF, Denver, CO. 1996.

46. Jacangelo, J., and Trussell, R., "Role of Membrane Technology in Drinking Water Treatment in the United States", **Desalination**, V113, pp119-127, 1997.
47. Trussell, R. R., "Spreadsheet Water Conditioning" **JAWWA** V90(6): 70-81, June 1998.
48. NAS, **Issues in Potable Reuse**, Report on NAS Committee of which Dr. Trussell was a member, National Academy Press, Washington D.C., 1998.
49. Adham, S., Trussell, R., Gagliardo, P., and Olivieri, A., "Membranes: a Barrier to Microorganisms." **Water Supply**, V16, Nos. 1/2, p336-340, 1998.
50. Adham, S., Trussell, R. S., Gagliardo, P., and Trussell, R. R., "Rejection of MS-2 Virus by RO Membranes", **JAWWA**, V90(9):130-135, Sep.1998.
51. Gagliardo, P., Adham, S., Trussell, R., and Olivieri, "Water Repurification via Reverse Osmosis", **Desalination**, V117, September 1998.
52. Trussell, R., "An Overview of Disinfectant Residuals in Drinking Water Systems", **Water Supply**, Vol. 16, Nos 3 & 4, p1-15., 1998
53. Trussell, R., Discussion: "Modeling Chlorine Inactivation Requirements of *Cryptosporidium parvum* Oocysts,"ASCE's **Journal of Environmental Engineering**, Vol. 124(11), p1141-1142, Nov. 1998.
54. Haas, C. and Karra, S., 1984, "Kinetics of Microbial Inactivation by Chlorine - I", **Water Research**, V18(11) pp1443-1449
55. Haas, C., and Trussell, R., "Frameworks for Assessing Reliability of Multiple, Independent Barriers in Potable Reuse Systems", **Water Science & Technology**, V38(6), pp. 1-8, Nov. 1998.
56. NAS, **Setting Priorities for Drinking Water Contaminants**, Report on NAS Committee of which Dr. Trussell was a Vice Chair, National Academy Press, Washington D.C., 1999.
57. Trussell, R., "Safeguarding Distribution System Integrity", **JAWWA**, V91, No. 1, pp46-54, January 1999.
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**Proceedings of the AWWA Annual  
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“The mechanisms of membrane fouling in  
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Section Conference**, San Francisco, CA.
134. Hokanson, D.R. and R.R. Trussell (2006).  
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on AOP Effectiveness in Removing Persistent  
Organic Pollutants.” Proceedings of the 10th  
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Phoenix, AZ, May 15-16.
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Denver, CO
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137. Crittenden, J.C.; K. Li, D. Minakata, P.  
Westerhoff, D. Hokanson, R. Trussell, ; H.  
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process performance of advanced oxidation

processes (AOPs).” The Croucher Foundation Advanced Study Institute (ASI), June 23-27, 2008, Hong Kong, China.

138. R.R. Trussell and D.R. Hokanson (2008) “Endocrine Disrupters, Pharmaceuticals and Personal Care Products: An Overview of Treatment,” Presented at the 2008 CA-NV- AWWA Fall Conference, Reno, NV, October 20-23.
139. Hokanson, D.R., R.S. Trussell, RR Trussell, G. Wetterau, L. McGovern, (2009) “A Groundwater Pilot Study in Camarillo: Occurrence and Removal of PhPCPs,” Presented at the 2009 ACE Conference, San Diego, CA June 14-18.
140. Hokanson, D.R. and Trussell, R.R. (2009), “Ozonation: Opportunities and Challenges,” Presented at 2009 CA-NV AWWA Fall Conference, Las Vegas, NV October 5-9.
141. Geringer, F.W., Trussell, R.S., Trussell, R.R., Lauri, P. (2010). “Preformed Chloramines for Biofouling Control During Seawater RO Desalination” Presented at CA-NV AWWA Spring Conference, Hollywood, CA March 29-April 1, 2010.
142. Trussell, R.R. (2010). “Science, Technology, and Water,” Presented at AWWA ACE Annual Conference, Chicago, IL June 20-24, 2010.
143. Trussell, R.R. (2010). “Drinking Water Research: An Overview of Past Accomplishments with an Eye toward the Future,” Presented at 2010 CA-NV AWWA Fall Conference, Sacramento, CA October 5-8, 2010.

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- Michael A. Anderson, Ph.D.

# MICHAEL A. ANDERSON, Ph.D.

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## ADDRESS

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## EMPLOYMENT HISTORY

- *Chair*, Environmental Sciences, University of California, Riverside. 2010 – present.
- *Professor*, Environmental Sciences, University of California, Riverside. 2009 – present.
- *Associate Professor*, Environmental Sciences, University of California, Riverside. 1996 – 2009.
- *Assistant Professor*, Environmental Sciences, University of California, Riverside. 1990 - 1996.
- *Environmental Chemist*, University of Georgia. 1984 - 1987.
- *Hydrologist*, US Dept. of Interior, Bureau of Land Management, Coeur d'Alene, ID. 1984.

## EDUCATIONAL BACKGROUND

- Ph.D., *Environmental Chemistry*. Virginia Tech, June, 1990.
- M.S., *Environmental Studies*. Bemidji State University, July, 1984.
- B.S., *Biology*. Illinois Benedictine College, May, 1982.

## RESEARCH INTERESTS AND AREAS OF SPECIALIZATION

- Applied limnology and lake/reservoir management
- Surface water quality and modeling
- Fate of contaminants in waters, soils and sediments

## RECENT RESEARCH PROJECTS

- *Environmental, Biological and Technical Support for Development of Species Conservation Habitat at the Salton Sea*. Funding Agency: California Dept. of Water Resources. 2010-2012.
- *Bathymetric, Sedimentological and Retrospective Water Quality Analysis of Lake Elsinore*. Funding Agency: Lake Elsinore-San Jacinto Watersheds Authority. 2010.
- *Managing Quagga Mussels in the Reservoirs of the Colorado River Aqueduct*. Funding Agency: Metropolitan Water District of Southern California. 2008-2010.

## RECENT PROFESSIONAL ACTIVITIES

- Vice-Chair, IWA Lake and Reservoir Management Specialist Group (2013-2014)
- Guest Professor, Huazhong Agricultural University, Wuhan, China (2011-14)
- Associate Editor, *Lake and Reservoir Management* (2007 – present)
- Member, Integrated Watershed Management, Environmental Protection Admin., Taiwan (2009)
- Member, San Diego Indirect Potable Reuse/Reservoir Augmentation Panel, NWRI (2009-12)
- Member, Water Science Management Board, California Bay Delta Authority CALFED (2005)
- Member, USEPA Drinking Water (2000, 2002) & USDA Water Resources (2002, 2003) Panels
- Member, UC Water Resources Center Technical Advisory Committee (2001-05)

## PEER-REVIEWED TECHNICAL ARTICLES

- Anderson, M.A., A. Komor and K. Ikehata. 2014. Flow routing with bottom withdrawal to improve water quality in Walnut Canyon Reservoir, CA. *Lake Reserv. Manage.* (in press).
- Anderson, M.A., J.L. Conkle, P. Pacheco and J. Gan. 2013. Use of hydroacoustic measurements to characterize bottom sediments and guide sampling and remediation of organic contaminants in lake sediments. *Sci. Tot. Environ.* 458-460:117-124.
- Martinez, D. and M.A. Anderson. 2013. Methane production and ebullition in a shallow, artificially aerated eutrophic temperate lake (Lake Elsinore, CA). *Sci. Tot. Environ.* 454-455:457-465.
- Wang, W., L. Delgado-Moreno, J. Conkle, M.A. Anderson, C. Amrhein, Q.F. Ye and J. Gan. 2012. Characterization of sediment contamination patterns by hydrophobic pesticides to preserve ecosystem functions of drainage lakes. *J. Soils Sediments* 12:1407-1418.
- Conkle, J.L., J. Gan and M.A. Anderson. 2012. Degradation and sorption of commonly detected PPCPs in wetland sediments under aerobic and anaerobic conditions. *J. Soils Sediments* 12:1164-1173.
- Reid, N.J., O. Holovachov and M.A. Anderson. 2012. Nematodes associated with the invasive quagga mussel (*Dreissena rostriformis bugensis*) in the Colorado River Aqueduct reservoirs, southern California, USA. *Nematology* 14:827-837.
- Anderson, M.A. and W.D. Taylor. 2011. Quantifying quagga mussel veliger abundance and distribution in Copper Basin Reservoir (California) using acoustic backscatter. *Water Res.* 45:5419-5427.
- Anderson, M.A. and P. Pacheco. 2011. Characterization of bottom sediments in lakes using hydroacoustic methods and comparison with laboratory measurements. *Water Res.* 45:4399-4408.
- Anderson, M.A. and J. Berkowitz. 2010. Aluminum polymers formed following alum treatment of lake water. *Chemosphere* 81:832-836.
- Reid, N.J., M.A. Anderson and W.D. Taylor. 2010. Distribution of quagga mussel veligers, *Dreissena bugensis*, in the reservoirs of the Colorado River Aqueduct. *Lake Reserv. Manage.* 26:328-335
- Kirby, M., S.P. Lund, W.P. Patterson, M.A. Anderson, B.W. Bird, L. Ivanovici, P. Monarrez and S. Nielsen. 2010. A Holocene Record of Pacific Decadal Oscillation (PDO)-Related Hydrologic Variability in Southern California (Lake Elsinore, CA). *J. Paleolimnol.* 44:819-839.
- Anderson, M.A. 2010. Influence of pumped-storage hydroelectric plant operation on a shallow polymictic lake: Predictions from 3-D hydrodynamic modeling. *Lake Reserv. Manage.* 26:1-13.
- Whiteford, J.K. and M.A. Anderson. 2009. Quantitation of diaminomaleonitrile using high performance liquid chromatography with UV and electrospray ionization mass spectrometric detection. *Anal. Lett.* 42:2567-2577.

- Reese, B.K. and M.A. Anderson. 2009. Dimethyl sulfide production in a saline eutrophic lake, Salton Sea, California. *Limnol. Oceanogr.* 54:250-261.
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- de Koff, J.P., M.A. Anderson and C. Amrhein. 2008. Geochemistry of iron in the Salton Sea, California. *Hydrobiol.* 604:111-121.
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- Rodriguez, I.R., C. Amrhein and M.A. Anderson. 2008. Laboratory studies on the coprecipitation of phosphate with calcium carbonate in the Salton Sea, California. *Hydrobiol.* 604:45-55.
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- Lawson, R. and M.A. Anderson. 2007. Stratification and mixing in Lake Elsinore, California: an assessment of axial flow pumps for improving water quality in a shallow eutrophic lake. *Water Res.* 41:4457-4467.
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- Berkowitz, J., M.A. Anderson and C. Amrhein. 2006. Influence of aging on phosphorus sorption to alum floc in lake water. *Water Res.* 40:911-916.
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Anderson, M.A. and P.M. Bertsch. 1993. Electrophoretic mobility and apparent particle size of kaolinite and bentonite in pure and mixed suspensions. *Soil Sci. Soc. Am. J.* 57:1641-1643.

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Anderson, M.A., P.M. Bertsch, S.B. Feldman, and L.W. Zelazny. 1991. Interactions of acidic metal-rich coal pile runoff with a subsoil. *Environ. Sci. Technol.* 25:2038-2046.

Anderson, M.A., P.M. Bertsch, and L.W. Zelazny. 1991. Fluoro-aluminum complexes on model and soil exchangers. *Soil Sci. Soc. Am. J.* 55:71-75.

Anderson, M.A. and J.C. Parker. 1990. Sensitivity of organic contaminant transport and persistence models to Henry's Law constants: Case of polychlorinated biphenyls. *Water, Air, Soil Pollut.* 50:1-18.

Anderson, M.A., P.M. Bertsch, and W.P. Miller. 1989. Beryllium in selected southeastern soils. *J. Environ. Qual.* 19:347-348.

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Bertsch, P.M., M.A. Anderson, and W.J. Layton. 1989. Aluminum-27 nuclear magnetic resonance studies of ferron-hydroxo-polynuclear Al interactions. *Mag. Resonance Chem.* 27:283-287.

Bertsch, P.M. and M.A. Anderson. 1989. Speciation of aluminum in aqueous solutions using ion chromatography. *Anal. Chem.* 61:535-539.

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Anderson, M.A. and P.M. Bertsch. 1988. Dynamics of aluminum complexation in multiple ligand systems. *Soil Sci. Soc. Am. J.* 52:1597-1602.

Anderson, M.A., P.M. Bertsch, and W.P. Miller. 1988. The distribution of lithium in selected soils and surface waters of southeastern USA. *Appl. Geochem.* 3:205-212.

Bertsch, P.M. and M.A. Anderson. 1988. Determination of aluminum extracted from soils by ion chromatography. *Soil Sci. Soc. Am. J.* 52:540-542.

#### **PEER-REVIEWED BOOK CHAPTERS**

Anderson, M.A. 2003. Isotopes. In B.A. Stewart and T.A. Howell (eds.) *Encyclopedia of Water Science*. Marcel Dekker, Inc. New York, NY. pp. 565-568.

Anderson, M.A., P.M. Bertsch, and L.W. Zelazny. 1993. Multicomponent transport through soil subjected to coal pile runoff under steady saturated flow. p. 137-164. In R. Keefer (ed.) *Trace Elements in Coal and Coal Combustion Residues*, Lewis Publ., Chelsea, MI.

## SELECTED TECHNICAL REPORTS (OUT OF 36 TOTAL)

Anderson, M.A., M. Tobin, and J. Tobin. 2011. *Biological Monitoring of Lake Elsinore*. Final Report. Lake Elsinore and San Jacinto River Watersheds Authority. 55 p..

Anderson, M.A., J. Sickman, N. Reid and J. McCullough. 2010. *Managing Quagga Mussels in the Reservoirs of the Colorado River Aqueduct*. Draft Final Report. Metropolitan Water District of Southern California. 43 pp.

Barry, B. and M.A. Anderson. 2010. *Hydrologic, Temperature and Water Quality Modeling in Support of Development of Species Conservation Habitat*. Draft Report to DWR. 19 pp+Appendices.

Anderson, M.A. 2009. *Mass-Balance and 1-D Water Quality Modeling of San Dieguito Reservoir: Development of Management Strategies*. Final Report to Santa Fe Irrigation District. 26 pp.

Anderson, M.A. 2008. *Predicted Water Quality and Public Health Impacts Resulting from Pathogen Inputs Near Water Intakes on Lake Tahoe*. In (Black & Veatch) *Lake Tahoe Source Water Protection Risk Assessment*. 118 pp. + Appendices.

Anderson, M.A., C. Paez, and S. Men. 2007. *Sediment Nutrient Flux and Oxygen Demand Study for Canyon Lake with Assessment of In-Lake Alternatives*. Final Report. San Jacinto River Watershed Council. 25 pp.

Anderson, M.A. 2007. *Predicted Effects of In-Lake Treatment on Water Quality in Canyon Lake*. Final Report. San Jacinto River Watershed Council. 31 pp.+Appendix.

Berkowitz, J. and M.A. Anderson. 2005. *Full-Scale Alum Application to Big Bear Lake, California: Water Quality and Geochemical Responses* Final Report. Big Bear Municipal Water District. 71 pp.

Anderson, M.A., J. Wakefield-Schmuck, J. Erguiza, J. San Jose and J. Berkowitz. 2004. *Impacts of Macrophyte Control Methods on Water Quality and Internal Recycling in Big Bear Lake*. Final Report. Big Bear Municipal Water District. 14 pp. + Appendices.

Anderson, M.A. and C. Amrhein. 2002. *Nutrient Cycling in the Salton Sea. Final Report*. Salton Sea Authority. 86 pp.

Anderson, M.A., K. Davis and M.V. Yates. 2001. *The Occurrence and Distribution of Indicator Bacteria in Canyon Lake*. Final Report. Santa Ana Regional Water Quality Control Board. 58 pp.

## UNIVERSITY TEACHING

ENSC 101: Water Resources (2012 - present)

ENSC 140: Limnology (1994 - 2012)

ENSC 176: Acquisition and Analysis of Environmental Data (1998 - 2006)

ENSC 204: Environmental Organic Chemistry (1997 - 2006)

ENSC 207: Surface Water Quality Modeling (2009 - present)

SWSC 203: Surface Chemistry of Soils (1992 - present)

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- Richard J. Bull, Ph.D.

## CURRICULUM VITAE

Richard J. Bull, Ph.D.

December, 2008

### PERSONAL DATA:

Current Title: Consulting Toxicologist  
MoBull Consulting  
1928 Meadows Drive North  
Richland, WA 99352

Tel. 509-628-0818  
Fax: 509-628-1398  
Cell: 509531-7991  
[rjbull@earthlink.net](mailto:rjbull@earthlink.net)

Professor Emeritus,  
Pharmacology and Toxicology  
Washington State University  
Pullman, WA

Place of Birth: Stillwater, Oklahoma

### EDUCATION:

	<u>Major</u>	<u>Degree</u>	<u>Year</u>
<u>Graduate:</u> Department of Pharmacology University of California San Francisco Medical Center San Francisco, California	Pharmacology	Ph.D.	1971
<u>Undergraduate:</u> College of Pharmacy University of Washington Seattle, Washington	Pharmacy	B.S.	1964

### EXPERIENCE:

1964-65 U.S. Public Health Service, Division of Hospitals, Baltimore, Maryland  
Duties: Resident in Hospital Pharmacy

1965-67 U.S. Public Health Service, Northeast Marine Health Science Lab., Narragansett,  
Rhode Island  
Duties: Chemist, Isolated and purified paralytic shellfish poison  
(saxitoxin) from the siphons of the Alaskan Butter Clam.

1967-70 Department of Pharmacology, University of California, San Francisco Medical  
Center, San Francisco, California  
Duties: Graduate student in pharmacology

Title of doctoral dissertation: "Saxitoxin, tetrodotoxin and excitation in cerebral cortex slices."

- 1970-77 Health Effects Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio  
Duties: Research Pharmacologist/Toxicologist. Principle area of research in the area of central nervous system and cardiovascular toxicology of heavy metals and their derivatives.
- 1977-81 Chief, Toxicological Assessment Branch, HERL, U.S. Environmental Protection Agency, Cincinnati, Ohio  
Duties: Direction of research designed to define the hazards associated with chemicals found in water. Position involved the direction of 28 permanent in-house professionals and technical staff and a sizable extramural program working in carcinogenesis, mutagenesis, development and target organ toxicology.
- 1981-84 Director, Toxicology and Microbiology Division, Health Effects Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio.  
Duties: Administrative and technical direction of a multidisciplinary research program. Principle program areas involved the definition of chemical and microbiological hazards associated with water. Research interests include determining mechanisms involved in chemically-induced disease and the importance of mechanisms in risk assessment. Size of the program was 90 FTE and 12 million dollars including extramural projects.
- 1984-94 Professor/Scientist of Pharmacology/Toxicology, College of Pharmacy, Washington State University, Pullman, Washington  
Duties: Teaching of Pharmacology/Toxicology to professional students and graduate students. Research interests include mechanisms involved in the induction of hepatic tumors by halogenated hydrocarbons and haloacetic acids.
- 1990-92 Chair, Pharmacology/Toxicology Graduate Program, Washington State University.
- 1994-2000 Senior Staff Scientist, Battelle Pacific Northwest Laboratory, Richland, WA  
Duties: Develop and manage a research program in health risk assessment in support of Department of Energy's problems with hazardous waste sites and other public concerns over chemical hazards. Direct research interests in the toxicology of drinking water disinfectant by-products in humans and experimental animals and halogenated solvents and their metabolites.
- 2000-present Consulting Toxicologist, MoBull Consulting, Kennewick, WA.  
Duties: Conduct studies of chemical problems encountered in water for water utilities domestic and internationally, federal, state and local governments. Special emphasis on chemicals found in drinking water. Also provide expert advice on regulation of chemicals in water and provide direction to research programs being developed by utilities to address their long-term plans for development and treatment of waters from varying sources. A particular interest is in potable reuse of municipal wastewater.
- 2000-2002 Adjunct Professor Department of Environmental Science and Regional Planning, Washington State U. Tri-Cities Campus  
Duties: Conduct research on risk assessment at low doses of environmental contaminants. Particular interests include low-LET radiation, by-products of the disinfection of drinking water, and halogenated solvents.

1994- present Adjunct Professor of Pharmacology and Toxicology at College of Pharmacy at Washington State University, Pullman, WA.

MEMBERSHIP IN SCIENTIFIC, PROFESSIONAL, AND SCHOLARLY SOCIETIES:

American Association for the Advancement of Science	1967 to 2004
Sigma Xi	1969 to 1994
American Society for Pharmacology and Experimental Therapeutics	1976 to 2002
Society of Toxicology	1978 to present
Pacific Northwest Association of Toxicologists	1985 to present
American Water Works Association	1990 to present
International Society for the Study of Xenobiotics	1992 to present

PROFESSIONAL RECOGNITION:

Awards:

1979 EPA Scientific Achievement Award for research efforts directed at detecting delays in brain development produced by perinatal Pb exposure.

1984 EPA Scientific Achievement Award for research documenting the formation of mutagenic chemicals from chlorination of humic acids.

Distinguished Service Medal, U.S. Public Health Service, May 30, 1985.

Offices:

President, Pacific Northwest Association of Toxicologists. 1988-1989.  
Councilor, Carcinogenesis Specialty Section of the Society of Toxicology (1995-7 and 2003-5)  
Nominating Committee, Society of Toxicology (1996-7)  
Membership Committee, Society of Toxicology (1997-1999)  
Chair, Membership Committee, Society of Toxicology (2000-2001)

Invited Presentations:

"Toxicology Research: Its application to the setting of drinking water standards. 16th Water Quality Conference, University of Illinois.  
"Effect of lead on the biochemical development of the rat cerebral cortex." Temple University, College of Medicine. Department of Pharmacology. November 1978.  
"Lead's effects on morphologic and biochemical development of the nervous system." University of Medicine and Dentistry of New Jersey. Department of Pharmacology. November 1979.  
"Bioassay Techniques for Evaluating the Possible Carcinogenicity of Adsorber Effluents" at Conference on Practical Application of Adsorption Techniques (Including GAC). Reston, Virginia. 1979.  
"Health Effects of Alternate Disinfectants and their Reaction Products" at 1979 Annual Meeting of the American Water Works Association San Francisco, California. June 24-29, 1979.  
"Is Drinking Water a Significant Source of Human Exposure to Chemical Carcinogens and Mutagens?" at Second Symposium on the Application of Short-Term Bioassays to the Fractionation and Analysis of Complex Environmental Mixtures. Williamsburg, VA. March 4-7, 1980.  
"Toxicological effects of drinking water disinfectants that are alternatives to chlorine." Miami University, Department of Zoology. March 1980.  
"Reactions of chlorine with humic acid to produce carcinogenic and mutagenic chemicals." Temple University, College of Medicine. Department of Pharmacology. October 1981.

- "Toxicological Problems Associated with Alternate Methods of Disinfection" 1981 Annual Conference of the American Water Works Association St. Louis, MO. June 7-11, 1981.
- "Toxicological Evaluation of Risks Associated with the Potable Reuse of Wastewater" at Water Reuse Symposium II held August 23-28, 1981. Washington, D.C.
- "Experimental Methods for Evaluating the Health Risks Associated with Organic Chemicals in Drinking Water" at 12th Annual Symposium on the Analytical Chemistry of Pollutants April 14-16, 1982 - Amsterdam.
- "The Effects of Lead on the Developing CNS of the Rat" International Conference on the Neurotoxicology of Selected Chemicals. Lead Neurotoxicity Symposium. September 20-21, 1982. Chicago, Illinois.
- "Toxicology of by-products of reactions between chlorine compounds with organic materials in water." University of Medicine and Dentistry of New Jersey. Department of Pharmacology. December 10, 1982.
- "Carcinogenic and mutagenic chemicals produced by reaction of chlorine with organic chemicals present in drinking water." Purdue University, School of Pharmacy. February 4, 1983.
- "In Vivo production of by-products of chlorine that possess carcinogenic and mutagenic properties." Washington State University, College of Veterinary Medicine. June 16, 1983.
- "Toxicology of Natural and Man-Made Toxicants in Drinking Water" at 14th Conference on Environmental Toxicology, Dayton, OH. November 5-17, 1983.
- "Health Effects Problems Anticipated with the Use of Chloramination for Disinfection of Drinking Water. American Water Works Association Annual Conference. Dallas, Texas, June 10-14, 1984.
- "Toxicological Data on Selected Hazardous Chemicals and Possible Extrapolation to Man." Working paper for Workshop "Approaches for evaluating human health hazards from drinking water" sponsored by the International Agency for Research on Cancer, WHO. Lyon, France. December 11-14, 1984.
- "Advantages and Disadvantages of Concentrate Studies to Define Health Hazards Associated with Potable Reuse of Waste Water." American Chemical Society, Environmental Chemistry Division in Philadelphia, Pennsylvania, August 26-31, 1984.
- "Characterization of the carcinogenic and mutagenic chemicals produced by chlorine in vivo and in vitro." Rutgers University, College of Pharmacy, Piscataway, N.J. February 8, 1984.
- "Identification of carcinogenic and mutagenic chemicals that arise from the chlorination of drinking water." Department of Energy, Battelle Pacific Northwest Laboratory Symposium on Health and Environmental Research on Complex Mixtures. October 21-24, 1985.
- "Carcinogenic and Mutagenic Properties of Chemicals in Drinking Water." International Symposium on Organic Micropollutants in Drinking Water and Health. Amsterdam, The Netherlands, June 11-14, 1985.
- "Identification of Carcinogenic and Mutagenic Chemicals That Arise From the Chlorination of Drinking Water." Symposium on Health and Environmental Research on Complex Mixtures. Richland, Washington, October 21-24, 1985.
- "The Ames Test and Other Toxicological Tests: Are They the Non-Specific Organic Parameters of the Future?" American Water Works Association Annual Conference in Dallas, Texas, June 10-14, 1985.
- "Future needs for regulatory positions on reuse," Preconference Seminar for AWWA Meeting. Denver, CO, June 22, 1986.
- "Toxicological hazards arising from the chlorination of humic acids." Water Research Center, Washington State University. Spring, 1986.
- "Use of Experimental Animals in Government and Industry." VPA 454 Guest Lecturer. Spring, 1986.
- "Health Effects Evaluations: Additives to Drinking Water," Preconference Seminar for AWWA Meeting. Kansas City, MO, June 14, 1987.
- "Relative Hazards Organic Chemicals in Drinking Water" AWWA Regulatory Roundtable Session, Kansas City, MO, June 17, 1987.
- "Mechanisms of Carcinogenesis: Importance to Quantitative Risk Assessment." Invited speaker at Third Annual Conference of the Association of State Drinking Water Administrators, Charleston, SC, Feb. 22-25, 1988.

- "Assessing Impacts of Hazardous Waste on Human Health" Conference on Hazardous Waste Outlook for the '90's: Regulation, Treatment Technology and Risk Assessment and Perception. Spokane, WA, May 23 and 24, 1988.
- "Introduction to the Risk Assessment Process" Symposium on Hazardous Waste in a Local Community: What Happens When its Processed? Ritzville, WA. Dec. 10, 1988.
- "Health Risks Associated with Hazardous Waste" Town Meeting, Lind. WA. February 13, 1989.
- "Health Risk Assessment" Cooperative Extension In Service Education Program. March 7, 1989.
- "Dichloroacetate and trichloroacetate as examples of major drinking water contaminants that are carcinogenic but not mutagenic." RIVM/KIWA Workshop, Genotoxicity of drinking water: Significance and future approach, Bilthoven, The Netherlands, May 10 & 11, 1989.
- 21st International Conference on Environmental Systems, San Francisco, CA, July 16, 1991. "Thyroid Effects of Iodine and Iodide in Potable Water" Sponsored by Society of Automotive Engineers, Inc.
- "Hazard Identification and Risk Assessment in Drinking Water". Drinking Water and Health in the Year 2000, September 12, 1991, Washington, D.C.
- "Key Health Issues with Alternate Disinfectants" Second International Symposium "Chlorine Dioxide: Drinking Water Applications. Cosponsored by CMA/AWWARF/USEPA. Houston TX, May 7-8, 1992.
- "The Role of Dichloroacetate in the Hepatocarcinogenicity of Trichloroethylene" Conference on Applications of Advances in Toxicology to Risk Assessment" Wright Patterson Air Force Base, Dayton, OH, May 19-21, 1992.
- "Risk Assessment for Chemical Contaminants" Symposium conducted at the American Water Works Association Annual Meeting, Vancouver, BC June 21, 1992.
- "Why Risk Estimates Vary" Lake Roosevelt Forum. July 22, 1992.
- "Toxicology of Disinfectants and Disinfectant By-Products" First International Conference on the Safety of Water Disinfection August 31 - Sept. 3, 1992 Sponsored by ILSI Health and Environmental Sciences Institute.
- "Haloacetates and Bromate: By-Products that may Critically Affect Drinking Water Disinfection." Fifth National Conference on Drinking Water. Winnipeg, Manitoba Sept 15, 1992
- "Chemical Risk Assessment Issues for By-Products of Drinking Water Disinfection" Presented at the Annual ILSI-Health and Environmental Sciences Institute Symposium in Nassau, Bahamas Jan 25-27, 1993.
- "Toxicology of Drinking Water Disinfectant By-Products" Presented at the Water Research Center Symposium on Drinking Water Disinfection, Medmanham, U.K. February 2-3, 1993
- "Water Contamination from Agricultural Processes: Physical, Chemical, and Microbial Risks" presented at Second Asian Conference on Food Safety, September 18-23, 1994. Sponsored by the International Life Sciences Institute.
- "Toxicology of Disinfectants and Disinfectant By-Products" presented at ILSI Symposium on Current Issues on Drinking Water Quality, Seoul, Korea September 15, 1994.
- "Toxicology of Water Contaminants" presented at conference on "Water Quality for the Food Technologist" Sidney, Australia, September 27, 1994. Sponsored by ILSI-Australasia and CSIRO.
- "Water Chlorination: Essential Process or Cancer Hazard?" Symposium organized and conducted at the Annual Society of Toxicology Meeting, Baltimore, MD, 1995
- "Carcinogenic Properties of Brominated Haloacetates" Presented at ILSI/HESI sponsored workshop in Chapel Hill, NC Oct. 23-25, 1995.
- "Role of Science in Judgments Made about Complex Environmental Exposures" Symposium on Research Frontiers and Challenges in the Environmental Sciences. AMSIE'97. Seattle, WA Feb. 13-18, 1997.
- "Carcinogenic Hazards and Risks from Drinking Water Disinfection. Second International Symposium on the Safety of Water Disinfection. Miami FL November 15-17, 1999
- "Future Directions in the Use of Mode of Action Information in Assessing Cancer Risks from Trichloroethylene (TCE). Workshop on Integration of Mechanistic, Toxicological, and Epidemiological Data into the EPA's Trichloroethylene Cancer Assessment. 39<sup>th</sup> Annual Meeting of the Society of Toxicology, Philadelphia, PA, March 23, 2000.

- "NDMA: A New Ballgame with Disinfection By-Products?" Early Bird Session for the Annual Water Quality Technology Conference, Seattle, WA 11/12/02
- Are There Significant Health Effects Associated with the Use of Chemical Disinfection of Drinking Water?" Workshop on research needs with disinfection by-products in Melbourne, Australia 10/29-31/01
- "Chemicals of Concern for Water: The Status of Research Assessing the Risk of Current Disinfection Practice" Keynote Speaker at the AWA-IWA conference Sydney, Australia 6/4-5/03
- "Are Organic Nitrogen-Containing Disinfection By-Products Potential Causes for Bladder Cancer and Reproductive Effects?" Annual Meeting of the American Water Works Association, Anaheim, CA, 6/18/03
- "Monitoring Water Quality: Chemical Contaminants" CDC Water Reuse Workshop Atlanta, GA, 3/13 & 14/03

#### MEMBERSHIPS ON NATIONAL ADVISORY COMMITTEES AND BOARDS:

- Advisor to NRC Committee on Lead in the Human Environment, 1977
- Interregulatory Agency Task Force on Neurotoxicology, 1976
- Drinking Water Research Committee (EPA), 1977-1984
- Chemical Testing and Assessment Research Committee (EPA), 1977-1981
- Program Advisory Group, National Center for Toxicological Research, 1978-1981
- TSCA Section 4 Workgroup (EPA), 1977-1980
- Primary Drinking Water Standards Workgroup (EPA), 1977-1984
- Member of Advisory Group to Denver Water Board on Potable Reuse of Wastewater, 1982 to 1995
- EPA Scientific Review Panel, 1978-1989
- Interagency Collaborative Group on Environmental Carcinogenesis, 1977-1982
- Workgroup on Health Effects of Space Station Wastewater Reuse and Atmosphere Recycling - National Aeronautics and Space Administration, 1985
- Member National Research Council Subcommittee on Drinking Water Disinfectants (USEPA), 1986-1987
- Member National Research Council Committee on Recycling, Reuse and Conservation of Water (U.S. Army), 1986
- Co-Chair of Space Station Water Quality Conference sponsored by NASA, July 1-2, 1986
- Member, National Research Council Committee on National Water Quality Assessment Program (USGS), 1987
- Chair, National Sanitation Foundation Health Effects Task Group for Drinking Water Additives, 1985 - 1989
- Member, National Research Council Subcommittee on Guidelines for Recommending Spacecraft Maximum Contaminant Levels, (Committee on Toxicology), 1989 - 1999.
- Chair, National Research Council Subcommittee on Water Quality in Space Station Freedom, Nov. 1, 1989-92.
- Drinking Water Committee of the Science Advisory Board of the U.S. Environmental Protection Agency, Nov. 1989 to 1994.
- IARC Working Group on the Evaluation of the carcinogenic Risk of Chemicals to Humans: Chlorination of Drinking Water, Nov. 1989 thru 1990
- Drinking Water and Health in the Year 2000. Breckenridge Workshop conducted in Summer of 1991. University of Arizona Superfund Grant Advisory Committee. 1991-1992
- Member, National Research Council Committee on the Viability of Augmenting Potable Water Supplies with Reclaimed Water., 1996-8
- Member, Science Advisory Panel for the Santa Ana River Water and Health Study. Orange County CA. 1997- 2003
- Chair, Drinking Water Committee of the U.S. Environmental Protection Agency's Science Advisory Board, 1997-2001
- Author and member of, International Program in Chemical Safety (WHO) consultation on Disinfection By-Products 1998-9

Member, EPA Subcommittee reviewing the proposed new Cancer Risk Assessment Guidelines of the Environmental Protection Agency 1999-2000  
Chair, National Research Council Committee on Copper in Drinking Water. 1999-2000  
Member and Coordinator, Science Advisory Panel for the National University of Singapore project on Potable Reuse of Wastewater.  
Member, Joint Committee of EPA Science Advisory Board and Science Advisory Panel for review of Endocrine Disruptor Screening and Testing Advisory Committee Report to the Agency, 1998-9  
Member of the Science Advisory Panel for the Medical University of South Carolina on the Environmental Management Science Program Project, 1999-2004.  
Co-Chair of Chloroform Risk Assessment Subcommittee of the EPA Science Advisory Board 1999-2000.  
Member, Research Strategies Advisory Committee of EPA Science Advisory Board 1999-2003  
Chair, National Research Council Subcommittee on Assessing Toxicological Risks to Deployed Military Personnel 2002-2003.  
Member, Science Advisory Panel for the Orange County Groundwater Replenishment System Project under the auspices of the National Water Research Institute. 2003-present.  
Member, Independent Advisory Panel for the San Diego Water Reuse Project under the auspices of the National Water Research Institute. 2004-present.  
Member, Science Advisory Panel for the Monterey Water Reuse Project under the auspices of the National Water Research Institute. 2006-

#### CONFERENCE ORGANIZATION AND EDITING:

International Symposium on Health Effects of Drinking Water Disinfectants and Disinfectant By-Products. April 21-24, 1981. Published in Environmental Health Perspectives 46, 1-241, 1982.  
Fourth Conference on Water Chlorination: Environmental Impact and Health Effects Organization and Editing of Session on Toxicology. October 18-23, 1981. Published by Ann Arbor Science, 1983.  
Fifth Conference on Water Chlorination: Environmental Impact and Health Effects. Organization and editing of papers presented in sessions on Health Effects and Risk Assessment. (Co-editor with Dr. Robert L. Jolley et al. on overall Proceedings) June 3-8, 1984.  
Symposium "Water Chlorination: Essential Process or Cancer Hazard?" 34<sup>th</sup> Annual meeting of The Society of Toxicology, Baltimore, MD, 1995.  
Roundtable Session: Should carcinogenesis data from transgenic animals be applied to safety assessment, if so, how? 36<sup>th</sup> Annual meeting of the Society of Toxicology, Cincinnati, OH, March 9-13, 1997  
Bromate Health Research Strategy Workshop. AwwaRF sponsored workshop held at Miami University, Feb. 11-13, 2005. Co-chaired with Joseph A. Cotruvo (proceedings published in a special issue of Toxicology)

#### PEER REVIEW ACTIVITIES:

Toxicology (Editorial board 1994 - present)  
Journal of Toxicology and Environmental Health (Editorial Board, 1994 - 2000)  
Biochemical Pharmacology  
Toxicology and Applied Pharmacology  
Fundamental and Applied Toxicology (Editorial Board 1986-94)  
Chemical Research in Toxicology  
CRC Critical Reviews in Toxicology  
Environmental Science & Technology (American Chemical Soc.)  
Journal of American Waterworks Association (Editorial Board 1986-92)  
Food and Chemical Toxicology  
NeuroToxicology  
Life Sciences

## Toxicology Letters

### INTERNATIONAL ACTIVITIES:

- Member of Consultation on Selection of Organic Substances for Inclusion in WHO Guidelines for Drinking Water Quality, 18-20 March 1980. Leidschendam, The Netherlands.
- Technical Advisor to WHO Work-Group on Quantification of Selected Health-Related Organic Compounds for WHO Guidelines for Drinking Water Quality. 19-25 November 1980, Ottawa, Canada.
- Preparation of working paper for International Agency for Research on Cancer (IARC-WHO) workshop on "Approaches for evaluating human health hazards from drinking water" to be held in Lyon, France, December 11-14, 1984.
- Organizing committee for International Symposium on Organic Micropollutants in Drinking Water and Health. Amsterdam, The Netherlands, June 11-14, 1985.
- IARC working Group on the Evaluation of the Carcinogenic Risk of chemicals to Humans: Chlorination of Drinking Water, Lyon, France, June 12-19, 1990.
- WHO Working Group on Developing Standards for Organic Contaminants in Drinking Water. Summer of 1991.
- Water Research Center of the United Kingdom Seminar on the Health Effects of Disinfectant By-Products. Feb. 2-3, 1993
- International Programme on Chemical Safety: Environmental Health Criteria for Disinfectants and Disinfectant By-Products. August 1998. Principal Author with R. Pegram, G. Amy and G. Craun as coauthors.
- Commonwealth CRC for Water Quality and Treatment. Disinfection Byproducts and Health Effects Workshop. Melbourne, Australia, October 29-31, 2001.
- Technical Advisor on Health Canada Workshop Held to Identify Critical Endpoints for Assessment of Health Risks Related to Trihalomethanes (THMS) in Drinking Water. Ottawa, September 18-19, 2002
- IARC Working Group on the Evaluation of Carcinogenic Risks To Humans Vol. 84 "Some Drinking Water Disinfectants and Contaminants, including Arsenic. Lyon Oct. 12-22, 2002.
- CRCWQT/AWWARF Disinfection Byproduct Collaborative Research Planning Workshop, Brisbane, Australia, 7/25-26/05

### APPOINTMENTS

- Adjunct Associate Professor, Ohio State University, College of Medicine, Department of Pharmacology, Columbus, Ohio
- Adjunct Professor, Miami University, Department of Zoology, Oxford, Ohio
- Adjunct Professor, Pharmacology/Toxicology, College of Pharmacy, Washington State University.

### THESIS AND DISSERTATION COMMITTEES

Major Advisor to the following graduate students at Washington State University.

- Mark A. Nelson, Ph.D.** (1989) The Importance of DNA Strand Breaks to the Hepatocarcinogenic Effects of Trichloroethylene.
- Idalia M. Sanchez M.S.** (1989) Characterization of Hepatotoxic Effects of Halogenated Acetic Acids in B6C3F1 Mice.
- Jeffrey L. Larson, Ph.D.** (1990) Mechanism of Trichloroethylene Hepatocarcinogenesis: The role of Dichloroacetate and Trichloroacetate.
- Karla D. Thrall, Ph.D.** (1990) Formation of Organic By-Products Following Consumption of Iodine Disinfected Drinking Water.
- Todd T. Sherer, Ph.D.** (1991) Changes in Thyroid Hormone Receptor mRNA Expression and the Effects of Thyroid Hormone in the Developing Rat Cerebellum.

- Michael V. Templin, Ph.D.** (1993) Dichloroacetate as the Active Metabolite in Trichloroethylene Hepatocarcinogenesis.
- Russell J. Eyre, Ph.D.** (1994) Species Differences in the Formation of Reactive Intermediates from the Metabolism of Trichloroethylene by the Cysteine-S-Conjugate/ $\beta$ -Lyase Pathway.
- Eric Austin, Ph.D.** (1997) The Role of Oxidative Stress to the Hepatotoxicity of Haloacetates.
- Anja J. Stauber, Ph.D.** (1997) Mechanisms of Hepatic Tumor Induction by Dichloroacetate and Trichloroacetate Differ: Effects on Cell Division, Cell Survival and Clonal Expansion in the Liver of B6C3F1 Mice.
- Junko Kato-Weinstein, Ph.D.** (1999) Factors Involved in the Hepatic Effects of Brominated and Chlorinated Haloacetates in B6C3F1 Mice.
- Alberto Gonzalez-Leon, Ph.D.** (1999) Modification of Haloacetate Metabolism in Rodents by Pretreatment in Drinking Water.
- James L. Merdink, Ph.D.** (1999) Formation of Dichloroacetate from Trichloroacetate. Implications to the Risk Assessment of Trichloroethylene.
- Melissa K. Lingohr Smith, Ph.D.** (2000) Dichloroacetate Modulates Glycogen Metabolism and Insulin Signaling Proteins *In Vivo* and *In Vitro*.

GRANT and CONTRACT FUNDING:

(principal investigator, R. Bull unless otherwise noted)

<u>Title</u>	<u>Source</u>	<u>Budget Direct Costs</u>	<u>Time Period</u>
Ethanol-Induced in Trichloroethylene Toxicity	U.S. Air Force (17%) AFOSR-86-0284	\$227,024	08/15/86 08/14/89
Importance of Hepatic Peroxisome Proliferation in Carcinogenic Responses to Environmental Chemicals and Complex Mixtures	Battelle	\$18,722	01/01/87 12/31/88
Differential Pharmacokinetics and Toxicology of Iodine and Iodide	NASA (16%) NAG 9-226	\$188,747	05/15/87 12/15/90
Chlorinated Acetic Acid Hepato-carcinogenesis	NIEHS 1 RO1 ESO4648-01	\$257,309	09/01/88 08/31/91
Application of Pharmacokinetic Analyses and Dosimetry to Species Differences in Sensitivity to Toxic Substances R. Bull, P.I., W. Hayton, D. Sylvester, D. Springer, Co.-P.I.	EPA CR-81216-01-0	\$1,145,182	11/01/88 12/31/92
Differential Effects of Iodine and Iodide on Thyroid Function on Thyroid Function	NASA NAG-9-545	\$245,368	10/1/91 9/30/93
Small mammals as dosimeter of toxic substances J.G. Hallett, P.I., M.A. O'Connell, R.J. Bull, Co-P.I.	EPA	\$315,827	10/01/91 09/30/94
Relationship of Dichloroacetate (DCA) and Trichloroacetate (TCA)-Induced Hepatic Tumors with Induction of Peroxisomes.	AWWARF (701)	\$255,000	4/1/92 3/31/95

R.J. Bull, P.I., D.K. Stevens, Co.-P.I.			
Utilization of Chemical and Cellular Kinetics to Improve the Accuracy of Risk Assessments. I. Physiologically Based Pharmacokinetic Modeling of Chlorinated Alkenes and their Metabolites. R.J. Bull, P.I., D.K. Stevens, Co.-P.I.	EPA CR 819283	\$155,000	10/1/91 9/30/94
Hepatic Toxicity and Carcinogenicity of Haloacetates R.J. Bull, P.I., D.K. Stevens, Co.-P.I.	NIEHS (RO1-ESO4648)	\$448,983	4/1/92 12/31/96
Utilization of Chemical and Cellular Kinetics to Improve the Accuracy Risk Assessment. II. Comparative metabolism of Chlorinated Solvents. R.J. Bull, P.I.	EPA CR 820614	\$206,000	8/1/92 6/30/95
Hepatocarcinogenic effects of haloacetates commonly found as by-products of drinking water disinfection. R.J. Bull, P.I.	PA CR 819562	\$248,000	10/1/92 3/31/96
Comparative kinetics of chloral hydrate and its metabolites in rats and humans R.J. Bull, P.I., D.K. Stevens & L. Robison, Co.-P.I.	EPA CR822577	\$235,000	8/19/94 8/18/96
Mechanisms Involved in Trichloroethylene Induced Liver Cancer R.J. Bull, P.I.	Department of Energy Competitive funding EM Science Program	\$1,800,000	9/1/96 6/30/00
Using Mode of Action to Assess Health Risks from Mixtures of Chemical and Physical Agents R.J. Bull, P.I.	SERDP CU-1073	\$1,400,000	6/13/97 6/12/00
Sensitivity to Radiation-Induced Cancer in Hemochromatosis. Initial PI, now Co-PI with James Morris, PNNL	Department of Energy Low-Dose Program	\$414,000	9/99 – 9/01
Optimizing the Scientific, Regulatory and Societal Impact of the DOE Low Dose Radiation Research Program supplement Antone Brooks, PI, R.J. Bull, Co.-PI	Department of Energy Low-Dose Program	\$1,300,000	9/00-5/03
<b>Projects awarded to MoBull</b>			
Risk Based Prioritization of Disinfection By-Products R.J. Bull, PI, David Reckhow, Co.-P.I.	Awwa Research Foundation No. 2869	\$350,000	1/03-12/05

Bromate Health Research Strategy Workshop J.A. Cotruvo, PI, RJ Bull Co-PIs	Awwa Research Foundation No.	\$75,000	6/04-12/05
Low Dose Risks from Bromate: The Relationship between Drinking Water Concentrations and the Actual Dose to Susceptible Organs in Rats and Humans J.A. Cotruvo & RJ Bull, Co-PIs	Awwa Research Foundation No. 4042	\$400,000 ca. \$40,000 to MoBull	3/07-12/10
Identifying Health Effects Concerns of the Water Reuse Industry and Prioritizing Research Needs for Nomination of Chemicals for Research to Appropriate National and International Agencies J.A. Cotruvo and RJ Bull, Co.-PIs	WateReuse Foundation No. 06-004	175,000	6/07-5/09
Methods Development for Disinfection By-Products Associated with Cancer Subcontract from University of Alberta	Awwa Research Foundation No. 4089	\$400,000 ca \$30,000 to MoBull	1/08-12/09

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#### PAPERS, POSTERS, AND PRESENTATIONS:

Dr. Bull has been active in a number of professional societies and presented papers and abstracts at their annual meetings. If a record of such activity is required a listing of these activities can be provided.

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## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- Professor Dr.-Ing. Jörg Drewes

## Professor Dr.-Ing. JÖRG E. DREWES

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### EDUCATION

Doctorate in Environmental Engineering (Ph.D.), Technical University of Berlin, Germany 1997

Dipl. Ing. Environmental Engineering (M.S.), Technical University of Berlin, Germany 1992

### EXPERIENCE

8/2013-present: **Chair Professor**, Chair of Urban Water Systems Engineering, Technische Universität München.

8/2013-present: **Research Professor**, Civil and Environmental Engineering, Colorado School of Mines, Golden CO.

8/2011-7/2013: **Director of Research**, NSF Engineering Research Center on Reinventing the Nation's Urban Water Infrastructure (ReNUWIt), Stanford, UC-Berkeley, New Mexico State University and Colorado School of Mines.

3/2010-7/2013: **Professor**, Civil and Environmental Engineering, Colorado School of Mines, Golden CO.

**Co-Director**, Advanced Water Technology Center (AQWATEC).

8/2010-8/2013: **Visiting Professor**, Water Desalination and Reuse Center (WDRC), King Abdullah University of Science and Technology, Thuwal, Saudi-Arabia.

7/2007-present: **Adjunct Professor**, UNSW Water Research Centre, The University of New South Wales, Sydney, Australia.

4/2006-3/2010: **Associate Professor**, Environmental Science and Engineering Division, Colorado School of Mines, Golden CO.

8/2001-4/2006: **Assistant Professor**, Environmental Science and Engineering Division, Colorado School of Mines, Golden CO.

9/1999-7/2001: **Associate Director**, National Center for Sustainable Water Supply (NCSWS), Arizona State University, Tempe, AZ, USA

8/1997-8/1999: **Visiting Professor**, Arizona State University, Tempe, AZ, USA

7/1992-7/1997: **Research Associate**, Technical University of Berlin, Germany.

### RESEARCH INTEREST

Energy efficient water and wastewater treatment engineering; energy recovery from waste streams; distributed water reuse and remotely operated treatment; potable reuse; monitoring strategies and treatment performance assessments; novel design approaches for natural treatment systems (riverbank filtration, aquifer recharge and recovery); state-of-the-art characterization of natural and effluent organic matter and emerging trace organic chemicals (endocrine disrupting compounds, pharmaceutical residues, household chemicals) in natural and engineered systems.

### AWARDS and HONORS

Chair, International Water Association (IWA) Water Reuse Specialist Group; Panel Member, National Research Council (NRC) on Gray Water Reuse 2013-2015; Panel Member, National Research Council (NRC) on Water Reuse 2008-2011; Member, Research Advisory Council WaterReuse Foundation (WRF); Chair, Science Advisory Committee on Compounds of Emerging Concern in Recycled Water, California State Water Resources Control Board; American Water Works Association Rocky Mountain Section Outstanding Research Award, 2007; Dr. Nevis Cook Graduate Teaching Award, Colorado School of Mines, 2003. Quentin Mees Research Award for outstanding water-related environmental research in the State of Arizona, 1999. Research Scholarship administered by the Deutsche Forschungsgemeinschaft (DFG), 1997 – 1999. Willy-Hager Award for outstanding research in the field of water and wastewater treatment, Germany, 1997.

### PUBLICATIONS (Selection)

#### Papers in peer-reviewed journals

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Bouwer, H., Fox, P., Westerhoff, P. & Drewes, J.E. (1999). Integrating water management and re-use: causes for concern? *Water Quality International*, Jan/Feb, 19-22.

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- Drewes, J. E., Bornhardt, C. & Jekel, M. (1996). Untersuchungen zur Nutzung von Klarwässern für eine Versickerung auf Rieselfeldböden. Schriftenreihe im Fachbereich Umwelt und Gesellschaft. Landschaftsentwicklung und Umweltforschung, Technische Universität Berlin, Berlin. Nr. 101. 93-100.
- Drewes, J. E. (1996). Wende zu einer nachhaltigen Wassernutzung. K.H. Hübler, U. Weiland (Eds.). Nachhaltige Entwicklung. Eine Herausforderung für die Forschung? Verlag für Wissenschaft und Forschung. Berlin. 153-166.
- Drewes, J. E. (1997). Behavior of organic compounds in domestic effluents used for groundwater recharge. Fortschritt-Berichte VDI-Verlag No 174, Umwelttechnik, Düsseldorf (in German).
- Drewes, J. E., Fox, P. & Ziegler, D. (1998). Impact of drinking water sources on refractory DOC in water reuse systems. Peters et al. (eds.), Artificial Recharge of Groundwater. Balkema, Rotterdam, 461-463.
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- Drewes, J. E. & Shore, L. S. (2001). Concerns about pharmaceuticals in water reuse, groundwater recharge, and animal waste. In: Ch. Daughton and T. L. Jones-Lepp (Eds.) American Chemical Society Symposium Series 791 "Pharmaceuticals and personal care products in the environment" No. 791, Washington, D.C., 206-228. (ISI: 5)
- Drewes, J. E. & Summers, S. R. (2002). Removal of NOM during bank filtration: Current knowledge and research needs. In: C. Ray, Melin, G. and Linsky, R. (eds.), Riverbank filtration: Improving source water quality. Kluwer Academic Publishers, Dordrecht, The Netherlands. 303-310.
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- Rivett, M., Drewes, J.E., Barrett, M., Chilton, J., Appleyard, S., Dieter, h.H., Wauchope, D. & Fastner, J. (2006). Chemicals: Health Relevance, Transport and Attenuation. In: WHO Ground Water Monograph. O. Schmoll, G. Howard, J. Cliton, and I. Chorus (eds.). World Health Organization (WHO), Geneva. IWA Publishing, London. 81-131.
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- Ray, C., Grischek, T., Hubbs, S., Drewes, J.E., Haas, D. and Darnault, C. (2008). Riverbank Filtration for Drinking Water Supply. ASCE Riverbank Filtration. American Society of Civil Engineers. Riverbank Filtration Task Force. John Wiley & Sons.
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- Xu, P., Cath, T., Wang, G., Drewes, J.E. and Ruetten, J. (2010). Consider the Pros and Cons of Desalination. In Sustainability of Water Resources and Supplies. *Editor Frederick Bloetscher. Publisher American Water Works Association (AWWA)*.
- Drewes, J.E. and Khan, S. (2010). Water Reuse for Drinking Water Augmentation. J. Edzwald (ed.) Water Quality and Treatment, 6<sup>th</sup> Edition. 16.1-16.48. American Water Works Association. Denver, Colorado.
- Bellona, C. and Drewes, J.E. (2010). Comparing the Phenomenological and Hydrodynamic Modeling Approaches for Describing the Rejection of Emerging Nonionic Organic Contaminants by a Nanofiltration Membrane. ACS Symposium Series, vol. 1048. Pharmaceuticals and Personal Care Products and Organohalogenes. Chapter 20, pp 397-420. DOI: 10.1021/bk-2010-1048.ch020, Washington, D.C.
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- Trinh, T., van den Akker, B., Le-Clech, P., Branch, A., Drewes, J.E., Khan, S. (in press). Impacts of hazardous events on performance of membrane bioreactors. F.I. Hai, K., Yamamoto, C. Lee (eds.). Membrane Biological Reactors: Theory, Modelling, Design, Management and Applications to Wastewater Reuse. IWA Publishing, London.
- Prieto, A.L., Vuono, D., Holloway, R., Benecke, J., Henkel, J., Cath, T.Y., Reid, T., Johnson, L., Drewes, J.E. (2013). Decentralized Wastewater Treatment for Distributed Water Reclamation and Reuse: The Good, The Bad and The Ugly – Experience from a Case Study. Book Series "*Novel Solutions to Water Pollution*", Vol. 1123. Chapter 15, pp 251-266. American Chemical Society.
- Xu, P., Elson, B., Drewes, J.E. (in review). Electrosorption of Heavy Metals with Capacitive Deionization: Water Reuse, Desalination and Resources Recovery. Desalination: Water for Water. Scrivener Publisher LLC.
- Cath, T., Geza, M., Drewes, J.E., Xu, P. (2013). Decision support tool for management of produced and frac-flowback water.

Wolkersdorfer, Brown & Figueroa (eds). Reliable Mine Water Technology. IMWA 2013. 1199-1204.

Trinh, T., van den Akker, B., Le-Clech, P., Branch, A., Drewes, J.E., Khan, S. (2014). Impacts of hazardous events on performance of membrane bioreactors. F.I. Hai, K., Yamamoto, C. Lee (eds.). Chapter 7. Membrane Biological Reactors: Theory, Modelling, Design, Management and Applications to Wastewater Reuse. IWA Publishing, London. 207-221.

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- Charles N. Haas, Ph.D.

# Charles N. Haas

**Present Position:** Betz Chair Professor of Environmental Engineering & Head,  
Department of Civil, Architectural and Environmental Engineering  
Drexel University  
Philadelphia, PA 19104  
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URL: <http://www.pages.drexel.edu/~haascn/>

**Date of Birth:** December 27, 1951

**Place of Birth:** Bronx, New York

**Citizenship:** U.S.A.

**Education:** B.S. (Biology), Illinois Institute of Technology (IIT), 1973.  
M.S. (Environmental Engineering), IIT, 1974.  
Ph.D. (Environmental Engineering in Civil Engineering), University of Illinois, Urbana,  
Illinois, 1978.

## Academic Appointments

2005-- : Head, Department of Civil, Architectural and Environmental Engineering  
2003–2005: Interim Head, Department of Civil, Architectural and Environmental Engineering  
2003--: Research Professor, Department of Emergency Medicine, Drexel University College of Medicine  
2002–:2005 Director of Environmental Engineering and member of Department Executive Committee  
1991– : Betz Chair Professor of Environmental Engineering, Drexel University.  
1989-1990: Acting Chairman, Pritzker Department of Environmental Engineering, Illinois Institute of  
Technology  
1988-1989: Visiting Professor of Environmental Engineering, University of Illinois at Urbana-Champaign  
1981-1990: Assistant Professor (1981-83), Associate Professor (1983-87), Professor (1987-90) Illinois  
Institute of Technology  
1978-1981: Assistant Professor of Environmental Engineering in the Department of Chemical and  
Environmental Engineering, (1979-1981), Acting Director of Environmental Engineering  
Programs, Rensselaer Polytechnic Institute

## Professional Memberships

American Chemical Society; American Association for the Advancement of Sciences; American Society for  
Engineering Education; American Statistical Association; American Society for Microbiology; American Water  
Works Association (Life Member); American Society of Civil Engineers; Association of Environmental  
Engineering and Science Professors; International Water Association; Sigma Xi; Society for Risk Analysis; Water  
Environment Federation; American Academy of Environmental Engineers

## Honors and Awards

Recipient, 1984 AAAS-USEPA Summer Environmental Science and Engineering Fellowship.  
Octave Chanute Award (Outstanding Paper), Western Society of Engineers, 1984.  
Charles Ellet Award (Outstanding Young Engineer), Western Society of Engineers, 1985.  
Listed in American Men and Women of Science (1994)  
Listed in Who's Who in Science and Engineering (1996)  
Listed in Who's Who in the East (1997)  
Listed in Who's Who in Medicine and Healthcare (1997)  
Listed in Who's Who in America, 51st edition (1996)  
Listed in Who's Who in the World (2001)  
Professional Research Award, Pennsylvania Water Environment Association (1997)  
American Academy of Microbiology, Elected as Fellow (1997)  
Frontiers in Research Award, Association of Environmental Engineering and Science Professors (sponsored by

Malcolm Pirnie, Inc) (2002).  
American Association for the Advancement of Science, Elected as Fellow (2002)  
Society for Risk Analysis, Elected as Fellow (2002)  
University of Illinois at Urbana-Champaign, Department of Civil and Environmental Engineering, Distinguished Alumnus Award (2003)  
International Ozone Association, Harvey M. Rosen Memorial Award (best paper in Ozone Science and Engineering for 2001-3) (2003).  
National Academies (National Academy of Sciences, National Academy of Engineering, Institute of Medicine, National Research Council): designated as a lifetime National Associate (2004).  
American Water Works Association, advisor to 2nd Place Academic Achievement Award Winner (Christopher Crockett—PhD dissertation) (2005).  
American Water Works Association, Water Science and Research Division, best paper award (“Risk Assessment of Waterborne Coxsackievirus”) (2005).  
American Academy of Environmental Engineers, Board Certified Environmental Engineering Member (BCEEM), elected by eminence (2007)  
American Society of Civil Engineers, elected Fellow (2010)  
International Water Association, elected Fellow (2011)

## **Workshops & Continuing Education Attended**

American Council on Education workshop for Department/Division Chairs and Deans, February 2006, San Diego.  
Peter Seldin Workshop on Preparing a Leadership Portfolio, March 2007, Philadelphia.

## **Funded Research Projects**

Co-principal Investigator "Hazardous Waste Processing and Disposal Practices--Best Technology." New York State Environmental Facilities Corporation (1979 for \$25,000).  
Co-principal Investigator "The Potential for the Application of Resource Recovery Practices in the Hazardous Waste Processing and Disposal Industry." New York State Environmental Facilities Corporation (1979 for \$25,000).  
Principal Investigator, "Microbiological Alterations in Water Quality in Distribution Systems and Granular Activated Carbon." U.S. Environmental Protection Agency (1980-2 for \$113,000).  
Principal Investigator, "Trace Metal Speciation". U.S. Environmental Protection Agency--Industrial Waste Elimination Research Center (1980-1982 for \$113,000).  
Co-principal Investigator "Evaluation of High-Performance Phosphorus Control POTW's in the Great Lakes Basin." U.S. Environmental Protection Agency (1981-1982 for \$88,850).  
Principal Investigator "Preparation of a Chapter on Chlorination-Dechlorination and Miscellaneous Halogens." U.S.Environmental Protection Agency via a subcontract from Oklahoma State University (1982-1985 for \$82,000).  
Principal Investigator "Metal Speciation and Separation." U.S. Environmental Protection Agency--Industrial Waste Elimination Research Center (1982-1983 for \$119,000).  
Principal Investigator "Wastewater Treatability Study." Modine Manufacturing Company (1982-1983 for \$28,000).  
Principal Investigator "Evaluation of Microbial Dynamics in the Calumet River and Downstream Waters." Metropolitan Sanitary District of Greater Chicago (1983-1985 for \$22,800).  
Co-principal Investigator, "Metal Speciation Kinetics." U.S.Environmental Protection Agency - Industrial Waste Elimination Research Center (1984 - 1988 for \$500,000).  
Principal Investigator, "Indefinite Delivery Contract for Research Support in Environmental Engineering" -- US Army Corps of Engineers, Construction Engineering Research Laboratory (1985 - 1987, \$1,900,000).  
Co-Principal Investigator, "Characterization of Diffusion of Solutes Through Compacted Clays" -- Milligan Venture Fund Grant (IIT - 1986-1987 for \$10,000).  
Principal Investigator, "Wastewater Treatability Study" -- Morton Thiokol, Morton Chemical Division (\$25,000 1986-1987).  
Co-principal Investigator, "Waste to Energy Recovery of Refuse as an Alternative to Landfill in Illinois", Illinois Department of Energy and Natural Resources (\$139,000, 1987- 1989).  
Principal Investigator, "Effects of Changing Disinfection Practices on Receiving Water Quality", Metropolitan Sanitary District of Greater Chicago (\$97,000, 1987-1990).  
Principal Investigator, "Beneficial Co-Utilization of Solvents and Plastic Scrap Wastes", Illinois Hazardous Waste Research and Information Center (\$6300, 1987).

Principal Investigator, "Disinfection of Microbial Biofilms", American Water Works Service Co., (\$30,400, 1987-8).

Principal Investigator, "Analysis of Giardia Disinfection Kinetics", USEPA Office of Drinking Water (\$15,000, 1987).

Co-Investigator, "Analysis of Performance of Superfund and SARA", Coalition on Superfund, (1988-89, \$250,000).

Principal Investigator, "Analysis of Proposed Sludge Regulations", Metropolitan Water Reclamation District of Greater Chicago, (1989, \$20,000).

Principal Investigator, "Equilibria of Mixed Metal Precipitates", IWERC (USEPA) (1990, \$55,000).

Principal Investigator, "Statistical Analysis of Waste Generation by Electroplaters and Metal Finishers", Metropolitan Water Reclamation District of Greater Chicago, (1990, \$9500).

Principal Investigator, "Analysis of Disinfection Survey Results", American Water Works Association, (1990, \$15,000).

Principal Investigator, "Development of Novel Models for Describing Multiple Toxicity Effects", Air Force Office of Scientific Research, (1991-94, \$173,925).

Principal Investigator, "Development and Validation of Rational Kinetic Approaches for Predicting Full-Scale Disinfection Performance", American Water Works Association Research Foundation (1991-1994, \$260,000).

Principal Investigator, "Analysis of Groundwater Disinfection Survey Results", American Water Works Association (1991-2, \$5000).

Co-Principal Investigator, "Microbial Risk Assessment", American Water Works Association Research Foundation (1993-1995, subcontract from University of South Florida, \$90,000).

Principal Investigator, "Review of Factors Affecting Metal Fate and Transport in Saline Waters", Dupont Corporation (1992, \$12,500).

Principal Investigator, "Effect of Level of Response on Toxicity of Mixtures", Air Force Office of Scientific Research (AASERT Program) (1993-1994, \$51,000).

Principal Investigator, "Review of Models for Chemical Fate and Transport", Betz Laboratories Inc. (1993-94, \$39,000)

Principal Investigator, "Disinfection of Water Mains", American Water Works Association Research Foundation (1993-1996, \$250,000).

Principal Investigator, "Monitoring for Giardia and Cryptosporidium", Philadelphia Water Department (1994-95, \$45,000).

Principal Investigator, "Models for Chemical Fate and Transport in Waste Treatment", Betz Laboratories Inc. (1995, \$45,000).

Principal Investigator, "Inactivation of Giardia by Ozone and Combined Chlorine", Montgomery-Watson Americas (1995, \$50,000).

Principal Investigator, "Risk Assessment from Sewage Discharges in Mamala Bay, HI", Subcontract from University of Arizona (Mamala Bay Commission), 1995, \$35,000.

Principal Investigator, "Risk Assessment of Heterotrophic Organisms in Point of Use Devices", Subcontract from University of South Florida (Water Quality Association), 1995-1996, \$15,000.

Principal Investigator, "Electroporation and Electroporation Aided Disinfection of Cryptosporidium and Giardia", National Science Foundation, 1995-1998, \$190,000.

Principal Investigator, "Estimation of Disinfection Efficiency of Philadelphia Water Department Plants for Protozoa", Philadelphia Water Department, 1996-1997, \$46,000.

Principal Investigator, "Review of Health, Environmental Effects, and Efficacy of Chlorination for Wastewater Disinfection and Cooling Water", Chlorine Institute, Inc., 1996, \$45,000.

Principal Investigator, "Development of Integrated Program for Chemical Fate and Transport in Waste Treatment", Betz Laboratories Inc. (1996-1997, \$45,000).

Co-Principal Investigator, "Literature Review on Cryptosporidium Removal in Water Treatment", Chlorine Chemistry Council, 1996, \$16,000 (with Gordon Finch).

Co-Principal Investigator, "Extension of Quantitative Microbial Risk Assessment Methods to Foodborne Pathogens", International Life Sciences Institute, 1997-1998, \$85,000 (with Joan Rose and Charles Gerba).

Principal Investigator, "Disinfection of Protozoa", Philadelphia Water Department, 1997-8, \$50,000.

Co-Principal Investigator, "Critical Review Of Existing Data On Physical And Chemical Removal Of Cryptosporidium In Drinking Water", AWWA Research Foundation, 1997-2000 (with Gordon Finch), \$150,000.

Co-Principal Investigator, Update The AWWARF Report On Experimental Methodologies For The Determination Of Disinfection Effectiveness To Include Cryptosporidium Disinfection Protocols”, 1997-8 (with Gordon Finch), \$25,000.

Co-Investigator, “Protocol for Cryptosporidium Risk Communication to Drinking Water Utilities”, AWWA Research Foundation, 1998-1999 (with Mitchell Small, Baruch Fischhoff et al., total contract \$195,843).

Co-Investigator, “Disinfection of Emerging Pathogens”, AWWA Research Foundation, 1998-2000 (with J. Jacangelo, C.P. Gerba), \$250,000.

Co-Investigator, “Microbial Benefits from Laundry Sanitizers”, Procter & Gamble Company, 1998, \$25,000.

Co-Principal Investigator, “Compilation and Kinetic Analysis of Data for Ozone Inactivation of Cryptosporidium”, International Ozone Association, 1998-1999 (with G. Finch, J. Jacangelo), \$23,000 (Drexel share).

Principal Investigator, “Is Disinfection a Function of Initial Microorganism Concentration?”, AWWA Research Foundation, 1999-2001, \$127,000.

Principal Investigator, “Survey on Drinking Water Disinfection”, American Water Works Association, 1998-1999, \$25,000.

Co-Investigator, “Synergistic Inactivation of Cryptosporidium Oocysts in Natural Waters”, AWWA Research Foundation, 1999-2001 (with Gordon Finch, Mike Belosevic), \$77,000 (Drexel share).

Principal Investigator, Peer Review of Class A Sludge Designation Petition, Metropolitan Water Reclamation District of Greater Chicago, 1999-2000, \$20,000.

Principal Investigator, Assessment of EPA Pathogen Equivalency Committee, US EPA, 2000, \$15,000.

Principal Investigator, "Use of Microbial Risk Modeling to Determine the Benefits of Topical Antimicrobial Products", Soap and Detergent Association, 2000-2002 (with Joan Rose and Charles Gerba), \$163,000.

Principal Investigator, "Disinfection of Protozoa", Philadelphia Water Department, 2000-2001, \$50,000

Principal Investigator, "Evaluation of the Analytical Capabilities, Today and Near Future, for the Monitoring of Drinking Water for Accidental or Intentional Contamination", Philadelphia Water Department, 2002-2003, \$100,000.

Principal Investigator, “Building Biodecontamination: A Process Engineering Approach”, National Science Foundation, 2003-2005, \$99,500 (with B. Farouk).

Principal Investigator, “Workshop on Advancing the Quality of Water (AQWA)”, National Science Foundation, 2003-2004, \$99,000.

Principal Investigator, “Delaware Valley Water Source Tracking Effort (DeVaWaSTE)”, Philadelphia Water Department, 2004-2011, \$400,000.

Principal Investigator, “Analysis of Data on Microbial Persistence With Antimicrobial Hand Products”, Soap and Detergent Association, 2004, \$20,000.

Principal Investigator, “Activated Ozone for Water Disinfection”, H2O3, Inc., 2004, \$35,000.

Principal Investigator, “Assessment of Physical Scale Models for Development of Room Decontamination Design Criteria”, funded via National Bioterrorism Civilian Medical Response Center (CIMERC), 2004-5, \$55,000.

Principal Investigator, “Wastewater Disinfection Strategies for the Metropolitan Water Reclamation District of Greater Chicago”, CTE Engineering, 2004-5, \$75,000.

Principal Investigator, “Expert Review of EPA Recreational Water Criteria – Scientific Basis”, Metropolitan Water Reclamation District of Greater Chicago, 2005, \$22,500.

Co-Principal Investigator, “CLEANER Project Office”, National Science Foundation, 2005-8, \$250,000 (Drexel share), \$3,000,000 total (lead institution: University of Illinois at Urbana-Champaign).

Co-Principal Investigator and Co-Director, “Center for Advancing Microbial Risk Assessment (CAMRA)”, US EPA and US Department of Homeland Security (Cooperative Center of Excellence), 2005-2010, \$2,200,000 (Drexel share), \$10,000,000 total funding (lead institution: Michigan State University).

Principal Investigator, “The Drexel University GAANN Fellowship Program: Educating Renaissance Engineers”, 2006-10 (\$510,000).

Principal Investigator, “Risk Assessment from Wet Weather Flows”, Philadelphia Water Department, 2007-2012, \$1,500,000.

## **Publications & Presentations**

### Books and Other Major Works

- 1) Recovery, Recycle and Reuse of Industrial Waste, K. E. Noll, C.N. Haas, C. Schmidt and P. Kodukula, Lewis Publishers, Chelsea MI (1985).

- 2) Process Design Manual for Wastewater Disinfection, coauthored by C.N. Haas. US EPA Center For Environmental Research Information, Cincinnati (1986).
- 3) Experimental Methodologies for the Determination of Disinfection Effectiveness, C.N. Haas, J.C. Hornberger, U. Anmangandla, M. Heath and J. Jacangelo. AWWA Research Foundation and American Water Works Association, Denver CO (1993).
- 4) Hazardous and Industrial Waste Treatment, (1995) Prentice-Hall, C.N. Haas and R. Vamos.
- 5) Development and Validation of Rational Design Methods of Disinfection (1995), AWWA Research Foundation, C.N. Haas, J. Joffe, J.C. Hornberger, U. Anmangandla, M. Heath and J. Jacangelo.
- 6) Benefits and Risks of Wastewater Chlorination (1997), The Chlorine Institute Inc. (Washington DC), Pamphlet 157, 193 pages, C.N. Haas, A. Fazil and A. Khan.
- 7) Benefits and Risks of Cooling Water Chlorination (1997), The Chlorine Institute Inc. (Washington DC), Pamphlet 158, 188 pages, C.N. Haas, A. Fazil and A. Khan.
- 8) Integrated Disinfection Design Framework (1998), AWWA Research Foundation and American Water Works Association, Denver CO, W.D. Bellamy, G.R. Finch and C.N. Haas.
- 9) Development of Disinfection Guidelines for the Installation and Replacement of Water Mains, AWWA Research Foundation, Denver CO, C.N. Haas, R.B. Chitluru, M. Gupta, W.O. Pipes, and G.A. Burlingame. (1998)
- 10) Quantitative Microbial Risk Assessment, C.N. Haas, J.B. Rose and C.P. Gerba, John Wiley (NY) (1999). (translated into Japanese)
- 11) Methodologies for the Determination of Disinfection Effectiveness, AWWA Research Foundation, C.N. Haas and G.R. Finch, Denver CO (2001).
- 12) Data Review on the Physical/Chemical Removal of Cryptosporidium, AWWA Research Foundation, C.N. Haas, K. French, G.R. Finch and R.K. Guest, Denver CO (2001).
- 13) Inactivation of Waterborne Emerging Pathogens by Selected Disinfectants, AWWA Research Foundation, J.G. Jacangelo, N.L. Patania, R.R. Trussell, C.N. Haas and C. Gerba, Denver CO (2002).
- 14) Effect of Initial Microbial Concentration on Disinfection Efficiency, AWWA Research Foundation, C.N. Haas and B. Kaymak, Denver CO (2002).

### Peer Reviewed Publications

- 1) "Oxygen Uptake Rate as an Activated Sludge Control Parameter." Journal of the Water Pollution Control Federation, 51, 938-943 (1979), Charles N. Haas.
- 2) "Physiological Alterations of Vegetative Microorganisms Resulting From Aqueous Chlorination." Journal of the Water Pollution Control Federation, 52, 1976-1989 (1980), C.N. Haas and R.S. Engelbrecht.
- 3) "Chlorine Dynamics During Inactivation of Coliforms, Acid-Fast Bacteria and Yeasts." Water Research, 14, 1749-1757 (1980), C.N. Haas and R.S. Engelbrecht.
- 4) "A Mechanistic Kinetic Model for Chlorine Disinfection." Environmental Science and Technology, 14, 339-340 (1980), C.N. Haas.
- 5) "Application of Predator-Prey Models to Disinfection." Journal of the Water Pollution Control Federation, 53, 378-386 (1981), C.N. Haas.
- 6) "Rational Approaches in the Analysis of Chemical Disinfection Kinetics." Chapter in W. Cooper (ed.) Chemistry in Water Reuse. Vol. 1, pp. 381-399. Ann Arbor Science Publishers, Inc. (1981), C.N. Haas.
- 7) "Practical Mixed Culture Processes." Advances in Fermentation Processes, 4, 1-29 (1980), C.N. Haas, H.R. Bungay and M.L. Bungay.
- 8) "Biological Process Diffusional Limitations." Journal of the Environmental Engineering Division, ASCE, 107, 269-273 (1981), C.N. Haas.
- 9) "Repeated Exposure of Escherichia coli to Free Chlorine: Production of Strains Possessing Altered Sensitivity." Water, Air and Soil Pollution, 16, 233-242 (1981), C.N. Haas and E.C. Morrison.
- 10) "Sodium Alterations of Chlorine Equilibria: Quantitative Description." Environmental Science and Technology, 15, 1243-1244 (1981), C.N. Haas.
- 11) "Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology." Journal of the American Water Works Association, 74, 322 (1982), C.N. Haas, M.A. Meyer and M.S. Paller.
- 12) "Enhancement of Chlorine Inactivation of E. coli by Sodium Ions." Water Chlorination Environmental Impact and Health Effects, volume 4, book 2, pp1087-96, edited by R.L. Jolley, Ann Arbor Science (1983), C.N. Haas and M. Zapkin.
- 13) "The Ecology of Acid-Fast Organisms in Water Supply, Treatment and Distribution Systems." Journal of the American Water Works Association, 75, 139-44 (1983), C.N. Haas, M.A. Meyer and M.S. Paller.

- 14) "Estimation of Risk Due to Low Doses of Microorganisms: A Comparison of Alternative Methodologies." *American Journal of Epidemiology*, 118,573-82 (1983), C.N. Haas.
- 15) "The Utility of Endotoxins as a Surrogate Indicator in Potable Water Microbiology." *Water Research*, 17, 803-7 (1983), C.N. Haas, M.A. Meyer, M.S. Paller and M.A. Zapkin.
- 16) "Effect of Effluent Disinfection on Risks of Viral Disease Transmission via Recreational Exposure." *Journal of the Water Pollution Control Federation*. 55, 1111-6 (1983), C.N. Haas.
- 17) "Engineering at the Microorganism Scale." *Advances In Fermentation Processes*, 6, 149-73 (1983), H.R. Bungay, M.L. Bungay and C.N. Haas.
- 18) "Microbial Dynamics in GAC Filtration of Potable Water." *ASCE Journal of Environmental Engineering*, 109, 956-61 (1983), C.N. Haas, M.A. Meyer and M.S. Paller.
- 19) "Application of Ion Exchangers to Recovery of Metal from Semiconductor Wastes." *Reactive Polymers*, 2, 61-70 (1984), C.N. Haas and V. Tare.
- 20) "Microbial Alterations in Water Distribution Systems and Their Relationship to Physical-Chemical Characteristics." *Journal of the American Water Works Association*, 75, 475-481 (1983), C.N. Haas, M.A. Meyer and Marc S. Paller.
- 21) "Kinetics of Wastewater Chlorine Demand Exertion," *Journal of the Water Pollution Control Federation*, 56, 170-3 (1984) C.N. Haas and S.B. Karra.
- 22) "Kinetics of Metal Removal by Chelating Resin from a Complex Synthetic Wastewaters." *Water Air & Soil Pollution*, 22, 429-39 (1984) V. Tare, S.B. Karra, and C.N. Haas.
- 23) "Estimation of Effective Intra-Particle Diffusion Coefficients with Differential Reactor Columns," *Journal of the Water Pollution Control Federation*, 56, 442-8 (1984) A.A. Aguwa, J.W. Patterson, C.N. Haas and K.E. Noll.
- 24) "Is Sodium Thiosulfate a Suitable Neutralizer For Chlorine in Microbiological Determinations?," C.N. Haas and M.A. Zapkin. *Journal of Environmental Science and Health Part A: Environmental Science and Engineering*, 19, 507-20 (1984).
- 25) "Kinetic Limitations on the Selective Precipitation Treatment of Electronics Wastes." *Water Air & Soil Pollution*, 24, 253-65 (1985) S.B. Karra, C.N. Haas, V. Tare and H.E. Allen.
- 26) "Kinetics of Microbial Inactivation By Chlorine. I. Review of Results in Demand-Free systems." *Water Research*, 18, 1443-1449 (1984), C.N. Haas and S.B. Karra.
- 27) "Kinetics of Microbial Inactivation By Chlorine. II. Kinetics in the Presence of Chlorine Demand." *Water Research*, In 18, 1451-4 (1984), C.N. Haas and S.B. Karra.
- 28) "Field Observations on the Occurrence of New Indicators of Disinfection Efficiency." *Water Research*, 19, 323-9 (1985), C.N. Haas, B.F. Severin, D. Roy, R.S. Engelbrecht, A. Lalchandani, and S. Farooq.
- 29) "Influence of Sodium, Potassium and Lithium on Hypochlorite Solution Equilibria." *Water Chlorination Environmental Impact and Health Effects*, volume 5, pp775-782 edited by R.L. Jolley, Lewis Publishers (1985), C.N. Haas and D.M. Brncich.
- 30) "Removal of New Indicators by Coagulation-Flocculation and Sand Filtration." *Journal of the American Water Works Association*, 77, 67-71 (1985). C.N. Haas, B.F. Severin, D. Roy, R.S. Engelbrecht, and A. Lalchandani.
- 31) "Direct Differential Reactor Studies on Adsorption from Concentrated Liquid and Gaseous Solutions." In *Fundamentals of Adsorption Processes*, A. Meyers and G. Belfort [eds.], pp411-20, United Engineering Trustees, NY (1984), K.E. Noll, C.N. Haas, J-P. Menez, A.A. Aguwa, M. Satoh, A. Belalia and P.S. Bartholomew.
- 32) "Sensitivity of Vegetative Protozoa to Free and Combined Chlorine. "Water Chlorination Environmental Impact and Health Effects, volume 5, pp 667-80 edited by R.L. Jolley, Lewis Publishers (1985), C.N. Haas, K. Khater and A. Wojtas.
- 33) "Economic Incentives for Hazardous Waste Management." *Journal of Environmental Systems*, C.N. Haas, 14, 373-93 (1985).
- 34) "Toluene-Humic Acid Association Equilibria: Isopiestic Measurements." *Environmental Science and Technology*, 19, 643- 5 (1985) C.N. Haas and B.M. Kaplan.
- 35) "Adsorption of Cadmium to Kaolinite in the Presence of Organic Materials." *Water, Air and Soil Pollution*, 27, 131-40 (1986) C.N. Haas and N.D. Horowitz.
- 36) "Revegetation Using Coal Ash Mixtures," *ASCE Journal of Environmental Engineering*," 111, 559-73 (1985) C.N. Haas and J.J. Macak.
- 37) "Validation of the Hazard Ranking System for the Assessment of Feedstock Frequencies in Superfund Site Contaminants", *Hazardous Waste and Hazardous Materials*, 2, 535 (1985) G.A. Vanderlaan and C.N. Haas.

- 38) "Statistics of Enumerating Total Coliforms In Water Samples by Membrane Filter Procedures", *Water Research*, 20, 525-30 (1986) C.N. Haas and B. Heller.
- 39) "A Heuristic Relationship for Faculty Size in Engineering Schools," *Engineering Education*, 78(7):710-11 (1988), C.N. Haas.
- 40) "Wastewater Disinfection and Infectious Disease Risks", *CRC Critical Reviews in Environmental Control*, 17, 1, 1-20 (1986), C.N. Haas.
- 41) "Alteration of Chemical and Disinfectant Properties of Hypochlorite by Sodium, Potassium and Lithium", *Environmental Science and Technology*, 20, 822-6 (1986), C.N. Haas, M.G. Karalius, D.M. Brncich, and M.A. Zapkin.
- 42) "Kinetics of Cadmium and Copper Hydrolysis", *Water Science and Technology*, 19, 1021-7 (1987), J.W. Patterson, C.N. Haas, R.J. Vamos, and E. Cooney.
- 43) "Recovery, Recycle and Reuse of Hazardous Waste", *Journal of the Air Pollution Control Association*, 36, 1163-8 (1986) K.E. Noll, C.N. Haas and J.W. Patterson.
- 44) "Micromixing and Dispersion in Chlorine Contact Chambers", *Environmental Technology Letters*, 9: 35-44 (1988) C.N. Haas.
- 45) "Electrolytic Recovery Techniques", chapter in *Standard Handbook of Hazardous Waste Treatment*, McGraw Hill, A.A. Aguwa and C.N. Haas (1989).
- 46) "Preliminary Determination of Limiting Nutrients for Indigenous Bacteria in Chicago Intake Water" *Water, Air and Soil Pollution*, 37:65-72 (1988), C.N. Haas, P. Bitter and P.A. Scheff.
- 47) "Maximum Likelihood Analysis of Disinfection Kinetics", *Water Research*, 22, 669-77 (1988).
- 48) "Assessing the Need for Wastewater Disinfection", *Journal of the Water Pollution Control Federation*, 59, 856-64 (1987), C.N. Haas et al.
- 49) "On the Existence of Ternary Interactions in Ion Exchange", *AIChE Journal*, C.N. Haas (1988).
- 50) "Error in Variables Parameter Estimation", *Journal of Environmental Engineering*, 115, 259-64 (1989), C.N. Haas.
- 51) "Effects of Ceasing Disinfection on a Receiving Water", C.N. Haas, J.G. Sheerin and C. Lue-Hing, *Journal of the Water Pollution Control Federation*, 60, 667-673 (1988).
- 52) "Averaging TNTC Counts", *Applied and Environmental Microbiology*, 54(8), 2069-72 (1988), C.N. Haas and B. Heller.
- 53) "Assessment of Risks Associated with Enteric Viruses in Contaminated Drinking Water", in *Chemical and Biological Characterization of Sludges, Sediments, Dredge Spoils and Drilling Muds*, ASTM STP 976, pps.489-494 (1988), C.P. Gerba and C.N. Haas.
- 54) "Chemical Composition of Bottled Mineral Water", *Archives of Environmental Health*, 44, 102-16 (1989), H.E. Allen, M. Halley-Henderson and C.N. Haas.
- 55) "Test of the Validity of the Poisson Assumption for Analysis of MPN Results", *Applied and Environmental Microbiology*, 54(12), 2996-3002 (1988), C.N. Haas and B. A. Heller.
- 56) "Analysis of Disinfection Data from Dilution Count Experiments", *Water Research*, 23, 345-9 (1989), C.N. Haas.
- 57) "Statistics of Microbial Disinfection", *Water Science and Technology*, 21, 3, 197-201 (1989), C.N. Haas and B. Heller.
- 58) "Estimation of Microbial Densities from Dilution Count Experiments", *Applied and Environmental Microbiology*, 55, 8, 1934-42 (1989), C.N. Haas.
- 59) "Kinetics of Inactivation of *Giardia lamblia* by Free Chlorine", *Water Research*, 24, 2, 233-8 (1990) C.N. Haas and B. Heller.
- 60) "Estimation of Averages in Truncated Samples", *Environmental Science and Technology*, 24, 912-19 (1990) C.N. Haas and P.A. Scheff.
- 61) "High Rate Coliform Disinfection of Stormwater Overflow", *Journal of the Water Pollution Control Federation*, 62, 282-7 (1990) C.N. Haas, K. Longley and T. Selfridge.
- 62) "Chloroform Formation by the Transfer of Active Chlorine from Monochloramine to Phloroacetophenone", *Water Chlorination Environmental Impact and Health Effects*, volume 6, pp649-64 edited by R.L. Jolley et al., Lewis Publishers (1990) K.V. Topudurti and C.N. Haas.
- 63) "Further Studies of Hypochlorite Ion Pair Chemistry and Disinfection Efficiency", *Water Chlorination Environmental Impact and Health Effects*, volume 6, pp729-740 edited by R.L. Jolley et al., Lewis Publishers (1990) C.N. Haas, C.D. Trivedi and J.R. O'Donnell.
- 64) "A Microbiological Perspective on Risks from Water Chlorination", *Water Chlorination Environmental Impact and Health Effects*, volume 6, pp971-2 edited by R.L. Jolley et al., Lewis Publishers (1990) C.N. Haas.

- 65) "Disinfection", chapter 14 (pp877-932) in *Water Quality and Treatment*, 4th edition, F.W. Pontius [ed.], McGraw Hill, NY (1990).
- 66) "Inactivation of *E. coli* by Combined Action of Free Chlorine and Monochloramine", *Water Research*, 25, 1027-32 (1991). Y. Kouame and C.N. Haas.
- 67) "THM Formation by the Transfer of Active Chlorine from Monochloramine to Phloroacetophenone", *Journal of the American Water Works Association*, May (1991) pps 64-6. K.V. Topudurti and C.N. Haas.
- 68) "Modeling Risk from *Giardia* and Viruses in Drinking Water", *Journal of the American Water Works Association*, 83, 11, 76-84 (1991), S. Regli, J. Rose, C.N. Haas and C. Gerba.
- 69) "Risk Assessment and the Control of Waterborne Giardiasis", *American Journal of Public Health*, 81, 709-13 (1991) J.B. Rose, C.N. Haas and S. Regli.
- 70) "Fundamental Considerations in Development of Solvent Dissolution Processes for Plastics", *Journal of Resource Management and Technology*, 19, 4, 186-91 (1991). C.N. Haas and C.R. Brougnier.
- 71) "A New Approach for the Analysis of Mixture Toxicity Data", *Water Science and Technology*, 26, 9-11, 2345-48 (1992), C.N. Haas.
- 72) "Development of Regression Models with Below Detection Limit Data", *Journal of Environmental Engineering*, 119, 2, 214-230 (1993), C.N. Haas and J. Jacangelo.
- 73) "Survey of Water Utility Disinfection Practices", *Journal of the American Water Works Association*, September 1992, pages 121-128, C.N. Haas et al.
- 74) "Biological Sulfide Prestripping for Metal and COD Removal", *Water Environment Research*, 65, 5, 645-649 (1993) C.N. Haas and C. Polprasert.
- 75) "Microbial Sampling: Is It Better to Sample Many Times or Use Large Samples?", *Water Science and Technology*, C.N. Haas, 27(3-4):19-25 (1993).
- 76) "A New Quantitative Approach for the Analysis of Binary Toxic Mixtures", *Environmental Toxicology and Chemistry*, 13:149-156 (1994), C.N. Haas and B.A. Stirling.
- 77) "Risk Assessment of Virus in Drinking Water", *Risk Analysis*, 13(5):545-552 (1993), C.N. Haas, J.B. Rose, C. Gerba and S. Regli.
- 78) "Reduction of Ion Exchange Equilibria Data Using an Error in Variables Approach", *AIChE Journal*, 40(3):556-569 (1994) R.J. Vamos and C.N. Haas.
- 79) "Waterborne Pathogens: Assessing Health Risks", *Health and Environment Digest*, 7(3):1-2, J.B. Rose, C.N. Haas and C.P. Gerba (1993).
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- 81) "Proposed Decision Tree for Management of Risks in Drinking Water: Consideration for Health and Socioeconomic Factors", in G.F. Craun [ed], *Safety of Water Disinfection: Balancing Chemical and Microbial Risks*, pps. 39-80, ILSI Press, Washington DC (1993), S. Regli, P. Berger, B. Macler and C.N. Haas.
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- 86) "Dose-Response Analysis Using Spreadsheets", *Risk Analysis*, 14(6):1097-1100 (1994), C.N. Haas.
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- 88) "Comment on 'Disinfection of Oocysts of *Cryptosporidium parvum* by Sand and Chlorine'", *Water Research* 27(6):729 (1995), C.N. Haas.
- 89) "Protozoan Monitoring: From the ICR to ESWTR", *Journal of the American Water Works Association*, 87(8):50-59 (1995), C.S. Crockett and C.N. Haas.
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- 93) "Development of an Action Level for *Cryptosporidium*", *Journal of the American Water Works Association*, 87(9):81-84, CN Haas, JB Rose (1995).
- 94) "Effect of sulfate on anaerobic processes fed with dual substrates", *Water Science and Technology* 31(9):101, C. Polprasert and C.N. Haas (1995).
- 95) "Linking Microbiological Criteria for Foods with Quantitative Risk Assessment", *Journal of Food Safety*, 15:121-32 (1995), J.B. Rose, C.N. Haas and C.P. Gerba.
- 96) "Prevalence of Shigellosis in the U.S.: Consistency with Dose-Response Information", C. Crockett, C.N. Haas, A. Fazil, J.B. Rose, and C.P. Gerba, *International Journal of Food Microbiology*, 30(1-2):87-100 (1996).
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## Presentations

- 1) "Amino Acids, Aquatic Bacteria and Diatoms: Possible Methods of Interaction." Presented at the 67th Annual Meeting of the Illinois State Academy of Sciences, Springfield, May, 1974.
- 2) "Physiological Alterations of Vegetative Microorganisms Resulting from Aqueous Chlorination," presented at the Research Symposium during the 51st annual meeting of the Water Pollution Control Federation, Houston, October, 1978.
- 3) "Physiological Basis for Chlorination," presented at a seminar of the Department of Civil Engineering, Syracuse University, November, 1978.
- 4) "Mechanistic Aspects of Disinfection Kinetics," presented at a seminar of the Department of Biomedical Engineering, Rensselaer Polytechnic Institute, Troy, NY, April, 1979.
- 5) "Mode of Microbial Inactivation by Chlorine," presented at the National Conference on Environmental Engineering, American Society of Civil Engineers, San Francisco, July, 1979.
- 6) "Rational Analysis of Ultraviolet Disinfection Kinetics," presented at the National Conference on Environmental Engineering, American Society of Civil Engineers, San Francisco, July, 1979.
- 7) "Rational Analysis of Microbial Regrowth." Presented at the 178th National Meeting of the American Chemical Society, Division of Environmental Chemistry, Washington, DC, September, 1979.
- 8) "A Quantitative Model of Post-Disinfection Microbial Dynamics." Presented at the Research Symposium during the 52nd Annual Meeting of the Water Pollution Control Federation, Anaheim, October, 1979.
- 9) "Rational Approaches in the Analysis of Chemical Disinfection Kinetics," Presented at the 179th National Meeting of the American Chemical Society, Division of Environmental Chemistry, Symposium on Chemistry and Chemical Analysis of Water/Wastewater Intended for Reuse, Houston, March, 1980.
- 10) "Repeated Exposure of E. coli to Free Chlorine: Production of Strains With Differential Resistance," Presented at the 80th Annual Meeting of the American Society of Microbiology, Miami, May, 1980.
- 11) "Acid-Fast Bacteria and Yeast as Indicators of Disinfection Efficiency." Invited Presentation before the Interstate Seafood Seminar, Ocean City, MD, October, 1980.
- 12) "Theory of Alternate Disinfectants." Invited presentation at the Seminar on Current Topics in Water Supply, New York State Section of the American Water Works Association, Ossining, NY, November, 1980.
- 13) "The Practical Importance of Understanding Disinfection Mechanisms." Presented at the 81st Annual Meeting of the American Society for Microbiology, Dallas, March, 1981.
- 14) "Effects of Various Additions on the Inactivation of E. coli by Chlorine. Presented at the 81st Annual Meeting of the American Society for Microbiology, Dallas, March, 1981.
- 15) "Statistical Analysis of New York State Department of Environmental Conservation Lake George Bacteriological Sampling Data." Presented at the 1st Symposium of the Lake George Research Group, Lake George, NY, April, 1981.
- 16) "Enhancement of Chlorine Inactivation of E. coli by Sodium Ions." Presented at the 4th Water Chlorination Conference, Monterey, CA, October, 1981.
- 17) "Practical Considerations in the Use of Halogen Disinfectants." Invited Presentation to the Second National Symposium on Municipal Wastewater Disinfection, sponsored by the U.S. EPA, Orlando, FL, January, 1982.
- 18) "Application of Ion Exchange to Recovery of Metals from Semiconductor Wastes." Presented at the NATO Advanced Studies Institute on Mass Transfer and Kinetics of Ion Exchange, Maratea, Italy, June, 1982.
- 19) "Estimation of Recreational Disease Risk due to Disinfection: Illinois—A Case Study." Presented at the 55th Annual Conference of the Water Pollution Control Federation, St. Louis, October, 1982.
- 20) Seminars presented during a visit to the Italian National Research Council, Water Research Institute, Bari, Italy, June, 1982:
  - "Rational Analysis of Chlorination Kinetics."
  - "Use of Computer Equilibrium Models for Assessment of Industrial Waste Chemistry."
  - "Novel Precipitation processes for Metal Recovery from Semiconductor Wastes."
  - "Application of Ion Exchange to Recovery of Metals from Semiconductor Wastes."
  - "Solid Phase Differential Reactor Studies on Adsorption in Air and Water."
- 21) Seminar presented to the Italian National Research Council, Water Research Institute, Rome, Italy, June 1982:
  - "Metal Removal and Recovery Processes: Experimental Results and Equilibrium Calculations."
- 22) "Relating Microbial Changes in Water distribution to Physical-Chemical Water Quality." Presented at the 74th Annual Conference, Illinois Section, American Water Works Association, Chicago, March 1983.

- 23) "Direct Differential Reactor Studies of Adsorption from Liquid and Gaseous Solutions." Presented at the Engineering Foundation Conference on Fundamentals of Adsorption, Upper Bavaria, West Germany, May, 1983.
- 24) "Water and Wastewater Disinfection." Seminar presented at IBM Corp., East Fishkill, NY, June 1983.
- 25) "Kinetic Limitations on the Recovery of Metals From Wastewater by Precipitation." Presented at the American Institute of Chemical Engineers National Meeting, Denver, August 1983.
- 26) "Microbial Risk Assessment." Invited Presentation at the Water Pollution Control Federation, Preconference Workshop on Wastewater Disinfection Alternatives, Atlanta, October, 1983.
- 27) "Engineering Waterborne Disease Reduction: How Much Is Enough?" Speech before the Western Society of Engineers, Chicago, November, 1983.
- 28) "Is Wastewater Disinfection Necessary?" Presentation to the Illinois Association of Environmental Professionals, April 1984.
- 29) "Sensitivity of Vegetative Protozoa to Free and Combined Chlorine." Presented at the 5th Conference on Water Chlorination: Environmental Impact and Health Effects, Williamsburg, VA, June, 1984.
- 30) "Influence of Sodium Potassium and Lithium on Hypochlorite Solution Equilibria." Presented at the 5th Conference on Water Chlorination: Environmental Impact and Health Effects, Williamsburg, VA, June, 1984.
- 31) "Scientific Principles of Disinfection" and "Need Assessments for Disinfection." Presented at the University of Wisconsin-Milwaukee Engineering Extension Program on Disinfection of Water and Wastewater, May, 1984.
- 32) "An Engineers View of Economic Incentives for Hazardous Waste Management." Seminar presented to the Institute of Environmental Studies, Drexel University, Philadelphia, August 1984.
- 33) "Effect of Cessation of Chlorination on Receiving Water Microbiology." Presented at a seminar of the Research and Development Department, Metropolitan Sanitary District of Greater Chicago, October 1984.
- 34) "Hazardous Waste Management Challenges." Invited plenary presentation to the Annual Meeting of the Illinois Public Health Association, Peoria, April, 1985.
- 35) "Steps Towards a Rational Kinetic Model of Wastewater Chlorination", seminar presentation, Department of Civil and Sanitary Engineering, Michigan State University, April, 1985.
- 36) Presentation on potential risk avoidance due to earlier intervention in a Salmonella outbreak before the Illinois House of Representatives Committee on State Government Administration and Regulatory Reform June, 1985.
- 37) "Development of Acid Fast and Yeast Organisms as New Indicators of Disinfection Efficiency", seminar presented to the Department of Microbiology and Immunology, University of Arizona, Tucson, August, 1985.
- 38) "Is Wastewater Disinfection Worth the Cost?", seminar to the School of Civil Engineering, Purdue University, March 1986.
- 39) "Recovery, Recycle and Reuse of Industrial Wastes", Presented at a program on Wastewater Pretreatment and Toxicity Control, University of Wisconsin Extension at Milwaukee, March, 1986.
- 40) "Chlorine Residual", presented at the WPCF Conference on Analytical Techniques in Pollution Control, Denver, May 1986.
- 41) "On the Poisson Assumption for Analysis of MPN Results", presented at the American Water Works Association Annual Meeting, Denver, June, 1986.
- 42) "Kinetics of Cadmium and Copper Hydrolysis", International Association on Water Pollution Research and Control, Biennial Conference, Rio de Janeiro, Brazil, August, 1986.
- 43) "Wastewater Disinfection: Concepts and Practices", R.S. Engelbrecht and C.N. Haas, invited paper, Second Joint Seminar on Wastewater Treatment Technology, Japan Sewage Works Association/Water Pollution Control Federation, Hiroshima City, Japan, November, 1986.
- 44) "Relationship Between Disinfection Mechanism and Disinfection Kinetics", invited paper, Seminar on Water and Wastewater Disinfection, American Society of Microbiology Annual Meeting, Atlanta, GA, March 1987.
- 45) "Disinfection Methods and Regulatory Changes", invited presentation to the Illinois Association of Water Pollution Control Operators, Springfield, IL, April, 1987.
- 46) "Further Studies on Hypochlorite Ion Pair Chemistry and Disinfection Efficiency", 6th Water Chlorination Conference, Oak Ridge TN, May, 1987.
- 47) "Inherent Experimental Variability", invited presentation at the American Water Works Association pre-conference seminar on "Assurance of Adequate Disinfection: ct or not ct", Kansas City, June, 1987.
- 48) "Wastewater Chlorination and Dechlorination", invited presentation to the Michigan Section, American Water Works Association, Ann Arbor, February 1988.
- 49) Invited presentations before a seminar sponsored by the Michigan Water Pollution Control Association on Wastewater Disinfection: Public Health Related Issues: "Effect of Effluent Disinfection on Risks of Viral

- Disease Transmission via Recreational Water Exposure” and “Water Pollution Control Federation Disinfection Committee: Report Status”, Ann Arbor, May 1988.
- 50) Invited speaker “Comparative Aspects of Solid Waste Management”, seminar on “Recycling and Solid Waste Disposal” sponsored by the University of Illinois, Rockford, June 1988.
  - 51) “Statistics of Microbial Disinfection”, International Association on Water Pollution Research and Control Biennial Meeting, Brighton, UK, July 1988.
  - 52) “Maximum Likelihood Analysis of Giardia Disinfection by Chlorine”, First Biennial Water Quality Symposium: Microbiological Aspects, Banff, Alberta, August 1988.
  - 53) “Maximum Likelihood Analysis of Disinfection Kinetics”, seminar to the Environmental Engineering Program, Department of Civil Engineering, University of Illinois at Urbana-Champaign, February 1989.
  - 54) “Multicomponent Interactions In Environmental Engineering”, seminar to the Institute of Environmental Studies, Drexel University, April 1989.
  - 55) “Chlorination/Dechlorination for New Disinfection Criteria”, invited presentation at the Water Pollution Control Federation preconference workshop, San Francisco, October 1989.
  - 56) “Fundamental Considerations in Development of Solvent Dissolution Processes for Plastics”, presented at the 6th International Conference on Solid Waste Management and Secondary Materials”, Philadelphia, December 1990.
  - 57) “Failure of Chick’s Law in Batch to CSTR Extrapolation of Chlorine Disinfection of Escherichia coli”, presented at the Annual Conference of the American Water Works Association, Philadelphia, June, 1991.
  - 58) “Occurrence of Pathogens and their Associated Risk”, invited paper, Regulating Drinking Water in the 1990’s, sponsored by the Northeast Regional Environmental Public Health Center, April, 1991, Amherst MA.
  - 59) “Status of Chloramination”, invited paper, Preconference Seminar on Water Quality Effects of Chloramination, AWWA Annual Meeting, June 1991, Philadelphia, PA.
  - 60) “Binary and Ternary Equilibria of Ion Exchange”, 46th Purdue Industrial Waste Conference, May 1991, West Lafayette IN.
  - 61) “Equilibrium of Mixed Solid Phases”, 46th Purdue Industrial Waste Conference, May 1991, West Lafayette IN.
  - 62) “Biological Sulfide Prestripping for Metal and COD Removal”, Annual Conference of the Water Pollution Control Federation, October 1991, Toronto, Canada.
  - 63) “Comparative Performance of Interval Estimators for Virtually Safe Dose”, Annual Meeting of the Society for Risk Analysis, December 1991, Baltimore.
  - 64) “Nonideal Interactions in Metal Separations in Environmental Engineering”, seminar to the Department of Chemical Engineering, Drexel University, January 27, 1992.
  - 65) “Risk Assessment of Infectious Disease from Waterborne Exposures”, seminar to the Department of Bioscience and Biotechnology, Drexel University, April 2, 1992.
  - 66) “New Approaches for the Analysis of Mixture Toxicity Data”, presented at the 16th Biennial Conference of the International Association on Water Pollution Research and Control, Washington D.C., May 1992.
  - 67) “Occurrence of Microorganisms”, invited presentation to the Netherlands Public Health Institute, Bilthoven, June 1992.
  - 68) “Microbial Risk Assessment”, invited presentation to the Netherlands Public Health Institute, Bilthoven, June 1992.
  - 69) “Quantifying Microbial Risk”, invited presentation at the First International Conference on the Safety of Water Disinfection: Balancing Chemical and Microbial Risks, Washington D.C., August 1992.
  - 70) “Trends in Environmental Protection”, invited presentation at the 6th environmental affairs conference, Betz Laboratories Inc., Trevose PA, September 1992.
  - 71) “Microbial Risk Assessment for Drinking Water”, poster by C.P. Gerba, Joan Rose and C.N. Haas, Society for Risk Analysis Annual Conference, San Diego CA, December 1992.
  - 72) “The Risk of Illness from Drinking Water”, seminar to the Department of Civil and Architectural Engineering and the Environmental Studies Institute, Drexel University, January 1993.
  - 73) “Microbial Risk Assessment of Drinking Water”, seminar to the Department of Environmental and Occupational Health and the Department of Civil Engineering and Mechanics, University of South Florida, Tampa, March 1993.
  - 74) “Testing for the Presence of Interactive Toxic Effects: A New Quantitative Procedure Based on Isobole Analysis”, presented at the Eastern North America Regional (ENAR) Meeting of the Biometric Society/American Statistical Association/ Institute of Mathematical Statistics, Philadelphia, PA, March 1993, with Bruce A. Stirling.

- 75) "Nonideal Interactions in Metal Separation Processes", seminar to the Department of Civil Engineering, University of Delaware, March 1993.
- 76) "The Effect of Free Chlorine, Preformed Monochloramine, Chlorine+ Preammoniation and Ozone on Giardia muris Cyst Viability", presented at the Annual Conference of the Pennsylvania Section of AWWA, April 1993, with Joel Hornberger, Uma Anmangandla and Josh Joffe.
- 77) "The Necessity for Wastewater Disinfection", invited presentation at the American Society for Microbiology conference on "Water Quality in the Western Hemisphere", San Juan PR, April 1993.
- 78) "Modeling the Risk of Legionella", D.E. Friedman, C.N. Haas and J.B. Rose, poster presentation at the American Society for Microbiology conference on "Water Quality in the Western Hemisphere", San Juan PR, April 1993.
- 79) "What We Think We Know and What We Think We Don't Know About Chlorination and Dechlorination", presented at the Water Environment Federation Specialty Conference on Wastewater Disinfection, May 1993, Whippany NJ.
- 80) "Pathogen Risks and Treatment Options", presented at the AWWA Preconference Seminar on Groundwater Disinfection, San Antonio, Texas, June 1993.
- 81) "Monte Carlo Methods in Risk Assessment", seminar presented at Roy F. Weston Co., West Chester PA, June 1993.
- 82) "Application of Risk Assessment to Standard Setting for Closed Life Support Systems", C.P. Gerba, C.N. Haas and J.B. Rose, presented at the 23rd International Conference on Environmental Systems, Colorado Springs, CO, July 1993.
- 83) "Verification of a Mechanistic Kinetic Model for Chloroform Formation from a Model Precursor During Water Chlorination", C.N. Haas and K. Topudurti, presented at the National Meeting of the American Chemical Society, Chicago IL, August 1993.
- 84) Invited discussion, "Health Effects of Water Reuse", presented at the Water Environment Research Foundation Assessment Workshop on "Water Reuse Assessment", WEF Annual Conference, Anaheim CA, October 1993, C.N. Haas.
- 85) "Simplified Method for Microscopic Determination of Giardia Disinfection Efficiency", C.N. Haas, J.C. Hornberger, U. Anmangandla and J. Joffe, AWWA Water Quality Technology Conference, Miami FL, November 1993.
- 86) "Bench to Pilot Scale Up: Impact on Microbial Inactivation", Mark S. Heath, Joseph G. Jacangelo and C.N. Haas, AWWA Water Quality Technology Conference, Miami FL, November 1993.
- 87) "Microbiological Issues", invited presentation to the US EPA Federal-State Toxicology and Risk Assessment Committee, Washington DC, December 1993.
- 88) Invited presentations to faculty and administration at University of Texas-El Paso: "Environmental Science and Engineering at Drexel University" and "Future Trends in Environmental Protection", November 1993.
- 89) "Estimating Risk from Waterborne Microorganisms", presented at the Annual Meeting of the Society for Risk Analysis, Savannah GA, December 1993.
- 90) "Microbial Risk Assessment", seminar presented to the USDA, Agricultural Research Service, Eastern Regional Research Center, Philadelphia, February 1994.
- 91) "Waterborne Microbial Diseases", invited presentation to AWWA – USEPA Workshop on Information Collection Rule, Washington DC, March 1994.
- 92) "Relevance of UIUC Disinfection Research to Current Problems", invited presentation, UIUC-CERL Symposium on Molecular Biology in Environmental Engineering, in Honor of Richard S. Engelbrecht, Champaign-Urbana IL, March 1994.
- 93) "Can Chlorine be Eliminated from Water Treatment?", invited seminar, MIT Program in Technology and Public Policy, May 1994.
- 94) "Reconciliation of Microbial Risk Assessment and Epidemiology: The Case of the Milwaukee Outbreak", AWWA Annual Conference, June 1994, New York City.
- 95) "The Risk of Infectious Disease from Drinking Water", seminar to the Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute, July 1994.
- 96) "The Relationship Between Endemic and Epidemic Disease Risk", presented at the biennial meeting of the International Association on Water Quality, Budapest Hungary, July 1994.
- 97) "Application of Reaction Engineering Approaches to Disinfection Process Design", seminar to the Department of Civil Engineering, University of Illinois at Urbana-Champaign, August 1994.
- 98) "Some Observations on Cryptosporidium Risk", invited presentation, "Water for Healthy Living: A Workshop on Public Decisions about Cryptosporidium", sponsored by AWWA, Washington DC, September 1994.

- 99) "Dose-Response Relationships and Community Risk", invited presentation, "Symposium on Waterborne Cryptosporidium", sponsored by the Centers for Disease Control and Prevention, Atlanta GA, September 1994.
- 100) "Cryptosporidium in Water: What is the Problem?", presented at the Pennjerdel Water Supply Committee meeting, Philadelphia, October 1994.
- 101) "Waterborne Diseases: Who is at Risk", presented at the AWWA Water Quality Technology Conference, San Francisco CA, November 1994, CP Gerba, JB Rose and CN Haas.
- 102) "Chlorine Ban Proposals from the Viewpoint of Water and Wastewater Treatment", invited presentation, Symposium on the Future Uses of Chlorine: The Role of the University, Massachusetts Institute of Technology, November 1994.
- 103) "Application of Reaction Engineering Approaches to Disinfection Process Design", seminar to Texas A&M University, Department of Civil and Ocean Engineering, August 1995.
- 104) "Statistical Analysis of Microbial Data", presented to the AWWA Technical Action Workgroup on Disinfection and Microbials, Washington DC, September 1995.
- 105) "Understanding the Behavior of Giardia and Cryptosporidium in an Urban Watershed: Explanation and Application of Techniques to Collect and Evaluate Monitoring Data", presented at the AWWA Water Quality Technology Conference, New Orleans, November 1995. CS Crockett and CN Haas.
- 106) "Generalized Independence And Additivity: Two Approaches To Quantitatively Describing Non-Ideal Toxic Behavior Of Chemical Mixtures", presented at the Society for Risk Analysis Annual Meeting, Honolulu, December 1995, CN Haas, S. Kersten, K. Cidambi and MJ Frank.
- 107) "Quantitative Microbial Risk Assessment: Review of Principles and Application to Recreational Settings", seminar to the University of Hawaii Water Resources Institute, December 1995.
- 108) "Principles of Microbial Risk Analysis", presented to the US Department of Agriculture, Office of Risk Assessment and Cost-Benefit Analysis, April 10, 1996.
- 109) "Dose Response Assessment for Infectious Microorganisms", invited presentation, Annual Meeting – American Society for Microbiology, New Orleans, May 23, 1996.
- 110) "Risk of Chemical Mixtures: Novel Methods", seminar to Procter and Gamble Co., Cincinnati OH, November 12, 1996 (with audio feed to P&G Europe).
- 111) "Novel Quantitative Approaches for Chemical Mixtures", seminar to Department of Environmental Systems Engineering, Clemson University, April 4, 1997.
- 112) "The Role of Risk Assessment in Setting US Drinking Water Standards". Nishihara Invited Lecture delivered to:
  - Hokkaido University (Japan) – Environmental Engineering program
  - Tokyo University – Department of Urban and Environmental Engineering
  - Nishihara Sanitation Company
  - Nihon University – Department of Civil Engineering
  - Japan Ministry of Health – Membrane 21 Conference
  - September 1-15, 1997.
- 113) "What we Think We Know and What We Don't Know about Chlorination-Dechlorination", presented at the preconference workshop on Disinfection, Water Environment Federation Technical Conference, October 18, 1997, Chicago.
- 114) "Risk of HIV to Wastewater Operators". Presentation at the 70th Annual Water Environment Federation Technical Conference, October 23, 1997, Chicago.
- 115) "Correlations and Copulas in Monte Carlo Analysis". Platform-Poster at the Annual Meeting of the Society for Risk Analysis, Washington DC, December 10, 1997.
- 116) "Risk Assessment for Household Sanitation", seminar to Procter and Gamble Co., Cincinnati OH, February 19, 1998.
- 117) "Risk Based Criteria for Pathogens in Drinking Water: Has the Time Come?", Seminar to the Department of Civil and Environmental Engineering, University of Delaware, March 27, 1998.
- 118) "Back to the Future: Engineering Safe Water and Safe Food in the 21st Century", Invited Lecture, Villanova University Chapter of Sigma Xi, April 3, 1998.
- 119) "Benefits of Employing a Disinfectant Residual", invited presentation at the AWWA/IWSA Conference on Disinfectant Residuals, April 26, 1998, Philadelphia PA. Also presented in Mulheim, Germany, October 2, 1998.
- 120) "Predicting Disinfection Performance In Continuous Flow Systems From Batch Disinfection Kinetics", presented at the biennial Conference of the International Association on Water Quality, June 1998, Vancouver BC (Canada).

- 121) "Frameworks for Assessing Reliability of Multiple, Independent Barriers in Potable Water Reuse", presented at the biennial Conference of the International Association on Water Quality, June 1998, Vancouver BC (Canada).
- 122) "A Quantitative Risk Assessment Model For *Listeria monocytogenes* And *E. coli* O157:H7", presented at the International Association of Milk, Food and Environmental Sanitarians, Nashville TN, August 1998/
- 123) "Epidemiology, Microbiology and Risk Assessment of Waterborne Pathogens Including *Cryptosporidium*", invited presentation – Conference on the National Food Safety Initiative: Implications for Microbial Data Collection, Analysis and Application, Arlington VA, October 15, 1998.
- 124) "What Is Disinfection?", presented at AWWA Preconference Workshop, November 1, 1998, San Diego CA.
- 125) "Risk Based Criteria for Pathogens in Drinking Water: Has the Time Come?", seminar to Department of Civil Engineering, San Diego State University, December 2, 1998, San Diego CA.
- 126) "Predicting Disinfection Performance in Continuous Flow Systems from Batch Disinfection Kinetics", seminar to the Department of Environmental Science and Engineering, University of North Carolina at Chapel Hill, November 11, 1998.
- 127) "Back to the Future: Engineering Safe Water and Safe Food in the 21st Century", presented to the Philadelphia Chapter of the Society for Risk Analysis, March 23, 1999.
- 128) "The Future of Drinking Water Science [and Engineering]". Invited presentation – EPA/AWWA Conference on Drinking Water: 2025. June 14, 1999, Washington DC.
- 129) "Watershed Management for Pathogen Control". Invited presentation – New York State Energy Research and Development Agency Conference on Management of Small Reservoirs. June 16, 1999, Albany NY.
- 130) "Formulation and Validation of a Dose Response Model for *Escherichia coli* O157:H7", presented at the International Symposium on Waterborne Pathogens, AWWA, Milwaukee WI, August 31, 1999.
- 131) "Inactivation of *Legionella pneumophila* by Free Chlorine", presented at the International Symposium on Waterborne Pathogens, AWWA, Milwaukee WI, August 31, 1999.
- 132) "Predicting Disinfection Performance in Continuous Flow Systems from Batch Disinfection Kinetics", seminar to the Department of Civil & Environmental Engineering, New Jersey Institute of Technology, September 22, 1999.
- 133) "Risk Based Criteria for Pathogens in Drinking Water: Has the Time Come?", seminar to the Department of Civil and Environmental Engineering, Princeton University, October 20, 1999.
- 134) "Community Level Impacts of Waterborne Infections", presented at the annual meeting of Society for Risk Analysis, Atlanta, December 7, 1999.
- 135) "Dermal Microbial Risk Assessment: Impact Of Germicidal Soap On Risk Of Infection From *Staphylococcus aureus*", presented at the annual meeting of the Society for Risk Analysis, Atlanta, December 6, 1999.
- 136) "Microbes and Monte Carlo", presented at the annual meeting of the American Association for Advancement of Science, Washington DC, February 22, 2000.
- 137) "Statistical Modeling in Drinking Water Production", invited presentation, IWA Workshop of Modeling Conventional Drinking Water Treatment Processes, Mar 16, 2000, Delft, The Netherlands.
- 138) "Dose Response Models", invited presentation, WHO-FAO Workshop on Microbial Risk Assessment, Utrecht, The Netherlands, June 13, 2000.
- 139) "Probabilistic Modeling of Drinking Water Treatment", seminar to the Department of Civil and Environmental Engineering, Duke University, September 7, 2000.
- 140) "Microbial Risk Factors: How We Got Here and Alternative Futures", invited presentation, AWWA Water Quality Technology Conference, Salt Lake City, November 7, 2000.
- 141) "Progress and Data Gaps in Quantitative Microbial Risk Assessment", invited presentation at the 2001 Asian Water Quality Conference, Fukuoka, Japan, September 12, 2001.
- 142) "Progress and Data Gaps in Quantitative Microbial Risk Assessment", invited presentation to the Department of Urban and Environmental Engineering, University of Tokyo, Japan, September 18, 2001.
- 143) "Decontamination Using Chlorine Dioxide", Testimony before the US House of Representatives, Committee on Science, hearing on "The Decontamination of Anthrax and Other Biological Agents", November 8, 2001, Washington DC.
- 144) "Bioterrorism 101", Invited presentation, Lehigh University chapter of Sigma Xi, November 28, 2001.
- 145) "The Role of Risk Analysis in Understanding Bioterrorism", invited plenary address, Society for Risk Analysis Annual Meeting, Seattle WA, December 3, 2001.
- 146) "The Risk of Inhalation Exposure to Anthrax Spores", seminar to the School of Environmental Science, Engineering and Policy, Drexel University, February 15, 2002.

- 147) "Disinfection Modeling", invited presentation, WEF Disinfection Specialty Conference, St. Petersburg FL, February 17, 2002.
- 148) "Microbial Dose-Response Models", presented at a short course on microbial risk assessment offered by the University of Ottawa to personnel from Food Canada and Health Canada, March 1, 2002, Ottawa, Canada.
- 149) "Chemical and Biological Terrorism and Higher Education", presented at a workshop organized by the Association of Independent Colleges and Universities of Pennsylvania, Harrisburg PA, March 7, 2002.
- 150) Invited Distinguished Public Health Scientist Lecture, "The Role of Risk Assessment in Responding to the Threat of Anthrax", Johns Hopkins University, Bloomberg School of Public Health, Baltimore, May 16, 2002.
- 151) "Risk Assessment, Bioterrorism and the Food Industry", invited presentation, First International Conference on Microbial Risk Assessment: Food, College Park MD, July 25, 2002.
- 152) "Quantitative Assessment Of Benefits From Using Topical Antimicrobial Hand Products: Case Study On E. coli Risk From Handling Raw Beef", Society for Risk Analysis Annual Meeting, New Orleans, December 9, 2002.
- 153) "Towards a Fourth Generation in Water (Chemical) Disinfection Process Design", seminar presented to the Department of Civil and Environmental Engineering, Tulane University, December 10, 2002.
- 154) "Risk Assessment, Bioterrorism and the Food Industry", seminar to the Eastern Regional Research Center, USDA, Wyndmoor PA, January 10, 2003.
- 155) "Pathogens: Understanding Risks and Control", invited presentation – Symposium on Drinking Water and Health, sponsored by Philadelphia Suburban Water and Drexel University, Philadelphia, March 25, 2003.
- 156) "Chemical and Biological Threats", presented at a workshop on Community Infrastructure Protection, Pennoni Associates, March 26, April 2, April 30 and May 7, Wilmington DE, Mt. Laurel NJ, Harrisburg PA and Philadelphia (2003).
- 157) "How Much is Enough to Protect Public Health: Statistical and Sampling Size Considerations for Environmental Sampling", invited presentation, Annual Meeting of the American Society for Microbiology, Washington DC, May 21, 2003.
- 158) "Overview of Risk Assessment Concepts and Methodologies", invited presentation, Workshop on Quantifying The Health Risk from Water Recycling Schemes, Brisbane, Australia, September 3, 2003.
- 159) "Quantitative Microbial Risk Assessment and Uncertainty Analysis", invited presentation, Workshop on Quantifying The Health Risk from Water Recycling Schemes, Brisbane, Australia, September 3, 2003.
- 160) "Numerical Investigation of the Effects of Reactor Configuration on the Efficacy of Microbial Inactivation", presented at the WEF Annual Conference, October 2003, Los Angeles CA.
- 161) "Quantitative microbial risk assessment+20: victories, challenges and a look forward", seminar to the Harvard Center for Risk Analysis, October 31, 2003, Boston MA.
- 162) "Risk Assessment", presented at workshop on "Reclaimed Water: Whose Water is it?", AWWA WQTC Conference, November 2, 2003, Philadelphia.
- 163) "Selection of an Appropriate Batch Inactivation Model – Why it Matters", presented at the WQTC Conference, Philadelphia, November 2003.
- 164) "Arrivederci "Minimal Infectious Dose": Have We Learned the Lesson Yet?:", presented at the 2003 Annual Meeting of the Society for Risk Analysis, Baltimore, December 7, 2003.
- 165) "Emission Rates of Biological Aerosols during the Land Application of Biosolids? Presented at the 2003 Annual Meeting of the Society for Risk Analysis, Baltimore, December 9, 2003.
- 166) "Disinfection 2020 (20/20)", Seminar presented to the Department of Civil Engineering, Villanova University, March 18, 2004.
- 167) "Disinfection 2020 (20/20)", Seminar presented to the Department of Civil and Environmental Engineering, University of Cincinnati, June 4, 2004.
- 168) "Quantitative Microbial Risk Assessment: An Introduction", invited presentation, 5th Annual Environmental Health Conference of the Association of Schools of Public Health, July 12, 2004, University of Minnesota.
- 169) "Quantitative microbial risk assessment+20: victories, challenges and a look forward", seminar to the Department of Soil, Water and Environmental Science, University of Arizona, Tucson, October 25, 2004.
- 170) "Arrivederci "Minimal Infectious Dose": Have We Learned the Lesson Yet?:", invited presentation – Workshop on Microbial Risk Assessment, US EPA – National Exposure Research Laboratory, Cincinnati OH, November 18, 2004.
- 171) "Reducing Waterborne Infectious Disease", seminar presented to the Department of Environmental Health Science, University of Michigan School of Public Health, November 29, 2004.

- 172) "Chemical Terrorism Against Food and Water Supplies", Symposium on Toxic Industrial Chemicals and Toxic Industrial Materials, sponsored by ATSDR and American Society for Medical Toxicology, Drexel University, June 13, 2005.
- 173) "Simulation of Anthrax Spore Transport and Inactivation in a Room: Scaling Analysis", S Soni, B Farouk and CN Haas, Proceedings of the 2005 ASME International Mechanical Engineering Congress and Exposition, November 5-11, 2005 Orlando FL.
- 174) "Human and Animal Health Risks Associated With Biosolids", C.N. Haas, presented at the annual meeting of the American Society for Microbiology, Orlando FL, May 23, 2006.
- 175) "Thresholds: (Lack of) Evidence for their Existence, and What We Would See if They Were Significant", invited presentation – Upstate NY Chapter of the Society for Risk Assessment, October 13, 2006.
- 176) "Animal Dose Response Data for Predicting Risk of BT Events: Preliminary Thoughts on Validation Using the 2001 AMI Incident as a Case Study", presented at the annual meeting of the Society for Risk Analysis, December 2006.
- 177) "Basic Microbial Dose Response", C.N. Haas, presented at the annual meeting of the American Society for Microbiology, May 20, 2007, Toronto.
- 178) "Developing Unifying Principles in Microbial Risk Assessment", presented at the annual meeting of the American Society for Microbiology, May 22, 2007, Toronto.
- 179) "E coli O157:H7 -- What we Know about Assessing its Risk to Human Health", presented at the annual meeting of the American Society for Microbiology, May 23, 2007, Toronto.
- 180) "Evolution of Disinfection of Water", presented at the annual meeting of the American Society for Microbiology, June 2008, Boston.
- 181) "100 Years of Disinfection", presented at the biennial conference of the International Water Association, Vienna, September 2008.
- 182) "Bioterrorism as a "New" Environmental Engineering Challenge", Invited presentation to the 3rd International Workshop on Environmental and Health Risk for Sustainability, University of Tohoku, Sendai, Japan, February 2, 2009.
- 183) "Basic Microbial Dose Response", presented at the biennial conference of the International Water Association, Montreal, September 2010.
- 184) "Statistical factors to consider in establishing risk based pathogens criteria for recreational water", Invited presentation – Gulf Coast Governors Conference on Gulf of Mexico Pathogens, Sarasota FL, September 2010.
- 185) "A Path to Fundamental Based Optimal Process Design in Environmental Engineering by Computer Experiments and Metamodels?" Seminar to the Department of Civil & Environmental Engineering, Temple University, October 2010.
- 186) "Animal and Human Dose-Response Models for prominent *Brucella* species", Presentation at Annual Conference of Society for Risk Analysis (by Sondra Teske, post-doc), Salt Lake City, December 2010.
- 187) "Dose-Response Model of Rocky Mountain spotted fever for humans", Presentation at Annual Conference of Society for Risk Analysis (by Sushil Tamrakar, PhD student), Salt Lake City, December 2010.
- 188) "Dose Response Using Animal Data", Invited presentation to the FDA Workshop on Listeriosis, Washington DC, March 2011.
- 189) "Risk Informed Response Plans for *B. anthracis*", invited presentation to the Armed Forces Public Health Conference, Newport News, March 2011.
- 190) "Re-envisioning a more sustainable urban water cycle", Invited presentation at Peking University in Shenzhen, April 2011.
- 191) "Introduction to QMRA", presentation at the biennial conference of the Association of Environmental Engineering and Science Professors, Tampa, July 2011.

### Non-Reviewed Publications

- 1) "Chemical Basis for Interaction Between Aquatic Bacteria and Phytoplankton," Final Report to the National Science Foundation, Student Originated Studies Program (1973).
- 2) "Soluble Phase Chemistry of Trace Metal Transport Through Secondary Wastewater Treatment Systems," M.S. Thesis, Department of Environmental Engineering, Illinois Institute of Technology (1974).
- 3) "Heavy Metals Transport Through Municipal Sewage Treatment Plants." Proceedings, 2nd National Conference on Complete Water Reuse (1975). With J.W. Patterson and P. Shimada.

- 4) Discussion on "Temperature-Toxicity Model for Oil Refinery Waste." Journal of the Environmental Engineering Division, Proceedings ASCE, 101,446 (1975).
- 5) "New Microbial Indicators of Disinfection Efficiency." Annual Report to the U.S. Army Medical Research and Development Command (1975). With R.S. Engelbrecht et al.
- 6) "Inactivation of New Indicators of Disinfection Efficiency, Part I. Free Available Chlorine Species Kinetics." Proceedings, 96th Annual Meeting, American Water Works Association (1976). With F. Surucu.
- 7) Discussion on "Cyanophage Analysis as a Biological Pollution Indicator—Bacterial and Viral." Journal of the Water Pollution Control Federation, 49, 1913 (1977).
- 8) "Acid-Fast Bacteria and Yeasts as Disinfection Indicators: Enumeration Methodology." Proceedings, 5th Water Quality Technology Conference, AWWA. (1977). With R.S. Engelbrecht.
- 9) "New Microbial Indicators of Disinfection Efficiency." U.S. EPA Environmental Protection Technology Series 600/2-77- 052 (1977). With R.S. Engelbrecht et al.
- 10) "Mechanism of Inactivation of New Indicators of Disinfection Efficiency by Free Available Chlorine." Ph.D. Thesis, Department of Civil Engineering, University of Illinois at Urbana-Champaign (1978).
- 11) "Literature Review—Disinfection." Journal of the Water Pollution Control Federation, 50, 1134 (1978), with J. Gould.
- 12) "The Future of Chlorination." Rensselaer Fresh Water Institute at Lake George Newsletter, 8 #3 (1978).
- 13) "Acid-Fast Bacteria and Yeasts as Indicators of Disinfection Efficiency." US With R.S. Engelbrecht, et al.
- 14) Discussion on "Effects of Chlorination on Differentiated Coliform Groups." Journal of the Water Pollution Control Federation, 51, 2961(1979).
- 15) "Literature Review—Disinfection." Journal of the Water Pollution Control Federation, 51, 123 (1979). With J. Gould.
- 16) "Mode of Microbial Inactivation by Chlorine." Proceedings of the ASCE Environmental Engineering Specialty Conference, pp646-52 (1979). With R.S. Engelbrecht.
- 17) "Rational Analysis of Ultra-Violet Disinfection Reactors." Proceedings of the ASCE Environmental Engineering Specialty Conference, pp540-7 (1979). With G. P. Sakellaropoulos.
- 18) Discussion on "Kinetics of Bacterial Deactivation with Chlorine." Journal of the Environmental Engineering Division, ASCE, 105, 1198 (1979).
- 19) "Hazardous Waste Processing and Disposal Practices—Best Technology." Report to the New York State Environmental Facilities Corporation (1979). With W.W. Shuster, et al.
- 20) "The Potential for the Application of Resource Recovery Practices in the Hazardous Waste Processing and Disposal Industry." Report to the New York State Environmental Facilities Corporation (1979). With W.W. Shuster, et al.
- 21) "Literature Review-Disinfection." Journal of the Water Pollution Control Federation, 52, 1224 (1980 with J. Gould.
- 22) "Literature Review—Disinfection." Journal of the Water Pollution Control Federation, 53, 789 (1981), with J. Gould.
- 23) "What are Hazardous Wastes?" In R.L. Robbins (ed.) Limiting Liability for Hazardous Wastes, Chicago-Kent College of Law (1981).
- 24) "Technical Arguments Against the Adoption of Changes in the Illinois Wastewater Fecal Coliform Standards." Paper submitted to the Illinois Pollution Control Board (1981).
- 25) "Practical Considerations in the Use of Halogen Disinfectants." In A.D. Venosa (ed.), Proceedings of the Second National Symposium on Wastewater Disinfection, U.S. Environmental Protection Agency, EPA600/9-83-009 (1983).
- 26) "Literature Review—Disinfection." Journal of the Water Pollution Control Federation, 54, 646 (1982). With J.J. McCreary.
- 27) "Evaluation of High-Performance Phosphorus Control POTW's in the Great Lakes Basin." Final Report to the US EPA. With J.W. Patterson et al.(1982).
- 28) "Management of Hazardous Wastes: An Illinois Perspective." Report to the Illinois Institute of Natural Resources, With J.W. Patterson (1982).
- 29) "Microbiological Alterations in Water Quality in Distribution Systems and Granular Activated Carbon." Final Report to the US EPA. With M.A. Meyer et al. (1983).
- 30) "Incentives for the Treatment and Disposal of Hazardous Wastes by Alternative Methods." Report to the US EPA and the American Association for the Advancement of Sciences (1984).

- 31) "Wastewater Disinfection-A Review of the Technical and Legal Aspects in Illinois." Metropolitan Sanitary District of Greater Chicago, Department of Research and Development, Report 84-17 (1984). With C. Lue-Hing et al.
- 32) "Computer Applications to Chemical Equilibria in Modeling and Simulation of Aqueous Environment." Proceedings of the 2nd International Conference on Computer Aided Analysis and Design in Civil Engineering (1985). With V. Tare.
- 33) "Risks Associated with Viruses in Drinking Water", Proceedings of the Third Conference on Progress in Chemical Disinfection, p460-8 (1986), C.P. Gerba and C.N. Haas.
- 34) "Effects of Ceasing Chlorination on Selected Indicator Populations Downstream of Metropolitan Chicago's Major Wastewater Treatment Facilities", Metropolitan Sanitary District of Greater Chicago, Department of Research and Development, Report 87-17 (1987). With S. Sedita and C. Lue-Hing.
- 35) "Methods and Monitoring – Statistical Approaches", Chapter 20 in Drinking Water Microbiology: Progress and Recent Developments, G.A. McFeters[ed.], Springer-Verlag, New York (1990). C.N. Haas and B. Heller.
- 36) "Development and Testing of a Methodology to Identify, ex post facto, the Determinants of Remedial Actions at Superfund Sites", Center for Hazardous Waste Management, IIT/IITRI (1989). With G. Paulson et al.
- 37) "User Manual for the Computer Program WASTE (Waste Alternative Solutions to Evaluate) [and accompanying software]. Report to the Illinois Department of Energy and Natural Resources, J.W. Van Nortwick, C.N. Haas and R. Porter (1989).
- 38) "Editorial: Acting in the Face of Uncertainty", Journal of the Water Pollution Control Federation, 62, 2, 115 (1990).
- 39) Discussion on "Analysis of Inactivation of Giardia lamblia By Chlorine", Journal of Environmental Engineering, 115, 1, 1210-2 (1990).
- 40) "Editorial: Let's Surprise Rip Van Winkle", Research Journal of the Water Pollution Control Federation, 63, 5, 755 (1991).
- 41) "Demand Exceeds Supply for Environmental Engineers", Engineering Horizons, Fall (1992), pp27-28.
- 42) Invited Book Review, "Taste and Odor Problems Associated with Chlorine Dioxide", Environmental Progress,, 13(1):F10-11 (1994).
- 43) "The Risk of Over reliance on Risk Assessment", Water Environment Research, 67, 1, 3 (1995).
- 44) "Waterborne Diseases – Who is at Risk?", Proceedings of the 1994 AWWA Water Quality Technology Conference, II:57-71, CP Gerba, JB Rose and CN Haas (1995).
- 45) "Risk Assessment in Microbial Water Quality Criteria", Australian Water and Wastewater Association Journal, November/December, pps 18-20, CN Haas (1995).
- 46) "Microbial Risk Assessment: A New Tool in Water Quality Management", CP Gerba, JB Rose and CN Haas, Proceedings of the 6th International Conference for "Ecology and Environmental Quality", June/July 1996, Jerusalem.
- 47) "Linking Microbiological Criteria for Foods with Quantitative Risk Assessment", Chapter 14 in JJ Sheridan, RL Buchanan and TJ Montville (eds.), HAACP: An Integrated Approach to Assuring the Microbiological Safety of Meat and Poultry, Food and Nutrition Press, Trumbull CT (1996).
- 48) "Quantitative Microbial Risk Assessment for Reclaimed Water", Proceedings – WaterTech, 1996 Annual Conference of the Australian Water and Wastewater Association, Sydney, May 1996, pp254-260. CP Gerba, JB Rose and CN Haas.
- 49) "Microbial Risk Assessment: A New Tool in Water Quality Management", Preservation of Our World in the Wake of Change, (Y Steinberger, ed.), VIA/B:732-735 (1996).
- 50) "Main Disinfection – Why Do it the Way We Do?", Opflow, 22(9):1,4 (1996), GA Burlingame, CN Haas and WO Pipes.
- 51) "Viewpoint: Acceptable Microbial Risk", Journal of the American Water Works Association, 88(12):8 (1996), CN Haas.
- 52) "Risk Assessment of HIV in Wastewater Collection and Treatment Systems", CN Haas, pages 103-108, in HIV in Wastewater, WEF Monograph (C. Lue-Hing, P. Tata and L. Casson eds.), Alexandria VA (1999).
- 53) "Disinfection in the 21st Century", Journal of the American Water Works Association, 92(2):72-3 (2000), C.N. Haas.
- 54) "Editorial: Environmental Engineering and Bioterrorism?", Journal of Environmental Engineering, 128(5):397 (2002), C.N. Haas.
- 55) "Toxic and Contaminant Concerns Generated by Hurricane Katrina", The Bridge (published by the National Academy of Engineering), Spring 2006, p5-13, D.D. Reible, C.N. Haas, J.H. Pardue, and W.J Walsh.

56) "WATERS Network - Transforming the Way the United States Assesses Water Quality and Manages This Valuable and Threatened Resource", WATER21 (International Water Association), Paula Estornell, Charles N. Haas, Barbara Minsker, Jerald L. Schnoor and Jami L. Montgomery, April 2007..

## Student Advising

### Rensselaer Polytechnic Institute

Year	Degree	Student	Title
1979	M.Eng.	P.A. Sajous	Oxygen Uptake Rate as a Control of Activated Sludge Process
1979	M.Eng	E.C. Morrison	Altered Sensitivity to Chlorine in E. coli.
1980	M.S.	P.A. Hughes	Laboratory Investigation of the Activated Sludge Process with Alum Addition for the Removal of Trace Metals.
1980	M.S.	C.A. Weitz, Jr.	Ultraviolet Reactor Design Using Hydraulic Parameters.
1982	M.Eng.	M.A. Zapkin	Inactivation of Escherichia coli by Chlorine in the Presence of Various Additives.

### Illinois Institute of Technology

Year	Degree	Student	Title
1981	M.S.	L.M. Mele	Surface Water Hydrology of Coal Refuse Disposal Sites.
1982	M.S.	R. Garunas	Acid Waste Gas Biodesulfurization: An Alternative to Chemical Sulfur Recovery Processes.
1982	M.S.	K.A. Lavelle	Desulfobacter Biocatalyzed Reduction of Gypsum Wastes: Applications to Phosphoric Acid Manufacturing.
1983	M.S.	S.B. Karra	Kinetic Limitations on the Recovery of Metals From Wastewater by Precipitation.
1984	M.S.	K. Khater	Inactivation of Tetrahymena pyriformis By Monochloramine.
1984	M.S.	T. Jamrock	Effect of Time and Temperature on the E.P. Toxicity Test.
1984	M.S.	A. Wojtas	Inactivation of Tetrahymena pyriformis By Free Chlorine.
1984	M.S.	D.M. Brncich	The Determination of Stability Constants for Na, Li, and K Ion Pairs with Ocl
1984	M.S.	N. Horowitz	The Effect of Organic Ligands on the Adsorption of Cadmium Onto Kaolinite.
1984	M.S.	B. Kaplan	The Influence of Humic Acid on Solubility and Air-Water Partitioning of Toluene.
1984	M.S.	J. Macak	The Use of Coal Ash Mixtures as a Final Cover in the Reclamation of Landfills.
1985	M.S.	G. Vanderlaan	Feedstock Chemicals and the Hazard Ranking System Data Base.
1985	M.S.	M. Karalius	Inactivation of Escherichia coli by Chlorine in the Presence of K <sup>+</sup> and Li <sup>+</sup> Ions.
1985	M.S.	Robert Renaud	Investigation of Thiosulfate and other Dechlorinating Agents.
1985	M.S.	John Sheerin	Magnitude and Decay of Fecal Coliforms in Chlorinated and Non Chlorinated Wastewater Discharges.
1985	M.S.	J.R. O'Donnell	Spectrophotometric Determination of KD for the LiOCl, NaOCl and KOCl Ion Pairs.
1986	M.S.	Paul Bitter	Analysis of Five Nutrient Effects on the Growth of Microorganisms in the City of Chicago Drinking Water Supply.
1986	M.S.	Bon Mui	Distribution of Coliforms in Lake Michigan.
1986	M.S.	R. J. Vamos	Kinetics of Cadmium Complexation Reactions with Chloride and Hydroxide
1986	M.S.	C. D. Trivedi	Inactivation of Escherichia coli by Free Chlorine and Monochloramine in the Presence of Potassium Ions.
1986	M.S.	Andrew Kling	Energy Waste in Aeration Processes.

1986	M.S.	Angela Podesta	A Rapid Membrane Filter Technique For the Concentration of Plankton in Finished Drinking Water.
1987	M.S.	Paul Favara	Metal Removal in SBR Systems Treating Hazardous Waste Leachate.
1987	M.S.	H. D.-Markazi	Effect of Ethylene Glycol on Transport of Chloride thru Landfill Liner Material.
1988	M.S.	C. Brougnier	Co-Disposal of Plastics and Solvent Wastes as Residual Fuel.
1988	Ph.D.	K.V. Topudurti	Transfer of Chlorine from Monochloramines and Organochloramines to a THM Precursor.
1988	M.S.	Marc Bonem	Plant Deposition of Nitrogen Dioxide (co advised).
1990	Ph.D.	Yao Kouome	CSTR Microbial Inactivation by Free and Combined Chlorine.
1990	Ph.D.	C. Polprasert	Biological Sulfide Production for Heavy Metal Removal.
1990	Ph.D.	Richard Vamos	Binary and Ternary Equilibria of Cation Exchange.
1990	M.S.	Chi Lo	Assessment of Solid Waste Generation Patterns and Potential for Recycling on the IIT Campus.
1990	M.S.	P. Cunningham	Carcinogenic Risk Assessment: A Monte Carlo Study of Methods for Determining Confidence Limits on the Virtually Safe Dose
1991	Ph.D.	J. VanNortwick	Mixed Metal Precipitation
1991	M.S.	B. Bush	Carcinogenic Risk Assessment: Calculating Confidence Limits on the Virtually Safe Dose

### Drexel University

Year	Degree	Student	Title
1992	M.S. (Env. Sci.)	Bruce Stirling	Biological Responses to Mixtures
1993	M.S. (Env. Eng.)	Joel Hornberger	Development of a Standard Method for the Determination of Disinfection Effectiveness Against Giardia Cysts
1993	M.S. (Env.Eng.)	Uma Anmangandla	Regression Analysis of Disinfection Kinetics
1994	M.S. (Env.Eng.)	Sean Kersten	Analysis Of Binary Toxic Mixtures Using A Model Of Independence
1995	M.S. (Env. Eng)	Kaushik Cidambi	Analysis Of Binary Toxic Mixtures Using A Generalized Additivity Model
1995	M.S. (Env.Eng)	Chris Crockett	Determination of Sources and Impacts of Giardia and Cryptosporidium in a Major Metropolitan Watershed
1996	PhD (Env Eng)	Jin Anotai	Effect of Calcium Ion on Chemistry and Disinfection Efficiency of Free Chlorine at pH 10
1996	M.S. (Env.Eng.)	Shubhangi Desai	Kinetics of Inactivation of G. muris by Monochloramine
1996	M.S. (Env.Eng.)	Aamir M Fazil	A Quantitative Risk Assessment Model for Salmonella
1996	M.S. (Env.Eng.)	R.B. Chitluru	Chlorination Kinetics for Water Main Associated Organisms
1996	M.S. (Env Sci)	J.L. Gambetese	Fate Modeling of Organic Compounds in Wastewater Treatment Plants: A Comprehensive Analysis of WATER7 and WATER8
1996	Ph.D.(Env Eng)	James Hagan	An Examination of Acute Environmental Toxicity of Pharmaceutical Compounds Using Quantitative Structure-Activity Relationships
1996	M.S. (Env Eng)	Josh Joffe	Data Analysis for Disinfection Kinetics Modeling.
1997	M.S. (Env Eng)	Joe Nattress	Benchmarking Giardia and Cryptosporidium Inactivation at the Philadelphia Water Department
1998	M.S. (Env Eng)	Dhumal Aturaliye	Electroporation Assisted Disinfection of Giardia and Cryptosporidium
1998	M.S. (Env Sci)	Aadithya Thayyar-Madabusi	A Quantitative Risk Assessment Model for Listeria monocytogenes and Escherichia coli O157:H7.
1999	Ph.D. (Env. Eng)	Mukul Gupta	Epidemiological Modeling of Waterborne and Foodborne Outbreaks

1999	MS (Env Eng)	Kathy French	Modeling Cryptosporidium Removal in Drinking Water by Physical Processes
1999	MS (Env Eng)	Chad Pindar	Clostridium perfringens as an Indicator for Cryptosporidium During Electroporation Assisted Disinfection
1999	MS (Env Eng)	Paul Batman	Water matrix effects on protozoan inactivation in chlorine-chloramine disinfection processes
1999	MS (Env Eng)	Dora D'Andrea	Inactivation efficiency of Mycobacterium by free chlorine
1999	MS (Env Sci)	Joseph Dmochowski	Benchmarking and modeling the inactivation of Legionella pneumophila using chlorine and chloramines
2000	MS (Env Eng)	Jason Sites	Analysis of Giardia Inactivation and Cryptosporidium Viability/Infectivity Assays in Various Disinfection Schemes
2001	PhD (Env Eng)	Paula R. Klink	Ion exchange on a chelating resin: multicomponent equilibrium predictions using binary data
2002	MS (Env Eng)	Jason Marie	Use of Microbial Risk Modeling to Determine the Benefit of Topical Antimicrobial Products
2002	PhD (Env Eng)	Dennis Greene	Numerical Simulation of Chlorine Disinfection Processes in Non-Ideal Reactors
2003	PhD (Env Eng)	Baris Kaymak	Effect of Initial Microorganism Concentration on Disinfection Efficiency by Chlorine.
2004	PhD (Env Eng)	Lijie Li	Effects of Initial Microbial Density on Disinfection Efficiency in a Continuous Flow System and Validation of Disinfection Batch Kinetics in a Continuous Flow System
2004	PhD (Env Eng)	Christopher Crockett	The Concentration and Resuspension of Cryptosporidium Oocysts by Sediments
2005	MS (MechE)	Sankalp Soni	Simulation of Contaminant Dispersal in An Apartment Building” (co-advised with Baki Farouk)
2005	PhD (Env Eng)	Thomas W. Armstrong	A quantitative microbial risk assessment model for human inhalation exposure to Legionella
2006	PhD (EnvEng)	Timothy A. Bartrand	High-Resolution Experimental and Numerical Analysis of Fine Bubble Ozone Contactors (co advised with Baki Farouk)
2006	MS (EnvEng)	Bishel B. Baby	A Dose-Response Analysis for Plague bacterium: Yersinia pestis
2007	PhD (EnvEng) (co advised)	Lynn A Arlauskas-Dekleva	1-Hydroxyanthraquinone: Activity in Paracoccus denitrificans and Potential Application for Biomass Reduction in Wastewater Treatment Facilities.
2008	MS (Env Eng)	Robert Praga	Water exposure and health impacts of recreational waters in an urban watershed
2009	PhD (EnvEng)	Joanna M. Pope	Tracking the Sources of Fecal Contamination in the Wissahickon Creek Watershed using Phenotypic and Genotypic Analytical Methods
2009	PhD (EnvEng)	Mark Weir	Development of Physiologically Based Pathogen Transport and Kinetics Model for Inhalation of Bacillus anthracis Spores
2010	PhD (EnvEng)	Shamia Hoque	Development of Computational Fluid Dynamics based Multiple Linear and Neural Network Metamodels for Bioaerosol Fate and Transport in Indoor Environments
2010	PhD (EnvEng)	Paula Estornell	Sustainable Development: Which Policy Process - Autocratic or Democratic- Leads to More Durable Policy and Environmental Outcomes?
2010	PhD (EnvEng)	Yin Huang	Incorporating Time to Response into Dose-Response Models Used in Quantitative Microbial Risk Assessment
2011	PhD (EnvEng)	Sushil Tamrakar	Dose-Response Models of Rickettsiae and Other Biological Agents of Concern
2011	MS (EnvEng)	Adam Erispaha	Modeling of Trihalomethane Formation Based on Consensus of Existing Empirical Models

## Student Research In Progress at Drexel University:

Degree	Student	Topic
PhD (Env Eng)	Russell Green (2002-)	Biologically Assisted Corrosion
PhD (EnvEng)	Michael Ryan (2008-)	Microbial Source Tracking
PhD (EnvEng)	Neha Sunger (2008-)	Recreational Water Risk Assessment
PhD (EnvEng)	Bidya Prasad (2011-)	Microbial Risk Assessment
PhD (EnvEng)	Kerry Hamilton (2011-)	Microbial Risk Assessment

## **Teaching Experience**

### Rensselaer Polytechnic Institute

#### Undergraduate

Unit Processes  
Thermodynamics  
Environmental Engineering Laboratory  
Chemistry for Environmental Engineers

#### Graduate

Advanced Aquatic Chemistry  
Biological Treatment

### Illinois Institute of Technology

#### Undergraduate

Water & Wastewater Treatment  
Introduction to Environmental Engineering

#### Graduate

Environmental Chemistry  
Biochemical Engineering  
Physical Treatment  
Sanitary Design  
Hazardous Waste Engineering  
Industrial Waste Treatment Criteria  
Groundwater Contamination  
Data Analysis

### Drexel University (\* - Undergraduate Course)

#### Undergraduate

Environmental Engineering I  
Unit Operations Laboratory  
Reaction Kinetics & Mass Transfer  
Bioterrorism (Special Topics)  
Professional Practice in Environ. Eng.  
Environmental Engineering Laboratory I, II  
Introduction to Environmental Engineering  
Water & Wastewater Design III

#### Graduate

Unit Operations: Biological  
Chemistry of the Environment  
Risk Assessment  
Advanced Environmental Chemistry  
Unit Operations: Physical-Chemical  
Topics in Environmental Engineering  
Hazardous Waste & Groundwater Treatment  
Biostatistics  
Environmental Impacts  
Sanitary Microbiology

### Service on External Graduate Student Committees

Alexa Oblensky, University of North Carolina at Chapel Hill, Department of Environmental Science and Engineering (advisor – Phil Singer), 2002-present.

Benjamin Tanner, University of Arizona, Department of Soil, Water and Environmental Sciences (advisor – Ian Pepper), 2003-2004.

James Brooks, University of Arizona, Department of Soil, Water and Environmental Sciences (advisor – Ian Pepper), 2003-2004.

Domenico Santoro, Polytechnic of Bari at Taranto (Italy), Faculty of Environmental Engineering (external examiner and collaborator; advisor – Lorenzo Liberti), 2004-2005.

### Post-Doctoral Scholars Advised

Vinod Tare (PhD – IIT Kanpur) – 1985-87  
Timothy Bartrand (PhD – Drexel Univ.) – 2007-8  
Sharon Nappier (PhD – Johns Hopkins) – 2008 – 2009  
Toru Watanabe (Japan Society for Promotion of Science sponsored; PhD Tohoku Univ.) – 2008-2009  
Sondra Teske (PhD – Univ. of Arizona) – 2009 --

## **Professional Activities**

### Editorial Boards

Founding Editor in Chief - Quantitative Microbiology (Kluwer), 1998-2001  
Applied and Environmental Microbiology (Editorial Board, 1988-1994)  
Water Environment Research (Board of Editorial Review, 1989-1995; Chair 1991-1995)  
Ozone Science & Engineering (Editorial Board, 1999 - 2001)  
Journal of Medical Risk (Editorial Board, 2003-)  
Risk Analysis (Associate Editor – Microbial Risk, 2006-)

### Panels and Seminars Chaired

Organized and Chaired a Seminar on "Mode of Action of Halogen Disinfectants Used in Water and Wastewater Treatment" at the Annual Meeting of the American Society for Microbiology, Dallas, March, 1981.  
Organized and Chaired a Session on "Disinfection and Chemical Oxidation" at the Annual Meeting of the American Institute of Chemical Engineers, New Orleans, November, 1981.  
Organized and Chaired a Session on "Potpourri: Industrial and Toxic Wastes" at the National Meeting of the American Institute of Chemical Engineers, Cleveland, August, 1982.  
Organized and Co-Chaired a Session on "Recovery of Metal Values From Industrial Wastes" at the National Meeting of the American Institute of Chemical Engineers, Denver, August 1983.  
Invited Chairman on "Disinfection of Wastewater Effluents" NSF State of the Art Conference on Disinfection of Wastewater Effluents and Sludges, Miami, May 1984.  
Organized and Chaired a Preconference Workshop on "Alternative Wastewater Disinfection Processes: Design and Operation", WPCF, Los Angeles, October 1986.  
Organized and Chaired a Preconference Workshop on "Emerging Issues in Effluent Disinfection", WPCF Preconference Workshop, Philadelphia, October 1987.  
Co-Organized and Co-Chaired a Preconference Seminar on "Practical Experience with Ozone for Organics Control and Disinfection", AWWA, Cincinnati, June 1990.  
Co-Organized and Co-Chaired a Preconference Seminar on "Water Quality Changes from Chloramination", AWWA, Philadelphia, June 1991.  
Co-Organized and Co-Chaired a Preconference Seminar on "Meeting Disinfection Byproducts Standards", AWWA, Vancouver, June 1992.  
Organized opening general session, "When is Wastewater Disinfection Necessary?" at WEF Specialty Conference on Wastewater Disinfection, Whippany NJ, May 1993.  
Co-Organized Preconference Seminars on "Disinfection: The New Basics" and "When is Groundwater Disinfection Necessary", AWWA, June 1993, San Antonio.  
Co-Organized Symposium on "Microbial Risk Assessment in Water and Food" at the Annual Conference, Society for Risk Analysis, Savannah GA, December 1993.  
Organized a Workshop on Microbial Risk Assessment of Food, Society for Risk Analysis, Washington DC, December 1997.  
Co-Organized Disinfection Specialty Conference, Water Environment Federation, Baltimore MD, April 19-22, 1998.  
Program Committee, AWWA/IWSA Conference "Protecting Water Quality in the Distribution System: What is the Role of Disinfectant Residual", Philadelphia, April 26-28, 1998.

Organized NSF supported expert workshop on Advancing the Quality of Water (AQWA), Chapel Hill NC, March 10–12, 2004.

Co-Organized WEF/AWWA/IWA Disinfection Specialty Conference, Pittsburgh PA, February 4-7, 2007

### Professional Society Activities

American Society of Civil Engineers,

Environmental Engineering Division.

Member, Task Committee on Disinfection Risk Assessment 1981-1985.

Water Supply and Resource Management Committee

Chairman, Task Committee on Control of Microbes in Drinking Water, 1989-90

Member, Executive Committee, Department Heads Council (2011-)

American Water Works Association

Member, Research Division Committee on Disinfection, 1980-1992.

Member, Water Quality Division Committee on Disinfection, 1982-present.; Chairman, 1989-1994

Member, Water Quality Division Committee on Organisms in Water, 1983-1987.

Member, Water Quality Division Committee on Status of Waterborne Diseases in the US and Canada, 1987-1995

Member, Student Activities Committee, 1984-1990.

Illinois Section Student Activities Committee, Member, 1981-1990; Chairman, 1983-1986.

American Water Works Association Research Foundation (AWWARF)

member, various project advisory committees (1993-current)

Association of Environmental Engineering and Science Professors

Chairman, Committee to revise recruitment brochure, 1981-1983.

Member, Board of Directors, 2001-2004

Treasurer and Member of the Executive Committee, 2002–2004

Chairman, Conference Planning Committee, 2003-present

International Water Association

USA National Committee

delegate (from ASM) 1988-2000.

Chairman 1994 - 2000

Chairman, USANC Membership Committee, 1991-1993.

Program Committee for 1998 (Vancouver), 2000 (Paris), 2001 (Berlin) and 2002 (Melbourne) Conferences, 1996-2001.

Water Environment Federation

Director-at-Large, 2004-2006.

Member, Research Committee, 1978-1982.

Member, Research Committee Task Force on Toxic Substances, 1980-1982.

Member, Committee on Disinfection, 1980-1988, 1991-present.

Vice-Chairman, 1982-1985.

Chairman, 1985-1988.

Member, Research Symposium Subcommittee of the Program Committee, 1984-1986.

Member, Illinois Association Student Activities Committee, 1981-1990.

Member, Technical Practices Committee Task Force on Disinfection, 1982-1985.

Chairman, Specialty Conference Planning Committee: Microbial Aspects of Surface Water Quality, 1988-1989.

Member, Board of Editorial Review for the Research Journal, 1989-1995.

Chairman, 1992-1995.

Co-Chairman, Third Specialty Conference on Disinfection (Baltimore, April 1998)

Water Environment Federation Research Foundation

member, Project Subcommittee (UV Disinfection) - Sept 1996-1998

member, Project Subcommittee (Water Reuse) - Oct. 1997-2001

member, Board of Directors – 2006-

Standard Methods for the Examination of Water and Wastewater

Chairman, Joint Task Group on Chlorine Residual, 1984-1992.

Member, Joint Task Group on Chlorine Demand, 1988-1994.

Society for Risk Analysis, Councilor (member, Board of Directors), 2000–2003  
American Association for the Advancement of Science, Division Y (General Interest)  
Electorate Nominating Committee (2002-2005).  
Chair-Elect (2008-9)  
Chair (2009-2010)  
American Society for Microbiology  
Public and Scientific Affairs Board, Committee on Environmental Microbiology, Member (2003-)

### Continuing Education Programs

Seminar on Current Topics in Water Supply, New York State Section of the American Water Works Association, Ossining, NY, November, 1980.  
Limiting Liability for Hazardous Wastes, a continuing education program for lawyers, sponsored by the Chicago-Kent College of Law, Chicago, November, 1981, was also a member of the program Steering Committee.  
WPCF Preconference Workshop on Wastewater Disinfection Alternatives, Atlanta, October 1983, Co-organizer and participant.  
University of Wisconsin-Milwaukee, Engineering Extension. Disinfection of Water and Wastewater, May 1984.  
WPCF Preconference Workshop on Disinfection Risk Assessment, New Orleans, September 1984, Co-organizer and participant.  
University of Wisconsin-Milwaukee, Engineering Extension. Disinfection of Wastewater, May 1985.  
University of Wisconsin-Milwaukee, Engineering Extension. Wastewater Pretreatment and Toxicity Control, March, 1986.  
University of Wisconsin-Milwaukee, Engineering Extension. Disinfection of Water, June 1986.  
WPCF Preconference Workshop on Design and Operation of Alternative Disinfection Systems, Los Angeles, October, 1986, Organizer and participant.  
WPCF Preconference Workshop on Emerging Issues in Effluent Disinfection. Philadelphia, October, 1987, Organizer and participant.  
WPCF Specialty Conference on Microbial Aspects of Surface Water Quality, Chicago, May 1989, Organizer.  
WPCF Preconference Workshop on Changing Standards for Effluent Disinfection, San Francisco, October 1989.  
California Business Law Institute, Environmental Regulation in Illinois, participant, November 1989.  
University of Wisconsin-Madison, Engineering Extension. Disinfection of Wastewater, October 1989, October 1990.  
University of Wisconsin-Madison, Engineering Extension. Disinfection of Water, November 1989.  
International Association of Milk, Food and Environmental Sanitarians, Co-Organized Workshop on Microbial Risk Assessment of Foods, Pittsburgh, July 1995.  
WEF Specialty Conference on Disinfection, Baltimore MD, April 1998, co-organized.  
AWWA/IWSA Symposium on Disinfection Residuals, Philadelphia PA, April 1998, member - planning committee.

## **University Service**

### Rensselaer Polytechnic Institute

RPI Department of Chemical and Environmental Engineering Committee on Graduate Students, Member, 1978-1981.  
Planning Committee for the UPS Conference, RPI Fresh Water Institute, 1979.  
Member, RPI Biohazard Safety Committee, 1979-1981.  
Advised RPI Safety Manager on Chemical Waste Disposal Practices, 1980-1981.

### Illinois Institute of Technology

Member, IIT Graduate Study Committee, 1981-90.  
Chairman, Departmental Faculty Search Committee, 1982-1984, 1987, 1990.  
Member, Armour College Committee on Promotion and Tenure, 1984-1986.  
Member, Institute Library Planning Committee, 1983-88.  
IIT Faculty Senate, Recording Secretary, 1984-1986.  
Corresponding Secretary, 1987-1988.

Member, New Business Committee, and IIT Projects Manager, Center for Hazardous Waste Management, 1987-89.  
Member, Search Committee for Dean of Armour College of Engineering, 1987-1988.  
Member, Department Chairman Search Committee, 1988-9.  
Member, IIT Faculty Council, 1989-90  
Chairman, Academic Affairs Committee, 1989-90

## Drexel University

### **University**

#### Faculty Senate

Member 1991-1992, 1994-1997

Vice Chair, 1994-1995

Chair, 1995-1996

Member, University Appeals Committee, 1991-94

Member, Search Committee for Associate Director of Enrollment Management (Graduate/Part Time), 1992

Chairman, University Biosafety Committee, 1996-1998.

University Assessment Committee (preparation for Middle States visit), 1998-2001

Member

Co-chair, Research & Graduate Task Force

Chairman, Search Committee for a Director of SESEP, 2000-2002

Member, Law School Development Committee, 2004-5.

Co-Director, Drexel Engineering Cities Initiative (DECI), 2008-present

Member, Vice Provost for Research Search Committee, 2009-10

Member, Academic Excellence Award Committee, 2009-10

### **College/School**

Chairman, BS Environ. Eng. Curriculum Development Committee, 1993.

Chairman, Environmental Policy Faculty Search Committee, 1997.

Member, The Drexel Engineering Curriculum Revision Committee, 2005-2007.

### **Department**

Chairman, Environmental Studies Institute Curriculum Committee, 1991-1994

Chairman, Civil and Architectural Engineering Department Graduate Committee, 1991-1992

Member, Civil and Architectural Engineering Department Committee on Laboratory Renovation, 1993-4.

Member, Search Committee, Architectural Engineering Faculty, 1993-1994.

Member, Search Committee, Environmental Engineering Faculty, 1996.

Member, Search Committee, Environmental Chemistry Faculty, 1993-1994, 1996

Chairman, SESEP Faculty Search Committee, 1997-1998.

Chairman, SESEP Curriculum Committee, 1999-2002

Chairman, ABET Preparation for Initial BS EnvE Accreditation, 1999-2002

Chair, Midterm Review Committees for Assistant Professors Lordgooei and Wartman, 2002.

Member, Departmental Promotion Committee for Associate Professor Welty, 2002.

Member, Department Head Search Committee, 2002-2003.

Member, CAEE Department Undergraduate Curriculum Committee, 2002-2005

Member CAEE Department Graduate Committee, 2003-2005

Chair, CAEE Department Faculty Search Committee, 2003-2004

## **Consulting Activities**

Energy & Resource Recovery Corporation (Subsidiary of Alpha Portland Industries)--performed a regulatory analysis and preliminary feasibility study for the use of hazardous wastes and spent solvents as supplemental fuel in cement kilns, 1979.

New York State Department of Civil Service - served as a member of oral examination panels for the positions of Associate Sanitary Engineer and Associate Air Pollution Control Engineer, March through May, 1981.

Patterson Associates, Inc.

--preparation of a state-of-the-art report on hazardous wastes in Illinois, Illinois Institute of Natural Resources, May through October, 1981.

--determination of hazardous waste production potential and management options for the forging industry, June through October, 1981.  
 --analysis of a the waste management profile for a large, privately held, conglomerate, November, 1986.  
 K.A. Steel Chemicals, Inc. --preparation of a technical document and testimony against the proposed changes in the Illinois wastewater fecal coliform standards, October 1981 through February, 1982.  
 PEER Consultants, Inc. -- reviewed draft US EPA report entitled "User Guide for Evaluating Remedial Action Technologies." August, 1982.  
 Waste Management, Inc. --Prepared testimony on the need for additional hazardous waste disposal capacity in Will County, Illinois, October, 1982.  
 Katz, Friedman, Schur and Eagle/United Auto Workers-- evaluation of technical documents relating to environmental impact of cooling water discharge at Quad Cities/Cordova Generating Station, June 1983-ongoing.  
 Bituminous Insurance Companies--evaluation of possible mechanisms for failure of the Galesburg, IL anaerobic digester, November 1984-1985.  
 Metropolitan Sanitary District of Greater Chicago--preparation of oral and written civil service examination materials and service on oral examination panels, 1981-1990.  
 Battelle Columbus Laboratories -- peer review of a document on feasibility of risk assessment for sludge management. August, 1985.  
 Hydrite Chemical Co.--Preparation of expert testimony on changes in wastewater bacteriological standards in the State of Wisconsin, December 1985 - March, 1986.  
 US EPA (Region VIII) -- Advised on the efficiency of and the means to improve disinfection and dechlorination at the Metro Denver Wastewater Treatment Plant, March 1986.  
 East Bay Municipal Utility District (Oakland, CA) -- Serve as a technical advisor on the design of an innovative stormwater overflow disinfection system, August 1986-April 1987.  
 E & E Hauling, Inc. -- Advised on environmental impact of an asphalt hot melting facility, January 1987.  
 Confidential client -- Advised on the feasibility of a proposal for a new solid waste disposal facility, March, 1987.  
 Peat Marwick Main, Inc. -- Preparation of examination questions for wastewater treatment plant operational personnel, November, 1987.  
 Metropolitan Waste Systems, Inc.  
 -- Preparation of testimony on need for solid waste disposal capacity in La Salle County, IL, March - May, 1988, January-May, 1989.  
 -- Assessment of need for a solid waste transfer station in Blue Island, IL. January 1989.  
 Madison (WI) Metropolitan Sanitary District -- Review of Petition for Disinfection Waiver and presentation of supporting testimony, August, 1988-February, 1989.  
 US EPA (Region IX)/US Department of Justice -- Expert witness regarding removal of pathogens and trace pollutants by secondary treatment processes (US and California vs. City of San Diego), October 1989 - February 1991.  
 James M. Montgomery Engineers -- Statistical evaluation of disinfection byproduct data, February 1990 - September 1990.  
 Land and Lakes Co. -- Assessment of need for additional solid waste disposal capacity in Will County, IL. December 1989 - November 1990.  
 Chlorine Institute -- preparation of review on chlorine fate in freshwater systems as part of FIFRA reregistration application, July-August, 1990.  
 Wade Miller and Associates, Inc., Cadmus Inc. -- Provided input and assistance in development of disinfection byproduct regulatory analysis in drinking water, July 1991 - 1998.  
 City of Philadelphia - Department of Personnel -- Served on Oral Examination Panel for Water Treatment Engineer, March 1993.  
 Miller, Cassidy LaRocca and Lewin; Carr Goodson and Lee; Elzufon Austin and Drexler - Expert witness on chlorination practices in water treatment (Hoechst Celanese et al. v. National Union et al.; Delaware Chancery Court), 1991-1994.  
 Montgomery Watson Engineers - Technical Advisory Panel Member, Multiclient Study on Disinfection of Cryptosporidium in Drinking Water, 1995-1999.  
 Carollo Engineers - Microbial Criteria Development for a Water Treatment Plant, including consideration of recycle streams and Cryptosporidium, 1996-1997.  
 Procter and Gamble Co.-Evaluate Beneficial Effects of Anti-Microbial Preparations, 1997-1999.  
 Procter and Gamble Co.-Analyze Kinetics of Algal Growth on Inhibitory Substrates, 1998-1999.

Holland & Knight - provide expert report and testimony regarding water and wastewater treatment (US and State of Maryland vs. Mayor and City Council of Baltimore), 1998-1999.

US Department of Justice - provide expert analysis on impact of sewage discharges on water quality (US vs. Penn Hills), 1998.

CDM, Inc. and Massachusetts Water Resources Authority - advise on novel integration approaches to evaluating disinfection "ct" values, 1998.

Foley, Hoag and Eliot (counsel for Massachusetts Water Resources Authority) -- expert in defense (US vs. Mass. Water Resources Authority) regarding necessity for filtration, 1999-2000.

Black and Veatch - Technical review and resource panel, Las Vegas Alternative Discharge Study, 2000.

McDermott, Will & Emery and Bayer Agricultural - Assistance with comments on proposed FDA withdrawal of use of fluoroquinolones in poultry rearing, 2001-2003.

Linowes And Blocher/Holland and Knight - Assistance with permit issues on limestone mining (potential groundwater impacts) in Miami-Dade, Florida, 2001-2004.

Alston and Bird - Provide expert support in administrative proceeding on behalf of Gwinnett County GA regarding defense against petition to deny effluent discharge permit modifications. (Lake Lanier Association et al. v. Georgia Environmental Protection Division). 2001-2002.

US Department of Justice - provide expert analysis on impact of microbial water quality on worker risks (John G. Abbott et al. vs. U.S.). 2002-2004.

Foley, Hoag and Eliot (counsel to Portland Water Bureau) – advise on regulatory issues relating to the Long Term 2 Enhanced Surface Water Treatment Rule, 2006.

Metropolitan Water Reclamation District of Greater Chicago (via CTE Engineers) – provide assistance with respect to regulatory proceedings on surface water quality and disinfection criteria, 2007-.

Hurvitz & Waldman – provide expert support in defense of litigation involving Legionella and drinking water, 2008-11.

US Department of Justice – provide expert analysis in criminal enforcement case under the Clean Water Act, 2011-

CDM, Inc. – Provide technical assistance regarding compliance with *Cryptosporidium* standards in Portland, OR, 2011-

## **Membership in Advisory Bodies**

External Thesis Examiner, Indian Institute of Technology, Kanpur, 1979, 1981, 1983, 1993, 1996.

Chaired peer review panel to review the research program on "Microbial Degradation in Distribution Systems" for US EPA, June 1983.

Member, State of Illinois Hazardous Waste Task Force, 1983-4.

Member, US EPA peer review panel to review work on microbial inactivation in drinking water disinfection, March 1986.

Member, US EPA peer review panel to review program on risk assessment from microorganisms in wastewater sludges, April 1986.

Invited ad hoc reviewer for the Drinking Water Subcommittee, US EPA Science Advisory Board, June 1987.

Assisted in preparation of resource document on wastewater disinfection, US EPA, 1988.

Member, peer review panel, Oklahoma Council on Science and Technology, 1989.

Member, study section, National Institute of Environmental Health Sciences, 1991, 1994.

Invited Participant, Workshop on the Methodology for Deriving National Ambient Water Quality Criteria for the Protection of Human Health, US EPA -- Office of Science and Technology, September 1992.

Member, City of Philadelphia, Department of Health, Advisory Committee on Cryptosporidium, October 1995-1999.

Member, Panel on Augmentation of Potable Water Supplies with Reclaimed Water, National Academy of Sciences, Water Science and Technology Board, 1996-1998.

Invited Participant, Workshop on Microbial Risk Assessment, hosted by NAS Committee to Review New York City Watershed Management Strategy, April 1998.

Member, Committee to Review New York City Watershed Management Strategy, National Academy of Science, Water Science and Technology Board, 1998-99.

Member, Oversight Steering Committee and Statistics Panel, EPA-George Washington University Cooperative Agreement on Risk Assessment, 1999-.

Member, Committee on Drinking Water Contaminants, National Research Council Water Science and Technology Board, 1999-2001.

Invited Participant, Consultation on "Harmonised Risk Assessment for Water-Related Microbiological Hazards",

World Health Organization, Stockholm, Sweden, September 12-16, 1999.

Invited Participant, World Health Organization and Food and Agricultural Organization, joint workshop on "Hazard Characterization of Pathogens in Food and Water", Bilthoven, The Netherlands, June 13-18, 2000.

Member, Committee on Toxicants and Pathogens in Biosolid Fertilizers, National Research Council, Board on Environmental Studies and Toxicology, 2001-2002.

Member, review team for the Environmental Pollution Control MS Program, Pennsylvania State University, March 2001.

Honors examiner, Swarthmore College, May 2001.

Member, Committee on Indicators for Waterborne Pathogens, National Research Council, Board on Life Sciences, 2002-2003

Member, Panel to Review EPA Research Plan on Water Security, National Research Council, Water Science and Technology Board, 2003-.2004

Member, Committee on Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents: How Clean is Safe? National Research Council, Board on Life Sciences, 2003-2005.

Member and Vice Chair, Committee on Public Water Distribution Systems: Assessing and Reducing Risks. National Research Council, Water Science and Technology Board, 2004-2006.

Member, Water Science and Technology Board (WSTB), National Research Council, 2004-2010.

Member, Committee on Water System Security, National Research Council, Water Science and Technology Board, 2004-2006.

Member, US EPA Board of Scientific Counselors Executive Committee, 2007-current.

Member, National Research Council Committee on Assessment of Water Reuse as an Approach for Meeting Future Water Supply Needs, 2008-2011.

Chair, National Research Council Committee on Evaluation of the Health and Safety Risk Analyses for the Planned Expansion of USAMRIID's Biosafety Level 3 and 4 Laboratories at Fort Detrick, Maryland, 2009-2010.

Member, US EPA Science Advisory Board Augmented Committee on Ecosystem Services and Processes to Provide Advice on Ballast Water Management, 2010-1.

Chair, National Research Council Committee on Assistance to the U.S. Army Medical Research and Materiel Command with Preparation of a Risk Assessment for the Medical Countermeasures Test and Evaluation (MCMT&E) Facility at Fort Detrick, MD, 2011-

November 2, 2011

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- Walter Jakubowski

February 2014

## CURRICULUM VITAE

NAME: Walter Jakubowski

PHONE: 509-448-3535

Email: waltjay@yahoo.com

ADDRESS: 4511 E. 42<sup>nd</sup> Avenue  
Spokane, WA 99223-1590 USA

### EDUCATION:

Brooklyn College of Pharmacy, Long Island University, Brooklyn, N.Y. Attended from 9/57 to 6/61

B.S. cum laude in Pharmacy Awarded June 1961

Oregon State University, Corvallis, Oregon

Attended from 9/66 to 6/68

M.S. in Microbiology Awarded June 1969

University of Minnesota, Minneapolis, Minnesota

Attended Graduate Summer Session June and July, 1977

Completed coursework in Fundamentals of Epidemiology and Fundamentals of Biostatistics; Certificate awarded

University of Minnesota, Minneapolis, Minnesota

Attended Graduate Summer Session June and July, 1979

Completed coursework in Epidemiology of Infectious Diseases and in Clinical Trials; Certificate awarded

### EXPERIENCE (Dates, employers, position title, and area of work, USPHS Commissioned Officer grade):

07/97- Present

Owner, WaltJay Consulting, Spokane, WA USA.  
Clients have included: U.S.E.P.A.; Science Applications International Corporation; GF Craun & Associates; Pfizer Ltd.; Versar, Inc.; Lovelace Clinic Foundation; Cadmus, Inc.; P&G; ICFI Consulting, et al.

02/94 – 07/97

U.S.EPA, AWBERC,NERL, Human Exposure Research Division, Cincinnati, Ohio 45268 - EPA Director, Technical Advisor. In a Division with about 50 staff members, provide expertise and

- conduct research on microorganism methods, occurrence and significance in the environment.  
Grade: CO-06
- 08/88 – 02/94 U.S. EPA, AWBERC, EMSL, Microbiology Research Division, Cincinnati, Ohio 45268 - Chief, Parasitology & Immunology Branch. Supervise 5-7 people in a research program on parasitic contaminants of water, wastewater and sludge, and on immunological methods for the detection and identification of environmental contaminants.  
Grade: CO-06
- 10/81 - 08/88 U.S. EPA, AWBERC, HERL, Toxicology & Microbiology Division, Cincinnati, OH 45268 - Chief, Parasitology & Immunology Section. Supervise research on health effects/microbial contaminants in water and wastewater; supervise 5-7 people in projects dealing with protozoa, helminths and immunology; project officer on extramural studies of health effects associated with water supplies and irrigation of wastewater.  
Grade: CO-06
- 09/76 - 10/81 U.S. EPA, ERC, HERL, Cincinnati, Ohio 45268 Chief, Bacterial & Parasitic Diseases Group. Supervise a research program on health effects of microbial contaminants of water and wastewater; supervise 5-7 people in projects dealing with bacteria, viruses, and protozoa; project officer on extramural studies of health effects associated with water supplies and wastewater treatment and disposal.  
Grade: CO-05
- 06/73 - 09/76 U.S. EPA, ERC, HERL, Cincinnati, Ohio 45268 Virologist. Improve and evaluate methods for concentrating and detecting human enteric viruses in drinking water.  
Grade: CO-05
- 06/68 - 06/73 U.S. EPA, NWW SRL, Gig Harbor, Washington Virologist. Develop methodology for concentrating and detecting human enteroviruses in drinking and estuarine waters; maintain tissue culture laboratory.  
Grade: CO-04
- 08/66 - 06/68 DHEW, USPHS, WSSR, NCUIH, Corvallis, Oregon - Microbiologist (Student). Complete requirements for obtaining a Master of Science degree in microbiology. Conduct thesis

research on adsorption of poliovirus by marine silt and clay in estuarine water.

Grade: CO-04

09/64 - 08/66

DHEW, USPHS, PNW Shellfish Sanitation Laboratory, Gig Harbor, Washington - Research Microbiologist. Conduct studies on accumulation and elimination of bacteria and bacterial viruses by oysters and clams.

Grade: CO-03

08/62 - 09/64

DHEW, USPHS Hospital, San Francisco, California -Staff Pharmacist. Manufacture, prepare, and dispense pharmaceutical preparations for hospital inpatients and outpatients.

Grade: CO-03

07/61 - 08/62

DHEW, USPHS Hospital, Norfolk, Virginia - Pharmacy Intern. Became familiar with all phases of PHS hospital pharmacy; manufacture, prepare, and dispense pharmaceuticals for hospital inpatients and outpatients.

Grade: CO-01

#### PROFESSIONAL MEMBERSHIPS:

American Society for Microbiology  
American Water Works Association  
International Water Association

#### COMMITTEES AND BOARDS:

APHA Water and Wastewater Committee, 1984  
Chairman, Sec. 912 - Pathogenic Microorganisms Joint Task Group, APHA Standard Methods, 16th and 17th Edition  
Chairman, Sec. 9711 - Pathogenic Protozoa Joint Task Group, APHA Standard Methods, 18th Edition, 1990-92  
Member, Sec. 913 Viruses JTG, APHA Standard Methods, 15-17<sup>th</sup> Eds.  
Pathogenic Suite Committee, USEPA, 1976-1986  
WPCF Safety and Health Committee, 1985-1987  
Pathogens Equivalency Committee, Office of Water, USEPA, 1986-1997  
Microbiological Methods Manual Steering Committee, 1987-1995  
Chairman, ASTM Section on Pathogenic Protozoa, Committee D.19 on Water, 1987-1997  
Chairman, ASTM Section on Helminths, Committee D.19 on Water, 1992-94  
Member, Sec. 9060, Samples JTG, APHA Standard Methods, 18th Ed., 1990-92  
Editorial Board, International Journal of Environmental Health

Research, 1990-present  
Member, Organisms in Water Committee and Waterborne Disease  
Outbreaks Subcommittee, American Water Works Association, 1990-1994  
Publications Board Member, American Public Health Association, 1992-1997  
Chair, Sec. 9711-Pathogenic Protozoa JTG, APHA Standard Methods, 20<sup>th</sup>  
Edition, 1995-1999  
Chair, Sec. 9711-Pathogenic Protozoa JTG, APHA Standard Methods, 21<sup>st</sup>  
Edition, 1999-2005  
Chair, Technical Task Force on Developmental Status of Environmental  
Sampling/Water Testing Surrogate Indicators for *Cryptosporidium* Centers for  
Disease Control & Prevention Working Group on Waterborne Cryptosporidiosis, 1995-  
2001.

#### HONORS AND AWARDS:

Rho Chi Honor Society, 1961  
USPHS Clinical Society Pharmacy Award, 1963  
Sigma Xi Society, 1968  
Nominated for U.S. EPA Scientific Achievement Award, 1979 & 1984  
USEPA Bronze Medal re Giardia, 1984  
USPHS Commendation Medal, re Wastewater Sludge Program, 1991  
USEPA Gold Medal re Milwaukee Cryptosporidium outbreak, 1994  
USEPA Bronze Medal re Drinking Water Regulations, 1997

#### ADDITIONAL ACTIVITIES:

Pharmacy license in Virginia and New York.

Served as member of Microbiology Panel at the "Protocol Development: Criteria and Standards for Potable Reuse and Feasible Alternatives" Workshop, ODW, Airlie House, Virginia, July 1980.

Served as member and rapporteur to the World Health Organization Biological Aspects Task Group on Drinking Water Guidelines, 1980-81.

Served as consultant to the Pan-American Health Organization on environmental virus methods at CETESB, Sao Paulo, Brazil, Aug. 1980.

Program Advisory Committee member/chairman, Ecology and Control Section for 2nd International Symposium on Legionella, Atlanta, GA, June 1983.

Served as presenter and co-rapporteur of Occupational Hazards Panel at the Commission of European Communities Workshop on "Epidemiological Studies of Risks Associated with the Agricultural Use of Sewage Sludge: Knowledge and Needs," Metz, France, May, 1985.

Member of the work group on development of the coliform and surface water filtration regulations, ODW, EPA, 1986-1989.

Lead author of Giardia section for revision of the World Health Organization International Drinking Water Guidelines, 1989-1995.

Member, Task Group for revision of the World Health Organization International Drinking Water Guidelines, 1989-1995.

Serve as a reviewer for manuscripts submitted to Journal of American Water Works Association, Journal of Infectious Disease, American Journal of Tropical Medicine and Hygiene, Western Journal of Medicine and Journal of the American Public Health Association, Applied and Environmental Microbiology, et al., continuing basis.

Member, OGWDW Work Group for development of ICR, ESWTR and D/DBP rules, 1993-1997.

Peer reviewer for the NYC Expert Panel on Water Supply, 1992-1993.

Member, NYC Advisory Panel on Waterborne Disease Assessment, 1993.

Organizer and participant, Protozoa, Virus and Coliphage Monitoring Workshop, Office of Water, Cincinnati, OH, 1993.

Participant, Microbial and Disinfection By-Product Research Needs Expert Workshop, AWWA Association Research Foundation, Miami, FL, 1993.

Presenter/participant, Milwaukee Boil Water Workshop, June 1994.

Presenter, participant and co-chair of environmental methods group, Centers for Disease Control and Prevention workshop on "Assessing the Public Health Threat Associated with Waterborne Cryptosporidiosis," Atlanta, GA, September 22-23, 1994.

Project Advisory Committee member, AWWARF Project #162, "Innovative and Rapid Methods for *Giardia/Cryptosporidium*," 1995-1999.

Presenter and participant, AWWA workshop on government *Cryptosporidium* research, Beltsville, MD, September 6, 1995.

Developer, steering committee member, presenter and participant at EPA workshop on Development of *Giardia/Cryptosporidium* Protocols, Crystal City, VA, September 11-12, 1995.

Member, Work Group on Bacteria/Disinfection Requirements, ORSANCO, 3/96

Participant, Expert Workshop on Waterborne Cryptosporidiosis in the Immunocompromised Population, AWWARF, Atlanta, GA, June, 1996.

Participant, FDA Workshop on *Cyclospora* Methods, Washington, DC, 8/96

Member, CDC Working Group on Waterborne Cryptosporidiosis and presenter at international teleconference on the Public Health Handbook, May, 1997

WERF Project Subcommittee Member for 98-HHE-2, "Fate and Persistence of Pathogens Subjected to Disinfection", 1997-

Invited participant, AOAC symposium on waterborne protozoa, Montreal, September 1998.

WERF Health Advisory Committee Member for 98-REM-1, "A Dynamic Model to Assess Microbial Health Risk Associated with Beneficial Uses of Biosolids", 1999-2002.

WERF Project Subcommittee Member for 00-PUM-3, "Microbial Risk Assessment Techniques and Applications for Nonpotable Uses of Reclaimed Wastewater 1999-2003.

Invited reviewer for "Water and Foodborne Diseases" section of report to Congress entitled "U.S. National Assessment on the Potential Consequences of Climate Variability and Change", October, 1999.

Faculty member, 1999 AWWA-WQTC Workshop "Detection and Quantitation of Infectious *Cryptosporidium*", Tampa, Florida, October, 1999.

Invited presenter and co-chair of "Water Treatment" session at "*Giardia* in the Rockies" conference, Canmore, Alberta, Canada, October, 2000.

Faculty member, 2000 AWWA-WQTC Workshop "Measuring Disinfection of *Cryptosporidium*: Cell Culture and Other In-Vitro Methods", Salt Lake City, Utah, November, 2000.

WERF Health Advisory Committee Member for 98-REM-1A, "A Dynamic Model to Assess Microbial Health Risk Associated with Beneficial Uses of Biosolids--Phase 2", 2003-2006.

Invited presenter, 4<sup>th</sup> International *Giardia* Conference and First Combined *Giardia/Cryptosporidium* Meeting, September 20-24, 2004, Amsterdam, The Netherlands.

WERF Project Subcommittee Member for 03-HHE-2, "Developing Better Indicators for Pathogen Presence in Waste Matrices", 2004-2007.

WaterReuse Foundation Project Advisory Committee Member for M-04-01, "Application of Microbial Risk Assessment Techniques to Estimate Risk Due to Exposure to Reclaimed

Waters”, 2005-2007.

WateReuse Foundation Project Advisory Committee Member for WRF-06-003, “Investigating the Occurrence of Infectious *Cryptosporidium* Oocysts in Recycled Water and Evaluating the Effectiveness of Various Disinfection Techniques”, 2006-2009.

Panel Member, EPA CCL Microbial Expert Focused Workshop: Phase II, Arlington, VA, June, 2006

Advisory Panel Member for the NWRI-Orange County Water District Independent Advisory Panel for the Groundwater Replenishment System, 2007-2013.

Liaison to the NWRI Independent Advisory Panel on the Orange County Waste District’s Santa Ana River Monitoring Panel.

Member of the 2012 NWRI Independent Advisory Panel for WateReuse Foundation Project 11-02 on criteria for direct potable reuse.

#### SELECTED JOURNAL ARTICLES:

Jakubowski, W., S.L. Chang, T.H. Ericksen, E.C. Lippy and E.W. Akin. 1978. Large-volume sampling of water supplies for microorganisms. *JAWWA*, 70:702-706.

Dykes, A.C., D. Juranek, R. Lorenz, S. Sinclair, W. Jakubowski and R. Davies. 1980. Municipal waterborne giardiasis: an epidemiologic investigation. *Ann. Int. Med.*, 92(Part 1):165-170.

Pahren, H.R. and W. Jakubowski. 1981. Health aspects of wastewater aerosols. *Water Sci. Technol.*, 13:1091-1096.

Harter, L., F. Frost and W. Jakubowski. 1982. *Giardia* prevalence among 1 to 3 year old children in 2 Washington State counties. *Am. J. Pub. Hlth.*, 72:386-388.

Dufour, A.P. and W. Jakubowski, 1982. Drinking water and legionnaires' disease. *JAWWA*, 74:631-637.

Holman, B., F. Frost, B. Plan, K. Fukutaki and W. Jakubowski. 1983. Recovery of *Giardia* cysts from water: centrifugation vs. filtration. *Water Res.*, 17:1705-1707.

Fannin, K.F., S.C. Vana and W. Jakubowski. 1985. Effect of an activated sludge wastewater treatment plant on ambient air densities of aerosols containing bacteria and viruses. *AEM*, 49:1191-1196.

Akin, E.W. and W. Jakubowski. 1986. Drinking water transmission of giardiasis in the United States. *Water Sci. Technol.*, 18:219-226.

Jakubowski, W. 1988. Purple burps and the filtration of drinking water supplies. Am. J. Pub. Hlth., 78:123-125.

Goldstein, N., W.A. Yanko, J.M. Walker and W.Jakubowski.1988.Determining pathogen levels in sludge products. Biocycle, 29:44-47, 67.

Erlandsen, S.L., L.A. Sherlock, M. Januschka, D.G. Schupp, F.W. Schaefer, III, W. Jakubowski and W.J. Bemrick. 1988. Cross-species transmission of *Giardia*: Inoculation of beavers and muskrats with cysts of human, beaver, mouse and muskrat origin. AEM, 54:2777-2785.

Ward, R.L., D.R. Knowlton, J. Stober, W. Jakubowski, T. Mills, P. Graham and D.E. Camann. 1988. Effect of wastewater spray irrigation on rotavirus infection rates in an exposed population. Water Res., 23(12):1503-1509.

Erlandsen, S.L., L.A. Sherlock, W.J. Bemrick, H. Ghobrial and W. Jakubowski. 1990. Prevalence of *Giardia* in beaver and muskrat populations in New England states and Minnesota: detection of intestinal trophozoites at necropsy provides greater sensitivity than detection of cysts in fecal samples. AEM, 56:31-36.

Casson, L.W., C.A. Sorber, J.L. Sykora, P.D. Gavaghan, M.A. Shapiro and W. Jakubowski. *Giardia* in wastewater--effect of treatment. 1990. Res. J. Water Poll. Control Fed., 62(5):670-675.

Jakubowski, W., J.L. Sykora, C.A. Sorber, L.W. Casson and P.D. Gavaghan. 1991. Determining giardiasis prevalence by examination of sewage. Water Sci. Technol., 24:173-178.

Sykora, J.L., C.A. Sorber, W. Jakubowski, L.W. Casson, P.D. Gavaghan, M.A. Shapiro and M.J. Schott. Distribution of *Giardia* cysts in wastewater. 1991. Water Sci. Technol., 24:187-192.

Rose, J.B., C.P. Gerba and W. Jakubowski. 1991. Survey of potable water supplies for *Cryptosporidium* and *Giardia*. Environ. Sci. and Technol., 25(8):1393-1400.

Erlandsen, S.L., W.J. Bemrick and W. Jakubowski. 1991. Cross-species transmission of avian and mammalian *Giardia* spp.: inoculation of chicks, ducklings, budgerigars, Mongolian gerbils, and neo-natal mice with *Giardia ardeae*, *Giardia duodenalis* (lamblia), *Giardia psittaci*, and *Giardia muris*. International J. Environ. Hlth. Res., 1(3):144-152.

Erlandsen, S.L., A.R. Weisbrod, L. Knutson, R. Olereich, W.E. Dodge, W.J. Bemrick and W. Jakubowski. 1991. Giardiasis in wild and captive bird populations; high prevalence in herons and budgerigars. International J. Environ. Hlth. Res., 1(3):132-143.

Sauch, J.F., D. Flanigan, M.L. Galvin, D. Berman and W. Jakubowski. 1991. Propidium iodide as an indicator of *Giardia* cyst viability. AEM, 57(11):3243-3247.

Mahbubani, M.H., A.K. Bej, M. Perlin, F.W. Schaefer, III, W. Jakubowski and R.M. Atlas. 1991. Detection of *Giardia* using the polymerase chain reaction and distinguishing live from dead cysts. *AEM*, 57(12):3456-3461.

Mahbubani, M.H., A.K. Bej, M. Perlin, F.W. Schaefer, III, W. Jakubowski and R.M. Atlas. 1992. The differentiation of *Giardia duodenalis* from other *Giardia* spp. based on the polymerase reaction and gene probes. *J. Clin. Microbiol.*, 30(1):74-78.

Rodgers, M.R., C.M. Bernardino and W. Jakubowski. 1993. A comparison of methods for extracting amplifiable *Giardia* DNA from various environmental samples. *Water Science Technology*, 27(3-4):85-88.

Gavaghan, P.D., J. L. Sykora, W. Jakubowski, C. A. Sorber, A. M. Sninsky, M. D. Lichte and G. Kelti. 1993. Inactivation of *Giardia* by anaerobic digestion of sewage sludge. *Water Science Technology*, 27 (3-4): 111-114.

Stadterman, K.L., A.M. Sninsky, J.L. Sykora and W. Jakubowski. 1995. Removal and inactivation of *Cryptosporidium* oocysts by activated sludge treatment and anaerobic digestion. *Wat. Sci. Tech.*, 31(5-6):97-104.

DuPont, H.L., C.L. Chappell, C.R. Sterling, P.C. Okhuysen, J.B. Rose and W. Jakubowski. 1995. The infectivity of *Cryptosporidium parvum* in healthy volunteers. *New England Journal of Medicine*, 332:855-859.

Rodgers, M.R., D.J. Flanigan and W. Jakubowski. 1995. Identification of algae which interfere with the detection of *Giardia* cysts and *Cryptosporidium* oocysts and a method for alleviating this interference. *AEM*, 61(10):3759-3763.

Jakubowski, W., S. Boutros, W. Faber, R. Fayer, W. Ghiorse, M. LeChevallier, J. Rose, S. Schaub, A. Singh and M. Stewart. 1996. Environmental methods for *Cryptosporidium*. *JAWWA*, 88(9):107-121.

Slifko, T.R., D.E. Friedman, J.B. Rose, S.J. Upton and W. Jakubowski. 1997. Unique cultural methods used to detect viable *Cryptosporidium parvum* oocysts in environmental samples. *Water Science Technology*, 35(11):363-368.

Slifko, T.R., D.E. Friedman, J.B. Rose and W. Jakubowski. 1997. An in Vitro method for detecting infectious *Cryptosporidium* oocysts with cell culture. *AEM*, 63(9):3669-3675.

Rodman, J.S., F. Frost, L. Davis-Burchat, D. Fraser, J. Langer and W. Jakubowski. 1997. Pharmaceutical sales—a method of disease surveillance? *Jour. Environ. Health*, 60(4):8-14.

Okhuysen, P.C., C.L. Chappell, C.R. Sterling, W. Jakubowski and H.L. DuPont. 1998. Susceptibility and serologic response of healthy adults to reinfection with

*Cryptosporidium parvum*. Infect. & Immun.,66(2):441-443.

Rodman, J.S., F. Frost and W. Jakubowski. 1998. Using nurses' hotline calls for disease surveillance. Emerging Infect. Dis. 4(2):329-332.

Chappell, C.L., P.C. Okhuysen, C.R. Sterling, C. Wang, W. Jakubowski and H.L. DuPont. 1999. Infectivity of *Cryptosporidium parvum* in healthy Adults with pre-existing anti-*C. parvum* Serum IgG. Am. J. Trop. Med. Hyg. 60(5):157-164.

Slifko, T.R., D.E. Huffman, B. Dussert, J.H. Owens, W. Jakubowski, Haas, C.N. and J.B. Rose. 2002. Correlation of cell culture and animal infectivity for *Cryptosporidium parvum* Genotype 2 (Ames, Iowa Isolate). Experimental Parasitology 101/2-3:97-106(Nov.2002; Pub. On-line 9/19/02).

J.E. Smith, Jr., P.D. Millner, W. Jakubowski, N. Goldstein and R. Rynk. Contemporary Perspectives on Infectious Disease Agents in Sewage Sludge and Manure. 2005. Compost Science & Utilization, The JG Press, Inc., Emmaus, PA.

Baque RH, Gilliam AO, Robles LD, Jakubowski W, Slifko TR. A real-time RT-PCR method to detect viable *Giardia lamblia* cysts in environmental waters. Water Res. 2011 May;45(10):3175-84. Epub 2011 Mar 23

**Walter Jakubowski**

*Consultant*

*WaltJay Consulting (Spokane, Washington)*

Education includes an M.S. in Microbiology from Oregon State University after graduating cum laude in Pharmacy from Brooklyn College of Pharmacy, Long Island University. He has certificated graduate training in Epidemiology from the University of Minnesota. He has been a hospital pharmacist and has research publications in this field. He conducted research on microorganisms in oysters and clams under the federal Shellfish Sanitation Program; however, most of his career has revolved around determining the health effects and public health significance of pathogens, especially intestinal protozoa and viruses, in drinking water, waste water and municipal sewage sludge. He has authored or co-authored more than 40 peer-reviewed publications in this area. He has served as a consultant to the World Health Organization on pathogenic intestinal protozoa (for development of the International Drinking Water Guidelines), and to the Pan-American Health Organization on environmental virus methods. He helped the Centers for Disease Control conduct the first international symposium on *Legionella* and Legionnaire's Disease.

With more than 49 years experience working with waterborne pathogens, he is a recognized international expert on *Giardia* and giardiasis and has given invited presentations on this organism at domestic and international conferences. In addition to developing and standardizing methods for the detection of intestinal protozoa and viruses in the environment, he initiated research designed to gather information on the occurrence and distribution of *Giardia* infection in wildlife. He developed the first practical method for detecting *Giardia* cysts in drinking waters and he was the first to recover cysts, using this method, from source waters and distribution system water from a public water supply involved in a waterborne outbreak. He has worked with a variety of international, national, state and local public health authorities on problems related to *Giardia* and other infectious organisms in water, wastewater and sludge.

He initiated landmark studies on the human infectious dose of *Cryptosporidium* oocysts. He chaired the Joint Task Group on Pathogenic Intestinal Protozoa for *Standard Methods for the Examination of Water and Waste Water* from 1978 to 2005. He was a charter member of USEPA's Pathogen Equivalency Committee and served on that committee until his retirement from the U.S. Public Health Service/Environmental Protection Agency in 1997. In 2006, he participated in an expert panel on procedures for improving the EPA mechanism for selecting microorganisms for the Drinking Water Contaminant Candidate List. He served on the National Water Resources Institute (NWRI) Independent Advisory Panel (IAP) for the Orange County (California) Water District's Groundwater Replenishment System from 2007 until 2013 and was also a liaison to the NWRI IAP on the Orange County Waste District's Santa Ana River Monitoring Panel. He served as a microbiologist and public health expert on the 2012 NWRI IAP for WateReuse Foundation Project 11-02 on criteria for direct potable reuse. He participated in a recently completed multi-organization research project to develop a molecular method for detecting and enumerating viable/infectious *Giardia* cysts of public health importance in environmental samples. His current interests include microbiological risk assessment and issues concerning waterborne pathogens in drinking water, wastewaters and reclaimed wastewater. He recently served as an advisor to Washington State in developing microbiological standards for the use of reclaimed wastewater. He was an invited participant in the 2010 WateReUse Foundation expert panel on "*Examination of Microbiological Methods for Use with Reclaimed Waters.*" He is on the editorial board for the International Journal of Environmental Health Research.

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- Perry L. McCarty, Sc.D.

## PERRY L. McCARTY

Perry L. McCarty, Silas H. Palmer Professor Emeritus, joined the Stanford University faculty in 1962 when he came to help develop the environmental engineering and science program. From 1980 to 1985 he was Chairman of Stanford's Department of Civil and Environmental Engineering, and from 1989 to 2002 served as Director of the Western Region Hazardous Substance Research Center. He has a B.S. Degree in civil engineering from Wayne State University (1953), and M.S. (1957) and Sc.D. (1959) degrees in sanitary engineering from M.I.T.

The focus of his research and teaching has been on water with primary interest in biological processes for the control of environmental contaminants. His early research was on anaerobic treatment processes, biological processes for nitrogen removal, and water reuse. Current interests are on aerobic and anaerobic biological processes for treatment of domestic wastewaters, and movement, fate, and control of groundwater contaminants.

He was elected to membership in the National Academy of Engineering in 1977 and the American Academy of Arts and Sciences in 1996. He received the John and Alice Tyler Prize for Environmental Achievement in 1992, the Athalie Richardson Irvine Clarke Prize for Outstanding Achievements in Water Science and Technology in 1997, and the Stockholm Water Prize in 2007.

Prof. McCarty has over 350 publications, and is coauthor of the textbooks, *Chemistry for Environmental Engineering and Science*, and *Environmental Biotechnology - Principles and Applications*. He has been active with several professional groups, especially the National Academies. Among his other awards are honorary Doctorates from the Colorado School of Mines and Nanyang Technological University in Singapore; Distinguished Member, American Society of Civil Engineers; Honorary Member in the American Water Works Association, the Water Environment Federation, and the American Academy of Environmental Engineers and Scientist; and Fellow with the American Association for the Advancement of Science and the American Academy of Microbiology. He was selected by the National Academies to be the 2001 Abel Wolman Distinguished Lecturer. Other honors include the Harrison P. Eddy Award for Noteworthy Research (1964 and 1977), the Thomas Camp Award for Unique Application of Engineering Research (1975), and the Gordon Maskew Fair Distinguished Engineering Educator Medal (2012) of the Water Environment Federation; the A. P. Black Research Award (1989) and Water Industry Hall of Fame Award (2009) of the American Water Works Association; the Walter L. Huber Research Prize (1964), the Simon W. Freese Environmental Engineering Lecture Award (1979), and J. James R. Croes Medal (1995) of the American Society of Civil Engineers; and the Joan Hodges Queneau Palladium Medal (2013) of the National Audubon Society.

## BIOGRAPHICAL SKETCH

**Name:** Perry L. McCarty

**Education:** B. S. Civil Engineering, Wayne State University, 1953  
S. M. Sanitary Engineering, Massachusetts Institute of Technology, 1957  
Sc.D. Sanitary Engineering, Massachusetts Institute of Technology, 1959

**Employment:**

1962-date: Faculty Member, Stanford University  
1999-date: Silas H. Palmer Professor of Civil Engineering Emeritus  
1989-2003: Director, Western Region Hazardous Substance Research Center  
1980-1985: Chairman, Department of Civil Engineering  
1975-1999: Silas H. Palmer Professor of Civil Engineering  
1967-1975: Professor of Civil Engineering  
1962-1967: Associate Professor of Civil Engineering  
2008-2013: World Class University Professor, Department of Environmental Engineering, Inha University, Incheon, Korea  
2004-2007: Chair Professor, Department of Environmental Science and Engineering, Tsinghua University, Beijing, China  
2003: Lecturer, Stanford Canada and Great Lakes College  
1971: Visiting Professor, University of Cape Town, South Africa  
1968-1969: Honorary Research Associate, Harvard University  
1969: Visiting Lecturer, Summer Institute in Advanced Sanitary Chemistry, Harvard University  
1968-1972: Faculty Member, Curso de Postgrado en Ingenieria Hidrologica, Ministerio de Obros Publicos, Venezuela  
1959-1962: Assistant Professor of Sanitary Engineering, Massachusetts Institute of Technology  
1958-1959: Instructor of Sanitary Engineering, Massachusetts Institute of Technology  
1958-1961: Associate, Rolf Eliassen Associates, Research, development, and industrial waste treatment design  
1957: Research Staff, Massachusetts Institute of Technology  
1956: Engineer, Civil Engineers, Inc., Subdivision and water treatment plant design  
1954-1956: U.S. Army  
1954: Field Engineer, George Jerome and Company, Construction inspector  
1953-1954: Instructor: Department of Civil Engineering, Wayne State University  
1953: Field Engineer: Hubbell, Roth and Clark, Subdivision development  
1952: Engineer: Pate and Hirn, Subdivision design  
1951: Field Engineer: Edwin Orr. Subdivision development

**Honors:**

Tau Beta Pi Fellowship, 1956-57.  
Harrison P. Eddy Award of the Water Environment Federation for Noteworthy Research (with Ross E. McKinney), 1962.  
Walter L. Huber Research Prize of the American Society of Civil Engineers, 1964.  
First prize for best paper presented at annual meeting of Society for Industrial Microbiology, 1965.  
Inaugural Distinguished Faculty Award in Sanitary Engineering, the American Association of Professors in Sanitary Engineering, 1966.  
NSF Science Faculty Fellowship, 1968-69.  
Thomas Camp Award of the Water Environment Federation, for Unique Application of Engineering Research, 1975.  
Member, National Academy of Engineering, 1977.  
Harrison P. Eddy Award of the Water Environment Federation for Noteworthy Research (with Kenneth J. Williamson), 1977.  
Simon W. Freese Environmental Engineering Lecture Award, American Society of Civil Engineers, 1979.  
Engineering-Science Research Award, Association of Environmental Engineering Professors (with Bruce E. Rittmann), 1979.  
Fellow, American Association for the Advancement of Science, 1980.  
Honorary Member, American Water Works Association, 1981.  
Thomas R. Camp Lecturer Award, Boston Society of Civil Engineers, 1983.  
Engineering-Science Research Award, Association of Environmental Engineering Professors (with Edward J. Bouwer), 1983.  
Distinguished Professor Lectureship, Association of Environmental Engineering Professors, 1984.  
Outstanding Publication Award (with Alonzo Wm. Lawrence), Association of Environmental Engineering Professors, 1985.  
Research Division Best Paper Award, American Water Works Association (with Marco Aieta) 1985.  
Life Member, American Water Works Association, 1987.  
Outstanding Publication Award, Association of Environmental Engineering Professors, 1988.  
Wayne State University Engineering Alumni Achievement Award, 1988.  
A. P. Black Research Award, American Water Works Association, 1989.  
Honorary Member, Water Environment Federation, 1989.  
Inaugural Tsuan Hua Feng Distinguished Lecturer, University of Massachusetts, 1989.  
CH2M HILL Research Award, Association of Environmental Engineering Professors (with Craig S. Criddle), 1990.  
The John and Alice Tyler Prize for Environmental Achievement, 1992.  
Engineering-Science Research Award, Association of Environmental Engineering Professors (with Lisa Alvarez-Cohen), 1992.  
Founder's Award for sustained and outstanding contributions to environmental engineering education, Association of Environmental Engineering Professors, 1992.  
Research Fellowship, Japan Society for the Promotion of Science, 1992.

Honorary Degree of Doctor of Engineering, Colorado School of Mines, 1992.  
 Fellow, American Academy of Microbiology, 1993.  
 Fellow, California Council on Science and Technology  
 J. James R. Croes Medal, American Society of Civil Engineers, 1995.  
 Life Member, American Society of Civil Engineers, 1995.  
 Fellow, American Academy of Arts and Sciences, 1996.  
 The Athalie Richardson Irvine Clarke Prize for Outstanding Achievements in  
 Water Science and Technology, 1997.  
 Certificate of Merit, Division of Environmental Chemistry, American  
 Chemical Society, 1997.  
 CH2M HILL Research Award, Association of Environmental Engineering  
 Professors (with James E. Anderson), 1997.  
 Dean's Award for Academic Excellence, Stanford University, 1997.  
 Outstanding Publication Award (with Edward J. Bouwer), Association of  
 Environmental Engineering Professors, 1998.  
 Inaugural Walter J. Weber Distinguished Lecturer, University of Michigan,  
 2000.  
 Inaugural Distinguished Visiting Lecturer, Environmental Engineering and  
 Science, University of Illinois, 2000.  
 Abel Wolman Distinguished Lecturer, National Academies, 2001.  
 The Barnett F. Dodge 2001 Distinguished Lecturer in Chemical Engineering,  
 Yale University  
 Inaugural Association of Environmental Engineers and Scientists  
 Distinguished Lecturer, Georgia Institute of Technology, 2002.  
 Outstanding Publication Award (with Kenneth Williamson), Association of  
 Environmental Engineering and Science Professors, 2003.  
 Inaugural Ryckman Lecture, Environmental Engineering and Science  
 Program, Washington University, 2003  
 Golden Drop Award, American Water Works Association, 2007  
 Stockholm Water Prize, 2007  
 Brown and Caldwell Lifetime Achievement Award, 2008  
 Lifetime Achievement Award, Groundwater Resources Association of  
 California, 2008  
 Honorary Member, American Academy of Environmental Engineers, 2009  
 Water Industry Hall of Fame, American Water Works Association, 2009  
 Honorary Degree of Doctor of Engineering, Nanyang Technological  
 University, Singapore, 2010  
 Honorary Professor, Harbin Institute of Technology, China, 2011  
 Association of Environmental Engineering and Science Professors Lecturer,  
 WEFTEC, 2011  
 Honorary Professor, National Chiao Tung University, Taiwan, 2011  
 Honorary Fellow, the Chinese Institute of Environmental Engineering,  
 Taiwan, 2011  
 Distinguished Member, American Society of Civil Engineers, 2012  
 Fellow, Water Environment Federation, 2012  
 Gordon Maskew Fair Distinguished Engineering Educator Medal, Water  
 Environment Federation, 2012

Life Member, Association of Environmental Engineering and Science Professors, 2012  
Joan Hodges Queneau Palladium Medal for engineering achievement in environmental conservation, National Audubon Society, 2013  
Gordon Maskew Fair Award for exemplary professional conduct, recognized achievements, and significant contributions to the world's environment, American Academy of Environmental Engineers and Scientists, 2014

**Organizations:** American Society of Civil Engineers  
Water Environment Federation  
American Water Works Association  
American Association for the Advancement of Science  
Association of Environmental Engineering and Science Professors  
Tau Beta Pi  
Omicron Delta Kappa  
Kappa Mu Epsilon  
Sigma Xi

**Professional Activities:**

Member, Research Grants Study Section on Environmental Science and Engineering, U.S. Public Health Service, 1964-1966.  
Member, Water Pollution Control Federation Program Planning Committee, 1964-1970.  
Chairman, American Water Works Association, Task Group on Nutrients in Water, 1965-69.  
Chairman, Workshop Seminar on Anaerobic Waste Treatment, U.S.P.H.S., 1965.  
Chairman, Standard Methods Committee on Gases in Water, 1965-1970.  
Assistant Editor, American Society of Civil Engineers, Sanitary Engineering Division Newsletter, 1965-68.  
Member, American Society of Engineering Education, Sanitary Engineering Committee, 1965-67.  
Consultant, Interagency Agricultural Wastewater Treatment Study, Federal Water Pollution Control Administration, U.S. Bureau of Reclamation, and California Department of Water Resources, 1966-1971.  
Chairman, National Symposium on Estuarine Pollution, ASCE, August 1967.  
Chairman, San Francisco Sanitary Engineering Section, American Society of Civil Engineers, 1967.  
Trustee, Water Quality Division, American Water Works Association, 1967 to 1974.  
Vice Chairman, American Society of Engineering Education, Environmental Engineering Division, 1968-69.

Board of Directors and Consultant, Biostimulation and Biototoxicity Study, California Water Resources Control Board, 1970-1971.

Member, Committee on Wastewater Reclamation, American Water Works Association, 1970-1972.

Member, Committee on Quality Control in Reservoirs, American Water Works Association, 1970-1973.

Consultant, Training Grants Division, Environmental Protection Agency, 1970-1975.

Vice Chairman, Gordon Research Conference on Environmental Science-Air, 1971.

Member, U.S. National Academy of Science – Indian National Science Academy Workshop on, "Water in Man's Life in India," September, 1971, New Delhi, India.

Consultant, Symbiotic Study on Agricultural Wastewaters, U.S. Bureau of Reclamation and California Department of Water Resources, 1971-1973.

Member, Advisory Board, *Environmental Science & Technology*, 1971-1973.

Member, Sanitary Engineering Advisory Committee, California Department of Public Health, 1971-1975.

Member, George Westinghouse Environmental Student Award Committee, American Society of Engineering Education, 1971-1973.

Member, Committee on Control of Nitrates, American Water Works Association, 1971-1974.

Chairman, Water Quality Division, American Water Works Association, 1972-1973.

Chairman, Gordon Research Conference, Environmental Sciences – Water 1972.

Participant, Smithsonian Institution Study on the Effect of Rapid Urbanization on the Environment in Seoul, Korea, 1972.

Member, Water Quality Policy Committee, National Academy of Sciences - National Academy of Engineering, Advisory to the National Commission on Water Quality, 1973- 1976.

Member, T & P Research Committee, American Water Works Association, 1973-1976.

Engineering Board of Consultants: John Wiley & Sons, 1974-1980.

Member, Environmental Studies Board, National Research Council, National Academies, 1976-1981.

Member, Potomac Estuary Committee, National Research Council, National Academies, 1976-1979.

Chairman, Panel on Treatment Processes, National Research Council, National Academies, 1976-1977.

Chairman, Research Committee, Technical and Professional Council, American Water Works Association, 1976-1981.

Member, Technical and Professional Council, American Water Works Association, 1976-1981.

Vice Chairman, Environmental Studies Board, National Research Council, National Academies, 1977-1980.

Member, Commission on Natural Resources, National Research Council, National Academies, 1977-1980.

Member, Stanford Technical Delegation to the People's Republic of China, March-April 1978.

Chairman, Camp Medal Award Committee, Water Pollution Control Federation, 1977-1979.

Member, Innovative and Alternative Technology Committee, California Water Resources Control Board, 1979-1981.

Member, Aquaculture Technical Advisory Committee, California Water Resources Control Board, 1979-1981.

Member, Scientific Advisory Board, Southern California Coastal Water Research Project, 1979-1980.

Member, Panel on Wastewater Reuse Criteria, National Research Council, National Academies, 1979-1982.

Member, Expert Committee on Engineering and Technology, International Joint Commission on the Great Lakes, 1979-1982.

Chairman, Committee to Review Potomac Estuary Experimental Water Treatment Plant, National Research Council, National Academies, 1979-1984.

Member, Committee to Review the Metropolitan Washington Area Water Supply Study, National Research Council, National Academies, 1979-1984.

Chairman, Scientific Advisory Board, Southern California Coastal Water Research Project, 1980-1986.

Member, Visiting Committee, Harvard University Division of Applied Science, 1980-1985.

Member, Wastewater Reclamation Health Effects Advisory Panel, California Department of Health Services, 1980-1985.

Member, Scientific Advisory Board, National Center for Ground Water Research, 1980-1986.

Member, National Science Foundation Advisory Subcommittee for Civil and Environmental Engineering, 1981-85.

Director, International Conference on Ground Water Quality, 1981.

Trustee, Research Division, American Water Works Association, 1981-1985.

Trustee, American Water Works Research Foundation, 1981-1985.

Guest Lecturer, Chinese Academy of Sciences, Biogas Production, Guangzhou and Chengdu, China, 1982.

Chairman, Scientific Panel to Evaluate Sacramento-San Joaquin Delta Water Quality, California Department of Water Resources, 1982-1983.

Member, Task Force on Ground Water Pollution, Office of Technology Assessment, U.S. Congress, 1983-1985.

Member, Engineering Education Board, National Academy of Engineering, 1984-1987.

Member, Engineering Research Board, National Research Council, National Academies, 1984-1986.

Member, Drinking Water Standards Committee, American Water Works Association, 1984-1986.

Member, Organizing Committee, Specialized Seminar on Degradation, Retention, and Dispersion of Pollutants in Groundwater, Copenhagen, 1984.

Chairman, Panel on Energy, Environment, and Resources, National Research Council, National Academies, 1984-1986.

Member, Committee on Groundwater Protection, National Research Council, National Academies, 1984-1986.

Member, Visiting Committee, Princeton University, Dept. of Civil Engineering, 1985-1988.

Chairman, Visiting Committee, University of Minnesota, Dept. of Civil Engineering, 1985.

Member, Technical Advisory Committee, Clean Sites, Inc., 1985-94.

Member, Commission on Mathematics, Physics, Resources, National Research Council, National Academies, 1985-1988.

Editor, *Journal of Contaminant Hydrology*, 1985-1993.

Member, Scientific Advisory Panel on Groundwater Recharge, State of California, 1986-1987.

Member, Visiting Committee, California Institute of Technology, Division of Engineering and Applied Science, 1986-92.

Chairman, Visiting Committee, University of California, Berkeley, Department of Civil Engineering, 1987.

Member, Visiting Committee, University of Southern California, Department of Civil Engineering, 1987.

Member, National Institute of Environmental Health Sciences Panel for review of Superfund Phase II proposals, 1988.

Chairman, Environmental Protection Agency Panel, for review of Hazardous Substance Research Center proposals, 1988.

Member, SCOPE Panel on Groundwater Contamination, 1988-1995.

Member, Civil Engineering Visiting Committee, Massachusetts Institute of Technology, 1989-1993.

Member, Advisory Committee for Center for Environmental Health Sciences, Massachusetts Institute of Technology, 1989-92.

Member, Board on Radioactive Waste Management, National Research Council, National Academies, 1989-1996.

Member, Research Council, WEF Research Foundation, 1989-95.

Chairman, Program Planning Committee, International Symposium on Processes Governing the Movement and Fate of Contaminants in Groundwater, 1989.

Member, Evaluation Committee on Civil Engineering, University of California, Berkeley, 1990.

Chairman, Committee on Remedial Action Priorities for Hazardous Waste Sites, National Research Council, National Academies, 1991-1994.

Chairman, Environmental Protection Agency Panel for review of proposals for Centers of Excellence, 1991.

Member, Visiting Committee, Dept. of Environmental Engineering and Science, University of North Carolina, Chapel Hill, 1992.

Member, Visiting Committee, Environmental Engineering Program, University of Texas, San Antonio, 1992.

Member, Advisory Board, Marine Bioremediation Program, University of Washington, 1993-1996.

Associate Editor, *Journal of Contaminant Hydrology*, 1993-2006.

Member, Editorial Board, *Biodegradation*, 1993-  
 Alcoa - Environmental Technology Advisory Board, 1993-2005  
 Member, Work Group, President's Council on Sustainable Development,  
 1994-1995.  
 Member, Commission on Geosciences, Environment, Resources; National  
 Research Council, National Academies, 1994-1997.  
 Member, National Forum on Science and Technology Goals - No. 1:  
 Environment, National Research Council, National Academies, 1995.  
 Chairman, Virtual Commission on Environmental Management Science,  
 National Research Council, National Academies, 1996-1998.  
 Member, Visiting Committee, Dept. of Civil Engineering, Northwestern  
 University, 1996.  
 Chairman, Peer Review Group, VOC Study in Groundwater, 1996-1999.  
 Member, Selection Committee, George and Cynthia Mitchell International  
 Prize for Sustainable Development, National Academy of Sciences, 1996-  
 1997.  
 Member, Visiting Committee, Dept. of Civil Engineering, Cornell University,  
 1996.  
 Member, Selection Committee, Blasker Award for Environmental Science and  
 Engineering, 1996-2001  
 Member, Committee on Intrinsic Bioremediation, National Research Council,  
 National Academies, 1997-2000 .  
 Member, Science Advisory Board, Strategic Environmental Research and  
 Development Program, U.S. DOD, DOE, and EPA, 1997- 2002, 2005-  
 2010.  
 Chairman, Blue Ribbon Panel on San Diego Water Repurification Project,  
 1998.  
 Member, Chemical & Environmental Engineering Department Industrial  
 Advisory Committee, University of Arizona, 1999-2002  
 Member, Committee on Assessment of Risks from Remediation of PCB-  
 Contaminated Sediments, National Research Council, National  
 Academies, 1999-2001  
 External Examiner, Environmental Engineering Program, Department of  
 Chemical and Environmental Engineering, National University of  
 Singapore, 1999-2001  
 Member, Expert Panel for Review of Groundwater Treatment Technology,  
 Aerojet General Corporation, 2000-2001.  
 Member, Expert Panel on Water Reuse, West Basin Municipal Utility District,  
 2001-2002  
 Member, Tritium Migration Independent Scientific Peer Review Panel, U.S.  
 Department of Energy, 2001-2002  
 Member, Civil Engineering Peer Committee, National Academy of  
 Engineering, 2001-2004  
 Member, Panel for Independent Review of DDT Contamination, Kenwood  
 Avenue, Los Angeles, requested by Congresswoman Jane Harmon, 2001  
 Member, Committee on Water Quality Improvement for The Pittsburgh  
 Region, National Research Council, The National Academies, 2002-2004

Member, Oversight Committee for Strengthening Science-Based Decision Making, Policy and Global Affairs Division, the National Academies, 2002-2007

Member, Research Advisory Board, National Water Research Institute, 2005-.

Member, Vietnam Education Foundation Review Panel, The National Academies, 2005.

Member, The Athalie Richardson Irvine Clarke Prize Executive Committee, 2005-2007.

Member, External Advisory Committee, Water: Systems, Science, Society Program, Tufts University, 2006-

Member, Committee on Sediments Dredging at Superfund Megsites, The National Academies, 2006-2007.

Member, Steering Committee for Environmental & Water Technologies, National University of Singapore, 2006-2007

Member, Division of Environmental Science & Engineering Visiting Committee, National University of Singapore, 2006-2007

Member, Project Evaluation Panel, Environmental and Water Industry Development Council, Ministry of the Environment and Water Resources, Singapore, 2006-

Associate Editor-in-Chief, *Frontiers of Environmental Science & Engineering in China*, 2006-.

Member, Lee Kuan Yew Water Prize Nominating Committee, Singapore, 2008-

Member, Peer Review Team, Capital Regional Districts Core Area Wastewater Management Program, Victoria, British Columbia, 2009

Member, Environmental Science and Engineering Visiting Committee, Colorado School of Mines, 2009

Member, International Scientific Advisory Board, World City Forum, Incheon, Korea, 2009.

Chair, External Review Committee, Academic Program Review of Environment Science and Engineering, Tsinghua University, Beijing, China, 2010.

Member, IWA China AD Advisory Group, 2013-

**Invited Guest  
Lecturer at  
Universities:**

Arizona State University  
Brigham Young University  
California Institute of Technology  
California State Polytechnical University San Luis Obispo  
Central Public Health Engineering Research Institute, Nagpur, India  
Chico State University  
Clarkson University  
Clemson University  
College of Engineering, Guindy, Madras, India  
Cornell University  
Dalian University of Technology, China  
Drexel University  
Georgia Institute of Technology  
Hanoi University of Technology, Vietnam  
Hanyang University, Korea  
Harvard University  
Hong Kong University of Science & Technology, Hong Kong  
Imperial College London, England  
Inha University, Korea  
Institute of Biology, Chinese Academy of Sciences, Chengdu, China  
Institute of Energy Conversion, Chinese Academy of Sciences, Guangzhou,  
China  
Iowa State University  
Johns Hopkins University  
Keimyung University, Korea  
Korea University, Korea  
Kyoto University, Japan  
Manhattan College  
Marquette University  
Massachusetts Institute of Technology  
Northeastern University  
Pennsylvania State University  
Princeton University  
Rensselaer Polytechnic Institute  
Rice University  
Rutgers University  
San Jose State University  
Seoul National University, Korea  
Sungkyunkwan University, Korea  
Swiss Federal Institute of Technology, Zürich, Switzerland  
Technische Universität, Dresden, Germany  
The Agricultural University Wageningen, The Netherlands  
Tokyo University, Japan  
Tsinghua University, Beijing, China

Tufts University  
University of Alberta, Canada  
University of Arizona  
University of Birmingham, England  
University of California Berkeley  
University of California Davis  
University of California Riverside  
University of California San Diego  
University of California San Francisco  
University of Cape Town, South Africa  
University of Central Florida  
University of Colorado  
University of Connecticut  
University of Florida Gainesville  
University of Houston  
University of Illinois  
University of Iowa  
University of Karlsruhe, Germany  
University of Maryland  
University of Massachusetts  
University of Michigan  
University of Nevada, Reno  
University of New Mexico  
University of North Carolina  
University of Notre Dame  
University of Oklahoma  
University of Texas Austin  
University of Texas Dallas  
University of Toronto  
University of Washington  
Vanderbilt University  
Vietnam National University, Ho Chi Minh City  
Vietnamese Academy of Science and Technology  
Virginia Polytechnic Institute  
Washington University  
Wayne State University  
Yale University  
Yonsei University, Korea

Perry L. McCarty  
Silas H. Palmer Professor, Emeritus  
Stanford University  
Stanford, California

### List of Publications

1. McCarty, P. L., and McKinney, R. E., "Volatile Acid Toxicity in Anaerobic Digestion," *Journal Water Pollution Control Fed.*, **33**, 223-232 (1961).
2. McCarty, P. L., and McKinney, R. E., "Salt Toxicity in Anaerobic Digestion," *Journal Water Pollution Control Fed.*, **33**, 399-415 (1961).
3. McCarty, P. L., and Vath, C. A., "Volatile Acid Digestion at High Loading Rates," *International Journal of Air and Water Pollution*, **6**, 65-73 (1962).
4. McCarty, P. L., and Brodersen, C. F., "Theory of Extended Aeration Activated Sludge," *Journal Water Pollution Control Fed.*, **34**, 1095-1103 (1962).
5. McCarty, P. L., Jeris, J. S., and Murdoch, W., "Significance of Individual Volatile Acids in Anaerobic Treatment" in *Proceedings of the 17th Industrial Waste Conference, 1962*, Purdue Engineering Extension Series No. 112, pp. 421-439 (1963); also *Journal Water Pollution Control Fed.*, **35**, 1501-1516 (1963).
6. Jeris, J. S., and McCarty, P. L., "Biochemistry of Methane Fermentation Using C<sup>14</sup> Tracers" in *Proceedings of the 17th Industrial Waste Conference, 1962*, Purdue Engineering Extension Series No. 112, pp. 181-197 (1963); also *Journal Water Pollution Control Fed.*, **37**, 178-192 (1965).
7. Speece, R. E., and McCarty, P. L., "Nutrient Requirements and Biological Solids Accumulation in Anaerobic Digestion" in *Advances in Water Pollution Research*, Vol. 2, Pergamon Press, London, pp. 305-322 (1964).
8. McCarty, P. L., and Brosseau, M. H., "Effect of High Concentrations of Individual Volatile Acids on Anaerobic Treatment" in *Proceedings of the 18th Industrial Waste Conference, 1963*, Purdue Engineering Extension Series No. 115, pp. 283-296 (1964).
9. McCarty, P. L., "The Methane Fermentation," Chap. 16, pp. 314-343 in *Principles and Applications in Aquatic Microbiology*, H. Heukelekian and N. C. Dondero, Eds., John Wiley, New York (1964).
10. McCarty, P. L., "Research and Development for Reuse of Water," pp. 55-59 in *Water; Development, Utilization, Conservation*, Western Resources Conference 1963, R. K. McNickle, Ed., University of Colorado Press, Boulder (1964).
11. Kugelman, Irwin J., and McCarty, P. L., "Cation Toxicity and Stimulation in Anaerobic Waste Treatment," *Journal Water Pollution Control Fed.*, **37**, 97-116 (1965).
12. Konecky, M. S., Kelley, E. J., Symons, J. M., and McCarty, Perry L., "The Determination of the Biodegradability of Detergents (Esso Research Biodegradation Test)," presented at the 36th Annual Meeting of the Water Pollution Control Fed. (October 1963).
13. McCarty, P. L., "Thermodynamics of Biological Synthesis and Growth" in *Advances in Water Pollution Research*, Vol. 2, pp. 169-187, Pergamon Press, New York (1965); also *International Journal of Air and Water Pollution*, **9**, 621-639 (1965).

14. McCarty, P. L., "Free Energy as a Parameter in Biological Treatment, A Discussion," *Journal Sanitary Engineering Division, American Society of Civil Engineers*, **89**(SA6), 65-68 (December 1963).
15. Lawrence, A. Wm., McCarty, P. L., and Guerin, F. J., "The Effects of Sulfides on Anaerobic Treatment" in *Proceedings of the 19th Purdue Industrial Waste Conference* (May 1964); also *International Journal of Air and Water Pollution*, **10**, 207-221 (1966).
16. Kugleman, I. J., and McCarty, P. L., "Cation Toxicity and Stimulation in Anaerobic Waste Treatment. II. Daily Feed Studies" in *Proceedings of the 19th Purdue Industrial Waste Conference*, pp. 667-686 (May 1964).
17. Lawrence, A. Wm., and McCarty, P. L., "The Role of Sulfides in Preventing Heavy Metal Toxicity in Anaerobic Digestion," *Journal Water Pollution Control Fed.*, **37**, 392-406 (1965).
18. McCarty, P. L., "Anaerobic Waste Treatment Fundamentals. Part I, Chemistry and Microbiology," *Public Works*, **95**, 107-112 (September 1964).
19. McCarty, P. L., "Anaerobic Waste Treatment Fundamentals. Part II, Environmental Requirements and Control," *Public Works*, **95**, 123-126 (October 1964).
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## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

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### Education

Dr. P.H.	University of California, Berkeley	1982	Environmental Health Sciences
M.P.H.	University of California, Berkeley	1978	Environmental Health Sciences
M.S.	University of Connecticut, Storrs	1975	Civil and Sanitary Engineering
B.S.E.	University of Connecticut, Storrs	1974	Civil Engineering

### Professional Certificates

Registered Civil Engineer, State of California

### Research and Professional Experience

**1985 – Present**, *Principal Engineer*, EOA, Inc.

As vice president of EOA, Inc., shares responsibility for administrative and management activities. Project management responsibility for projects including NPDES permit compliance, pretreatment program development, wastewater reclamation, risk assessment, urban runoff, and regulatory program development and analysis.

**1997 – 1999**, *Project Director/Investigator*, Public Health Institute  
San Diego Wastewater Reclamation Study: AQUA 2000 Microbial Testing Program.

**1985 – 1997**, *Project Manager*, Western Consortium for Public Health  
\$6.8 million San Diego Wastewater Reclamation Health Effects Study.

**1983 – 1993**, *Staff Specialist IV (PostDoc)*, University of California, School of Public Health  
Management and technical responsibilities for several research projects related to groundwater resource evaluation and database system development for groundwater contamination data management. Project manager for the U.S. Army Water Quality (Infectious Agent) Risk Assessment Project.

**1974 – 1985**, *Water Resources Control Engineer*, San Francisco Regional Water Quality Control Board  
Senior Engineer in charge of the Basin Planning Section responsible for policy development, water quality, and basin planning projects. Manager of the Board's Toxic Task Force responsible for hazardous material site clean-up policy development, underground Tank Leak Detection Program, risk assessment study, assistance to local hazardous material ordinances, and supervision of site investigations at some 20 sites. Also, preparation of NPDES and WDR Permits, clean water grant facilities planning, plant inspections, and pretreatment program implementation.

**HONORS AND AWARDS:** Chi Epsilon, EPA Fellowship, EPA SAB (Consultant); Blending Testimony to U.S. House of Representative – Subcommittee on Water Resources and Environment – April 13, 2005

**PUBLICATIONS:** Principal and co-author of a number of technical publications and project reports.

## **Congressional Testimony and Independent Review Panels (recent)**

1. Congressional Testimony to Subcommittee on Water Resources and Environment, Washington, D.C., April 13, 2005. "Public Health Implications Associated with the Practice of Wastewater Treatment Plant Blending – Concerns and Misconceptions," Olivieri, A.W.
2. ILSI Risk Science Institute - Revised MRA Framework Workshop, funded by US EPA and AWWA, May 11-12, 1999.
3. Tampa Bay - Independent Review Panel Member – Joan Rose Chair, 2002.
4. University of Warwick, U.K., Steering Committee member - Development of Standards and Guidelines for Potable Reuse, April 2004.
5. FDA and Department of Health Services Independent Review Panel – surface discharge and disinfection issues – Monterey, 2007
6. Health Effect Studies, SCVWD & Australia, Colloquium on Indirect Potable Reuse invited panel member, January 29, 2007.
7. NWRI – Monterey Peninsula Groundwater Recharge Independent Review Panel – George Tchobanoglous Chair, Feb. 28, March 1 and 2, 2007 (Environmental Engineering and Risk Assessment panel member)
8. NWRI – Orange County Independent Review Panel – George Tchobanoglous Chair, March 31, 2008 – July 7, 2009. (Environmental Engineering and Risk Assessment panel member).
9. WERF PSC member - Quantification of pathogens and sources of microbial indicators for QMRA in recreational waters (PATH2R08) 2009-2010.
10. WateReuse Foundation - 2009 Research Needs Workshop Project Prioritization, San Diego, CA. (member for past three workshops).
11. California State Water Resources Control Board & Department of Public Health, CEC Blue Ribbon Advisory Panel, 2009-2011.
12. California State Water Resources Control Board, Advisory Panel for CECs in Coastal and Marine Ecosystems, 2010-2012.
13. California State Water Resources Control Board, Advisory Panel for CECs in Coastal and Marine Ecosystems – Monitoring Plan Development, 2012 – ongoing.
14. CUWA/NWRI/WateReuse – Direct Potable Reuse Workshop (Invited Participant), April 26-27, 2010.
15. NWRI - Independent Advisory Panel for California Department of Public Health – Review of Water Recycling Criteria for Agricultural Irrigation (Vice Chair), 2010-2012.

16. SFEI and RMP

17. NWRI - Orange County Independent Review Panel – George Tchobanoglous Chair, Disinfection Optimization (Environmental Engineering and Risk Assessment panel member). 2014
18. NWRI – Expert Panel for CDPH on Development of Water Recycling Criteria for Indirect Potable Reuse through Surface Water Augmentation and the feasibility of Developing Criteria for Direct Potable Reuse, Dr. Rhodes Trussell (Chair), 2014 - ???
19. NWRI – Independent Advisory Panel on Evaluating Indirect Potable Reuse for the Santa Clara Valley Water District (Dr. James Crook – Chair), 2013 – Ongoing.
20. Texas Water Development Board – Evaluation the Potential of Direct Potable Reuse in Texas, Expert Review Panel member (via Alan Plummer Assoc, Inc.), 2013 – Ongoing.

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2. "Protection of Ground Water in the San Francisco Bay Area from Hazardous Materials Contamination," Eisenberg, D.M. and A.W. Olivieri, 1984 ASCE National Convention, San Francisco, CA, October 3-4, 1984.
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8. "Application of a Relative Site Ranking Methodology to Regulation of Groundwater Contamination Sites," Olivieri, A.W., D.M. Eisenberg, R.C. Cooper, 1986 ASCE Conference Environmental Engineering, Cincinnati, Ohio, July 8-10, 1986.
9. "Determining Appropriate Response for Underground Fuel Tank Leaks," Eisenberg, D.M. A. W. Olivieri, D.M. Tempelis, Proceedings of HAZMACON 1986, Anaheim, California, April 29-May 1, 1986.
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2. "Public Health Risk Evaluation of Wastewater Disposal Alternatives, Cooper, R.C. and A.W. Olivieri, Paper in Microbial Health Considerations of Soil Disposal of Domestic Wastewater, EPA-600/9-83-017.
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53. "Microbial Risk Assessment Interface Tool: User Documentation," Soller J.A., Seto, E., and Olivieri, A.W., *Water Environment Research Foundation, WERF 04-HHE-3*, 2007.
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55. *Quantitative Microbial Risk Assessment for Recreational Exposure in Northern California Receiving Waters*, Olivieri, A.W., Danielson, R.E., Seto, E., Shidell, V., and Pirondini, T., *Poster, 8<sup>th</sup> NWQMC*, Portland, Oregon, May 2012.
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4. " Direct Potable Reuse of Reclaimed Wastewater: Preliminary Results of Five Year Study," Cooper, R.C., et.al., Poster at 1989 ASM Annual Meeting, New Orleans, La., May 14-18, 1989.
5. " Study of Direct Potable Reuse of Reclaimed Wastewater: Preliminary Results," Olivieri, A.W., et.al., Proceedings ASCE 1989 National Conference in Environmental Engineering, Austin, Texas, July 10-12, 1989.
6. " Alameda County Non-Point Source Action Plan," Olivieri, A.W., APWA Nonpoint Source Workshop, Oakland, Ca, May 25, 1988.
7. " Wastewater Reuse," Olivieri, A.W., et.al., Application of U.S. Water and Air Pollution Control Technology in Korea, KEPA & USTDP Conference, Seoul, Korea, March 21-24, 1989.
8. " Overview of U.S. Water Pollution Control Technologies," Olivieri, A.W., D.M. Eisenberg, and R.C. Cooper, Application of U.S. Water and Air Pollution Control Technology in Korea, KEPA & USTDP Conference, Seoul, Korea, March 21-24, 1989.
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10. " If You Don't Want It In The Bay, We Can Use It Here," Olivieri, A.W. et.al., WateReuse Association of California Symposium VII, San Diego, CA. October 13-15, 1993.

11. " City of San Diego Study of Potable Reuse of Reclaimed Wastewater: Final Results," Thompson, K., Olivieri, A.W., e.al., Proceedings ASCE 1992 Environmental Engineering Water Forum (Saving A Threatened Resource - In Search of Solutions, Baltimore, Maryland, August 2-6, 1992.
12. " The San Diego Aquaculture Reuse Facility Health Effects Study," Thompson, K., Olivieri, A.W., et.al., AWWA 1990 Annual Conference Proceedings, Cincinnati, Ohio, June 17-21, 1990, p1503-1511.
13. "Heavy Metal Contaminants in the Municipal Wastewater Stream - Sources and Potential for Additional Regulation," Goebel, R.G., A.W. Olivieri, D.M. Eisenberg, H. Farnham, Water Pollution Control Association 1990 Annual Conference, Honolulu, Hawaii, February 8-9, 1990.
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15. " City of San Diego Study of Potable Reclaimed Wastewater: Final Results," Thompson, K., Olivieri, A.W., et.al., NWSIA 1992 Biennial Conference, Newport Beach, CA, August 23-27, 1992.
16. "City of San Diego Study of Potable Reuse of Reclaimed Water," Thompson, K, Olivieri, A.W., Eisenberg, D., Cooper, R.C., Danielson, R.E., and Pettegrew, L.A., 1992 national Conference on Environmental Engineering.
17. " City of San Diego Study of Direct Potable Reuse of Reclaimed Water: Final Results," Thompson, K., Olivieri, A.W., et.al., American Water Works Association, Annual Conference, Vancouver, B.C., June 18-22, 1992.
18. "City of San Diego Potable Reuse of Reclaimed Water: Final Results," Thompson, K, Cooper, R.C., Olivieri, A.W., Eisenberg, D., Pettegrew, L.A., Desalination (DSLNAH), Volume 88, No. 1-3, October 1992, p201-214.
19. "Upgrading Wastewater Treatment Pond Effluent For Unrestricted (Nonpotable) Reuse," Eisenberg, D., A.W. Olivieri, T. Hall, J. Addeo, M. Stanek, 2nd IAWQ International Specialist Conference on Wastewater Stabilization Ponds and The Reuse of Pond Effluents, November 30th through December 3, 1993, University of California, Berkeley.
20. "Modeling the Fate of Copper Discharged to San Francisco Bay," Chen, C.W., D. Leva, A. Olivieri, Journal of Environmental Engineering, Vol. 122, No. 10, October 1996.
21. "Membrane: An Alternative to Disinfection," Gagliardo, P. Adham, SS., Trussel, R.R., Olivieri, A.W., Najim, I.N., and Richardson, T., WEF Specialty Conference on Disinfecting Wastewater for Discharge and Reuse, Portland, Oregon, March 1996.
22. "Removal of Microorganisms by an Advanced Water Repurification System," Adham, SS., Gagliardo, P., Trussel, R.R., Olivieri, A.W., Najim, I.N., and Richardson, T., AWWA-Water Quality Technology Conference, Boston, MA, November 1996.

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24. "Membranes as an Alternative to Disinfection," Gagliardo, P.F., Adham, S.S., Trussell, R.R., Olivieri, A.W. AWWA 1997 Annual Conference, Atlanta, Georgia, June 15-19, 1997.
25. "Reliability Analysis of an Advanced Wastewater Treatment Facility," Eisenberg, D.M., A.W. Olivieri, J.A. Soller, P.F. Gagliardo, proceedings of the 1998 ASCE National Environmental Engineering Conference, Lake Buena Vista, Florida, 1998.
26. "A Methodology to Evaluate Water and Wastewater Treatment Plant Reliability", Eisenberg, D., J.A. Soller, R. Sakaji, and A. Olivieri, IAWQ 3<sup>rd</sup> International Symposium on Waste Water Reclamation, Recycling, and Reuse, Paris, France, July 2000.
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32. "Evaluation of First Flush Pollutant Loading and Implications for Waster Resources and Urban Runoff Management," Soller, J., Stephenson, J., Olivieri, K., Downing, J., and Olivieri A.W., Proceedings AWWA/WEF 2004 Water Sources Conference, Austin, Texas.
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34. "Seasonal Tertiary Wastewater Treatment in California – An Analysis of Public Health Benefits and Costs," Olivieri, A.W. and Soller J., CWEA, 78<sup>th</sup> Annual Conference, April 4-7, 2006, Sacramento, CA.

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36. “A Systematic Approach to Evaluating Beneficial Use Condition and Stormwater Impacts on Receiving Bodies,” Sommers, C., Calhoun, B., McCumby, K., and A.W.Olivieri, Flood Management Association, National Conference, Tahoe, 2008.
37. “Is Stormwater Impairing Steelhead? – Assessing Sediment Impacts on Aquatic Life Uses in two Northern California Creeks,” Sommers, C., Calhoun, B., Chesterman, D. and A.W.Olivieri, Flood Management Association, National Conference, Tahoe, 2008.
38. Microbial Risk Assessment of Human Health Impacts Associated with Water Contact Recreation during Wastewater Treatment Plant Blending, Konnan, J., Olivieri, A.W., Seto, E., prepared for EBMUD as part of WERF 03-CTS-12 project, 2009.
39. *Characterizing the Quality of Effluent and other Contributory Sources During Peak Wet Weather Events*. Water Environment Research Foundation 03-CTS-12. Gray, D. et.al. (co-author MRA Chapter), WERF/IWA 03-CTS-12P/PPa, 2009.
40. Disinfection Practices for the Orange County Sanitation District – Final Report, NWRI Independent Advisory Panel, October 1, 2009.
41. “California's Blue Ribbon Panel Recommendations for Monitoring of Compounds of Emerging Concern in Water Reuse Applications,” 14th Annual Water Reuse & Desalination Research Conference May 24-25, 2010, Tampa, FL.
42. “Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water,” Drewes, J.E., Anderson, P., Denslow, N., Olivieri, A.W., Schlenk, D., Snyder, S.A., Recommendations of Science Advisory Panel, Report to California State Water Resources Control Board, June 25, 2010.
43. “The Municipal Regional Stormwater Permit: Managing Municipal Stormwater Runoff in the San Francisco Bay Area,” Mumley, T., and Olivieri, A., SFEI (Regional Monitoring Program) publication, *The Pulse of the Estuary- Linking the Watersheds and the Bay*, October, 2010.
44. “Monitoring Strategies for Chemicals of Emerging Concern (CECs) in California’s Aquatic Ecosystems,” Anderson, P., Denslow, N, Drewes, J.E., Olivieri, A., Schlenk, D. (Chair), Scott, G.I., and Snyder, S., Recommendations of Science Advisory Panel, Report to California State Water Resources Control Board, SCCWRP Technical Report 692, May 2012.
45. “Review of California Water Recycling Criteria for Agricultural Irrigation,” Cooper, R.C. (Chair), Olivieri, A.W. (Vice Chair), Cahn, M., Colford, J., Crook, J., Debroux, J.F., Mandrell, R., Suslow, T., and Tchobanoglous, G., NWRI Independent Advisory Panel for California Department of Public Health. July 2012

46. Designing Monitoring Programs for Chemicals of Emerging Concern in Potable Reuse – What to include and what not to include? Drewes, J.E., Anderson, P., Denslow, N., Olivieri, A.W., Schlenk, D., Snyder, S.A., and Maruya, K.A., *WS&T*, 67.2, 201.
  
47. An Adaptive, Comprehensive Monitoring Strategy for Chemicals of Emerging Concern (CECs) in California's Aquatic Ecosystems, Maruya, K.A., Schlenk, D., Anderson, P., Denslow, N, Drewes, J.E., Olivieri, A., Scott,G.I., and Snyder, S, *Integrated Environmental Assessment and management (IEAM)*, Vol. 10, Number 1, pp. 69-77, 2013.

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- David L. Sedlak, Ph.D.

## DAVID L. SEDLAK

### EDUCATION

**University of Wisconsin**, Madison, Wisconsin  
Water Chemistry  
**Dissertation:** Abiotic Oxidation of Polychlorinated Biphenyls (PCBs) Ph.D.  
June 1992

**Cornell University**, Ithaca, New York  
Environmental Science B.S.  
June 1986

### EXPERIENCE

October 1994-Present: **Professor (2004-present), Associate Professor (2000-2004) and Assistant Professor (1994-2000)**, Department of Civil and Environmental Engineering, University of California, Berkeley, CA

January 2010-March 2010: **Visiting Academic**, Advanced Water Management Centre, University of Queensland, Brisbane, Australia

July 2003-June 2004: **Visiting Associate Professor**, School of Civil and Environmental Engineering, University of New South Wales, Sydney, Australia

April 1992-June 1994: **Postdoctoral Fellow**, Swiss Federal Institute for Environmental Science and Technology, Dübendorf, Switzerland

July 1986-June 1988: **Staff Scientist**, ENVIRON Corporation, Princeton, New Jersey

### RESEARCH INTERESTS

Fate of wastewater-derived chemical contaminants in conventional and advanced wastewater treatment plants, fate of steroid hormones in the aquatic environment, chemical fate during groundwater recharge and in engineered treatment wetlands, metal speciation in soil and water.

### AWARDS

US National Academy of Engineering Gilbreth Lecturer, 2010  
Fulbright Alumni Initiative Award, 2010  
Fulbright Senior Scholar Award for Australia, 2003  
Paul L. Busch Award for Innovation in Applied Water Quality Research, 2003  
National Science Foundation CAREER Development Award, 1998  
Hellman Family Fund Faculty Award, 1995  
Graduate Student Award, ACS Division of Environmental Chemistry, 1991  
Graduate Student Paper Award, ACS Division of Environmental Chemistry, 1990  
Carl Ladd Scholarship, Cornell University, 1985  
New York State Regents Scholarship, Cornell University, 1982-1986

### PROFESSIONAL AFFILIATIONS AND SERVICE

Associate Editor, *Environmental Science & Technology*  
Associate Editor, *Water Research*

Chair, Gordon Research Conference Environmental Sciences Water, 2004 & 2012  
Member, US EPA Science Advisory Board, Drinking Water Committee, 2002-2009  
Member, US EPA Board of Scientific Counselors Drinking Water Subcommittee, 2005  
Member, US National Research Council Research Committee on Water Reuse, 2008-2011  
Member, American Chemical Society  
Member, Association of Environmental Engineering Professors  
Review Panel Member, National Science Foundation (1998, 2002, 2003, 2006)  
Review Panel Member, USEPA Ecosystem Research Division Peer Review, 2007

## UNIVERSITY SERVICE

Co-Director, Berkeley Water Center  
Deputy Director, NSF Center on Reinventing Urban Water Infrastructure  
Director, Berkeley Environmental Solutions Laboratory  
Executive Committee, UC Toxic Substances Teaching & Research Program, 2002-2009  
Group Leader, Environmental Engineering Program, 2003-2006  
Member, Committee on Undergraduate Prizes, 2003-2007  
Member, Committee on Undergraduate Scholarships and Honors, 2000-2003  
Organizing Committee, California Colloquium on Water, 2001-2009

## PEER-REVIEWED PUBLICATIONS

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- Dickenson E.R.V., Snyder S.A., Sedlak D.L. and Drewes J.E. (2011) Indicator compounds for assessment of wastewater effluent contributions to flow and water quality. *Water Research*, 45(3): 1199-1212.
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- Kim J.Y., Lee C., Sedlak D.L., Yoon J., Nelson K.L. (2010) Inactivation of MS2 by Fenton's reagent. *Water Research*, 44(8): 2647-2653.
- Agus E. and Sedlak D.L. (2010) Formation and fate of chlorination by-products in reverse osmosis desalination systems. *Water Research*, 44(5): 1616-1626.
- Lavado R., Loyo-Rosales J.E., Floyd E., Kolodziej E.P., Snyder S.A., Sedlak, D.L. and Schlenk D. (2009) Site-specific profiles of estrogenic activity in agricultural areas of California's inland waters *Environ. Sci. Technol* 43(24): 9110-9116.
- Pham A.L.T., Lee C., Doyle F.M. and Sedlak D.L. (2009) A silica-supported iron oxide catalyst capable of activating hydrogen peroxide at neutral pH. *Environ. Sci. Technol* 43(23): 8930-8935.
- Lee C. and D. L. Sedlak (2009) A novel homogeneous Fenton-like system with Fe(III)-phosphotungstate for oxidation of organic compounds at neutral pH values. *J. Molec. Catal. A*, 311(1-2): 1-6.

- Dickenson E.R.V., Drewes J.E., Sedlak D.L., Wert E.C. and Snyder S.A. (2009) Applying surrogates and indicators to assess removal efficiency of trace organic chemicals during chemical oxidation of wastewaters. *Environ. Sci. Technol* 43(16): 8930-8935.
- Robrock K.R., Coelhan M., Sedlak D.L. and Alvarez-Cohen, L. (2009) Aerobic biotransformation of polybrominated diphenyl ethers (PBDEs) by bacterial isolates. *Environ. Sci. Technol* 43(15): 5705-5711.
- Keenan C.R., Goth-Goldstein R., Lucas D. and Sedlak D.L. (2009) Oxidative stress induced by zero-valent iron nanoparticles and Fe(II) in human bronchial epithelial cells. *Environ. Sci. Technol* 43(12): 4555-4560.
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- Lee, C. and D. L. Sedlak (2008) Enhanced formation of oxidants from bimetallic nickel-iron nanoparticles in the presence of oxygen. *Environ. Sci. Technol.* 42(22): 8528-8533.
- Keenan C.R. and Sedlak D.L. (2008) Ligand-enhanced reactive oxidant generation by nanoparticulate zero-valent iron and oxygen. *Environ. Sci. Technol* 42(18): 6936-6941.
- Pehlivanoglu-Mantas E. and Sedlak D.L. (2008) Measurement of dissolved organic nitrogen forms in wastewater effluents: concentrations, size distribution and NDMA formation potential. *Water Research*, 42(14): 3890-3898.
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- Lim M.H., Snyder S.A. and Sedlak D.L. (2008) Use of biodegradable dissolved organic carbon (BDOC) to assess the potential for transformation of wastewater-derived contaminants in surface waters. *Water Research*, 42(12): 2943-2952.
- Keenan C.R. and Sedlak D.L. (2008) Factors affecting the yield of oxidants from the reaction of nanoparticulate zero-valent iron and oxygen. *Environ. Sci. Technol* 42: 1262-1267.
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- Gerecke A.C. and Sedlak D.L. (2003) Precursors of *N*-Nitrosodimethylamine (NDMA) in natural waters. *Environ. Sci. Technol.* 37, 1331-1336.
- Mitch W.A. and Sedlak D.L. (2002) Factors affecting the formation of NDMA during chlorination. *Environ. Sci. Technol.*, 36, 588-595.
- Bedsworth W.W. and Sedlak D.L. (2001) Determination of metal complexes of ethylenediaminetetraacetate (EDTA) in the presence of organic matter by high performance liquid chromatography. *J. Chromatography A*, 905, 157-162.
- Huang, C.H. and Sedlak, D.L. (2001) Analysis of estrogenic hormones in municipal wastewater effluent and surface water using ELISA and GC/MS/MS. *Environmental Toxicology and Chemistry*. 20, 133-139.
- Sedlak D.L., Gray J.L. and Pinkston K.E. (2000) Understanding microcontaminants in recycled water. *Environ. Sci. Technol.* 34, 508A-515A.
- Weissmahr K.W. and Sedlak D.L. (2000) Influence of metal complexation on the degradation of dithiocarbamate fungicides. *Environ. Toxicol. & Chem.* 19, 820-826.
- Voelker B., Sedlak D.L. and Zafiriou O.C. (2000) Chemistry of superoxide radical in seawater: reactions with organic Cu complexes. *Environ. Sci Technol.* 34,1036-1042.
- Abu-Saba K., Flegal A.R. and Sedlak D.L. (2000) Reduction of hexavalent chromium by copper in the presence of superoxide. *Marine Chemistry*. 69, 33-41.
- Bedsworth W.W. and Sedlak D.L. (1999) Sources and environmental fate of strongly complexed nickel in estuarine waters: the role of ethylenediaminetetraacetate. *Environ. Sci. Technol.* 33(6): 926-931.
- Zafiriou O.C., Voelker B. and Sedlak D.L. (1998) Chemistry of superoxide radical in seawater: reactions with inorganic Cu complexes. *J. Phys. Chem. A* 102, 5693-5700.
- Weissmahr K.W., Houghton C.L. and Sedlak D.L. (1998) Analysis of the dithiocarbamate fungicides Ziram, Maneb, Zineb and the flotation agent Ethylxanthogenate by ion-pair reversed phase HPLC. *Anal. Chem.* 70, 4800-4804.

- Sedlak D.L., Phinney J.T. and Bedsworth W.W. (1997) Strongly complexed Cu and Ni in wastewaters and surface runoff. *Environ. Sci. Technol.* 31(10), 3010-3016.
- Sedlak D.L. and Chan P.G. (1997) The reduction of Cr(VI) by Fe(II) in natural waters. *Geochimica et Cosmochimica Acta*, 61, 2185-2192.
- Sedlak D.L., David M.M., Hoigné J., Colville R.N., Seyffer E., Wiepercht W., Lind J. and Fuzzi S. (1997) The cloudwater chemistry of iron and copper at Great Dun Fell, U.K.. *Atmospheric Environment*, 31(16) 2515-2526.
- Choularton T.W., Colville R.N., Bower K.N., Sedlak D.L. and others (1997) The Great Dun Fell cloud experiment 1993: an overview. *Atmospheric Environment*, 31, 2393-2405.
- Voelker, B. and Sedlak, D.L. (1995) Iron reduction by photoproduct superoxide in seawater. *Marine Chemistry* 50, 93-102.
- Matthijsen J., Builtjesi P.J.H. and Sedlak D.L. (1995) Cloud model experiments on the effect of iron and copper on tropospheric ozone under marine and continental conditions. *Meteorology and Atmospheric Physics*, 57, 43-60.
- Sedlak D.L. and Andren A.W. (1994) The effect of sorption on the oxidation of polychlorinated biphenyls (PCBs) by hydroxyl radical. *Water Res.* 28(5),1207-1215.
- Sedlak D.L. and Hoigné J. (1994) The oxidation of S(IV) in atmospheric waters by photo-oxidants and iron in the presence of copper. *Environ. Sci. Technol.* 28(11), 1898-1906.
- Sedlak D.L. and Hoigné J. (1993) The role of copper and oxalate in the redox cycling of iron in atmospheric waters. *Atmospheric Environment* 27A(14), 2173-2185.
- Sedlak D.L., Dean K.E., Armstrong D.E. and Andren A.W. (1991) Interaction of quicklime with polychlorobiphenyl-contaminated solids. *Environ. Sci. Technol.* 25, 1936-1940.
- Sedlak D.L. and Andren A.W. (1991) Aqueous-phase oxidation of polychlorinated biphenyls with hydroxyl radicals. *Environ. Sci. Technol.* 25(8), 1419-1427.
- Sedlak D.L. and Andren A.W. (1991) Oxidation of chlorobenzene with Fenton's reagent. *Environ. Sci. Technol.* 25(4), 777-782.

#### **NON-REVIEWED PUBLICATIONS**

- Sedlak, D.L. and von Gunten, U. (2011) The chlorine dilemma. *Science* 331(6013), 42-43.
- Sedlak D.L., Pinkston K.E., Gray J.L. and Kolodziej E.P. (2003) Approaches for quantifying the attenuation of wastewater-derived contaminants in the aquatic environment. *Chimia*, 57(9), 567-569.
- Mitch W.A. and Sedlak D.L. (2002) *N*-Nitrosodimethylamine (NDMA): an emerging chlorine disinfection byproduct. *Water Science & Technology:Water Supply*, 2, 191-198.
- Sedlak D.L. and Pinkston K.E. (2001) Factors affecting the concentrations of pharmaceuticals released to the aquatic environment. *Wat. Res. Update*, 120, 56-64.
- Huang C.H., Renew J.E., Smeby K.L., Pinkston K. and Sedlak D.L. (2001) Assessment of potential antibiotic contaminants in water and preliminary occurrence analysis. *Wat. Res. Update*, 120, 30-40.
- Sedlak D.L., Bedsworth W.W., Jenkins D., Kang S.J. and Murin J. (2000) Assessing methods of removing metals from wastewater: a review of data and methodologies. Final report to the Water Environment Research Foundation: Project 97-CTS-4.
- Sedlak D.L. (1999) Pharmaceutically-active compounds in the aquatic environment and their relationship to water reuse. Proceedings of the 9th biennial symposium on artificial recharge of groundwater. Tempe, Arizona, June 10-12, 1999.

- Sedlak D.L., Bedsworth W.W. and Jenkins D. (1998) The role of speciation in the removal of nickel by the San Jose/Santa Clara Water Pollution Control Plant and its fate in San Francisco Bay. Environmental Engineering Health Sciences Laboratory, report 98-01.
- Sedlak D.L. and Bentley A. (1997) The role of photochemistry in the transport and transformation of arsenic. University of California Water Resources Center Technical Completion Report: UCAL-WRC-W-853.
- Sedlak D.L. (1997) Analytical Techniques for determining metal speciation in polluted waters. 5th International Conference on the Transport, Fate and Effects of Silver in the Environment. Hamilton, Canada, September 4-6, 1997.
- Voelker B.M., Zafiriou O.C. and Sedlak D.L. (1995) Metal redox cycling by photoproduced superoxide radical. 210th National Meeting of the American Chemical Society, Chicago, IL, August 21-26, 1995.
- Sedlak D.L. (1995) The use of ionizing radiation to study reactions of hydroperoxyl and superoxide radicals in sunlit waters. 210th National Meeting of the American Chemical Society, Chicago, IL, August 21-26, 1995.
- Sedlak D.L. and Hoigné J. (1995) Mechanisms of iron redox reactions in sunlit cloudwater. 210th National Meeting of the American Chemical Society, Chicago, IL, August 21-26, 1995.
- Sedlak D.L. and Andren A.W. (1994) Photo-enhanced sorption of silver to bentonite. 2nd International Conference on the Transport, Fate and Effects of Silver in the Environment. Madison, WI, September 11-14, 1994.
- Sedlak D.L. and Hoigné J. (1993) The use of  $\gamma$ -radiation to simulate the free radical chemistry of sunlit waters. 6th European Symposium on the Physico-Chemical Behavior of Atmospheric Pollutants. Varese, Italy, October 1993.
- Hoigné J., Zuo Y., Sedlak D.L., von Piechowski M., Bühler R. (1992) The role of iron and copper species for reactions of photooxidants and photochemical reactions in atmospheric waters. Joint CEC/EUROTRAC Workshop, Leuven Belgium, September 1992.
- Sedlak D.L. and Andren A.W. (1992) Hydroxyl radical transformations of polychlorinated biphenyls in the presence of particles. 203rd National Meeting of the American Chemical Society, San Francisco, CA April 1992.
- Sedlak D.L. and Andren A.W. (1990) Oxidation kinetics of chlorobenzene with Fenton's reagent: reaction pathway, intermediates and kinetics. 199th National Meeting of the American Chemical Society, Boston, MA, April 1990.

#### **INVITED PRESENTATIONS (PARTIAL LIST)**

- “The Past, Present and Future of Potable Water Reuse” Gloyna Lecture, Johns Hopkins University, Department of Environmental Engineering and Geography, Baltimore, MD. April 19, 2011.
- “Closing the Loop on Urban Water Systems” Keynote Borchardt Lecture, The 2011 Borchardt Conference, Ann Arbor, MI. February 23, 2011.
- “Watering the Megacities” National Academy of Engineering, 2011 National Meeting, University of Southern California, Los Angeles. February 10, 2011.
- “Production of Hydroxyl Radicals by Iron-Containing Fenton Catalysts at Circumneutral pH Values. 16<sup>th</sup> Advanced Oxidation Technologies Conference. San Diego, CA. November 16, 2010.
- “Reinventing Urban Water Systems” Gilbreth Lecture, National Academy of Engineering Annual Meeting. Washington, D.C., October 3, 2010.

- “Is Potable Water Reuse a Viable Solution to Urban Water Shortages?” Swiss Federal Institute for Environmental Science & Technology (Eawag). Dübendorf, Switzerland, April 30, 2010.
- “Reinventing Urban Water Systems” 2010 Indo-American Frontiers of Engineering Symposium, Jaypee Palace Hotel, Agra, India March 10-13, 2010.
- “Is Potable Water Reuse a Viable Solution to Urban Water Shortages?” Singapore Public Utilities Board. February 2, 2010.
- “Short-Circuiting the Hydrologic Cycle to Meet Urban Water Needs” 2009 Nobel Conference: H<sub>2</sub>O Uncertain Resource. Gustavus Adolphus College, St. Peter, MN. October 7, 2009.
- “Oxidant Production from Iron Nanoparticles: Mechanisms, Contaminant Transformation and Impacts of Biological Systems” UC Santa Barbara, CA. May 18, 2009.
- “Agricultural Sources of Endocrine-Disrupting Compounds (EDCs) and the Fate of EDCs in Surface Waters and Wetlands” AQWATEC Distinguished Lecturer, Colorado School of Mines. Golden, CO. March 26, 2009.
- “Environmental Engineers Engineering the Environment” Urban Water Security Alliance, Brisbane Australia, January 12, 2009.
- “Oxidant Production from Iron Nanoparticles: Mechanisms and Environmental Implications” Department of Civil and Environmental Engineering, Stanford University, November 7, 2009.
- “Thinking Beyond the Box About the Challenges Posed by Emerging Contaminants” AEESP/WEF Scientist’s Luncheon, WEFTEC 2008, Chicago, IL, October 20, 2009.
- “Engineering Surface Waters to Minimize the Impacts of Steroid Hormones and Related Compounds” Department of Civil and Environmental Engineering, University of Texas, Austin, TX, October 9, 2008.
- “The Oxidation of Organic Compounds with Nanoparticulate Iron” Invited speaker, 5<sup>th</sup> Annual IWA Leading Edge Technology Conference, Zürich, Switzerland, June 3, 2008.
- “Turning Rust Into Gold: Harnessing the Oxidation of Iron to Improve Water Quality” Distinguished Faculty Lecturer, School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA. April 15, 2008 and Environmental Engineering Seminar Series, UCLA, May 20, 2008.
- “Will The Toxics We Pour Down the Drain Come Back and Bite Us?” University of California Research and Teaching Program Annual Meeting, Riverside, CA. April 12, 2008.
- “Treatment and Treatability of Pharmaceuticals in Water Treatment Plants” Society of Toxicology Annual Meeting, Seattle, WA. March 18, 2008.
- “Where Will the Golden State Find its Water in a Brown Future?” Discover Cal Faculty Lecture Series, Los Angeles, CA and San Diego, CA, November 27 and 28, 2007.
- “Can We Transform Ourselves Out of the Risks Posed by Wastewater-Derived Contaminants?” Plenary Speaker, Society of Environmental Toxicology and Chemistry Annual Meeting, Milwaukee, WI, November 12, 2007.
- “Wastewater-Derived Contaminants: A Challenge for the Predictive Tools Developed by Environmental Chemists.” Department of Chemistry, University of South Carolina, Columbia, S.C., October 5, 2007.
- “Sources, Fate and Treatment of Endocrine-Disrupting Compounds in Surface Waters” Bogazici Institute of Technology, Istanbul, Turkey. June 14, 2007.
- “Fate of Wastewater-Derived Organic Contaminants in Engineered and Natural Systems” Pharmaceuticals and Personal Care Products in the Environment Symposium. California Department of Toxic Substance Control, Sacramento, CA. May 22, 2007.

- “EDTA Complexes in Sewage and Their Use as Wastewater Tracers” Plenary Talk, Complexing Agents between Science, Industry, Authorities and Users. Ascona, Switzerland. March 13, 2007.
- “Steroid Hormones and Endocrine Disruption in Agricultural Watersheds” Department of Energy, Environmental and Chemical Engineering, Washington University, St. Louis, MO. March 2, 2007.
- “Sources, Fate and Potential Impacts of Steroid Hormones in the Aquatic Environment” Department of Chemical & Environmental Engineering, UC Riverside. September 29, 2006.
- “Potential Human Health Risks Posed by Chemical Contaminants in Water From Reuse Projects” Workshop on Water Reuse, Physicians for Social Responsibility, Los Angeles. September 28, 2006
- “Emerging Contaminants in San Francisco Bay” Keynote Presentation, San Francisco Estuary Institute 2006 Annual Meeting. Oakland, CA. September 12, 2006.
- “Quantifying Sources and Attenuation of Wastewater-Derived Contaminants” UC Davis Department of Civil and Environmental Engineering. May 22, 2006.
- “Chemical Contaminants in Water Produced by Desalination” AWWA Regional Meeting, San Francisco, CA. April 27, 2006.
- “Quantifying Sources and Attenuation of Wastewater-Derived Contaminants” Environmental Toxicology Program, UC Santa Cruz. April 25, 2006.
- “Oxygen activation by iron and its role in the abiotic transformation of organic compounds” 231st ACS National Meeting, Atlanta, GA. March 28, 2006.
- “Characterization and Fate of rDON” WERF workshop on Organic Nitrogen. Washington, DC. March 10, 2006.
- “Wastewater-Derived Contaminants: Problems and Potential Solutions” National University of Singapore. January 19, 2006.
- “Challenges and Opportunities Associated with Wastewater-derived contaminants” California Water Environment Association, Los Angeles, CA. January 12, 2006.
- “Strategies for Assessing the Fate of Wastewater-Derived Chemical Contaminants” Pacificchem 2005 Congress, Honolulu, HI. December 15, 2005.
- “Challenges and Opportunities Associated with Wastewater-derived contaminants” Department of Chemistry, University of Buffalo, NY. November 11, 2005.
- “Oxidation of Organic Contaminants on Nanoparticulate Zero-Valent Iron” USEPA Workshop on Nanotechnology for Site Remediation, Washington, DC. October 20, 2005.
- “The Significance of PhPCPs in US Drinking Water” American Water Works Association National Meeting, San Francisco, CA, June 15, 2005.
- “NDMA Fate and Transport” WateReuse Association Research Conference, Orlando, FL, May 24, 2005.
- “Tools for Tracking the Fate of Wastewater-Derived Contaminants in Effluent-Dominated Waters” Plenary address, Southern California Society for Environmental Toxicology and Chemistry, Los Angeles, CA, May 21, 2005.
- “Technologies for Enhancing Water Supplies” Berkeley in Silicon Valley Symposium, Santa Clara, CA, May 7, 2005.
- “Protecting human health and aquatic ecosystems from potential impacts of wastewater-derived Contaminants” Departmental seminar, University of Illinois, CAMPWS Program, Urbana, IL November 12, 2004 and Stanford University, Stanford, CA October 15, 2004.

- “Androgen, estrogen and progestin hormones in the aquatic environment” Plenary lecture, SECOTOX 2004, Sogkla, Thailand, September 31, 2004.
- “The use of propranolol enantiomers to discriminate between combined sewer overflows and wastewater effluent discharges” ACS National Meeting, Philadelphia, PA August 25, 2004.
- “Understanding Microcontaminants in Recycled Water”, Keynote presentation, OZ-AQUAREC Workshop IV, Detection, Fate and Removal of Trace Contaminants, Wollongong, Australia, February 13, 2004.
- “The Fate of Wastewater-Derived Contaminants in Engineered and Natural Systems”, Departmental Seminar, CSIRO, Adelaide, Australia, January 29, 2004.
- “Quantification of NDMA Precursors in the Aquatic Environment”, American Water Works Association 2003 National Meeting, Anaheim, CA, June 18, 2003.
- “Wastewater-Derived Chemical Contaminants to Water Providers”, American Water Works Association 2003 National Meeting, Anaheim, CA, June 18, 2003.
- “Occurrence and Treatment of Endocrine Disrupters and Pharmaceuticals in Municipal Wastewater Effluent”, San Gabriel Watermaster, Azusa, CA, May 29, 2003.
- “The Fate of Wastewater-Derived Contaminants in Engineered Treatment Wetlands”, Departmental Seminar, Department of Oceanography, Stony Brook University, Stony Brook, NY, May 2, 2003.
- “Wastewater-Derived Chemical Contaminants to Water Providers”, American Water Works Association California and Nevada Regional Meeting, Reno, NV, October 16, 2002.
- “Wastewater-Derived Chemical Contaminants.” Association of California Water Agencies Conference on Xenobiotics. Sacramento, CA, September 2002.
- "N-Nitrosodimethylamine: The Unexpected Disinfection Byproduct." Gordon Research Conference, Environmental Sciences: Water. Plymouth, NH, June 2002.
- "Emerging Contaminants: New Research Opportunities for Bioremediation Specialists." NIEHS Conference on Bioremediation, Monterey, CA. June 2002.
- "Factors Controlling the formation of N-Nitrosodimethylamine (NDMA) during Chlorination." Water Reuse Foundations, 2001 Annual Research Conference. Monterey, CA.
- "Factors Affecting the Fate of Pharmaceuticals in the Aquatic Environment." National Ground Water Association International Conference on Pharmaceuticals and Endocrine Disrupters. Minneapolis, MN, November 2001.
- "Emerging Issues in Environmental Chemistry." Department of Environmental Toxicology and Chemistry, Oregon State University, Corvallis, OR. November 2001.
- "Effluent-Derived Chemical Contaminants in Recycled Water." Department of Civil and Environmental Engineering, MIT, Boston, MA. November 2001.
- "Endocrine Disrupters in Municipal Wastewater." Department of Environmental Engineering, National Autonomous University of Mexico (UNAM), Mexico City, Mexico. July 2001.
- "Challenges Associated with Quantification of Trace Concentrations of Pharmaceutically-Active Compounds (PhACs) in a Complex Matrix." American Water Works Association Research Foundation Emerging Contaminants Conference, Chicago, IL. April 2001.
- "The Fate and Transport of Hormones in the Aquatic Environment." Environmental Engineering Science seminar series, California Institute of Technology, Pasadena, CA. March 2001.
- "Analytical Challenges Associated with Identification of Endocrine Disrupters in Water." American Water Works Association Special Symposium, Denver, CO. March 2001.
- "Immunochemical Methods for Quantifying Hormones in Polluted Waters." Swiss Chemical Society Meeting, Basel, Switzerland. November 2000.

- "The Environmental Chemistry of Water Reuse." Harvard University College of Engineering and Applied Sciences, May 1999.
- "Pharmaceutically Active Compounds (PhACs) in the Aquatic Environment and their Relationship to Water Reuse." Plenary lecture, 9th Biennial Symposium on Artificial Recharge of Groundwater, Phoenix, AZ, June 1999.
- "The Role of Speciation in the Removal of Cationic Metals by Wastewater Treatment Systems: A Short Course on Metal Removal in Wastewater Treatment Plants." Water Environment Research Foundation, Orlando, FL, October 98.
- "Metals as Catalysts of Sunlight-Induced Reactions in Natural Waters." Geological Society of America, 1998 Annual Meeting, Toronto, Canada, October 1998.
- "Analytical Techniques for Determining Metal Speciation in Polluted Waters." Plenary lecture, Fifth International Argentenum Conference, Hamilton, Ontario, Canada, September 1997.
- "Thermodynamic Data and the Prediction of Metal Speciation in Polluted Waters." National Institute of Standards and Technology (NIST), Gaithersberg, MD, August 1998.
- "The Treatment and Environmental Fate of Strongly Complexed Metals." Department of Civil and Environmental Engineering, UC Davis, November 1997 and Department of Civil Engineering, University of Nevada, Reno, February 1998.
- "Superoxide radical ( $O_2^-$ ) and the Photoredox Chemistry of Copper and Chromium." 18th Annual Meeting of the Society of Environmental Toxicology and Chemistry, San Francisco, CA, November 1997.
- "Analytical Techniques for Determining Metal Speciation in Polluted Waters." Plenary lecture, Fifth International Argentenum Conference, Hamilton, Ontario, Canada, September 1997.
- "The Treatment and Environmental Fate of Strongly Complexed Metals". Department of Civil and Environmental Engineering, UC Davis, November 1997.
- "Strongly Complexed Nickel and Copper Discharged by Anthropogenic Sources." Department of Civil Engineering, Stanford University, Stanford, CA. May 16, 1997.

## **NWRI Expert Panel for the California Department of Public Health**

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CV for Proposed Expert Panel Member:

- Timothy J. Wade, Ph.D.

# Timothy J. Wade

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## EDUCATION

**Ph.D., Epidemiology** **2002**  
**University of California, Berkeley**  
Specific research activities focused on waterborne disease. Received Warren Winklestein Award for outstanding Epidemiology doctoral student

**Master's of Public Health** **1998**  
**University of California, Berkeley**  
Concentration: Epidemiology/Biostatistics

**Bachelor of Arts** **1989**  
**Claremont McKenna College**  
Major: Psychobiology. Elected by faculty to Sigma Xi

**California Polytechnic, Pomona** **1990-1991**  
Graduate coursework in biological science

## PROFESSIONAL EXPERIENCE

**Branch Chief** **August 2010-present**  
**Epidemiology Branch**  
**United States Environmental Protection Agency**

- Determined research priorities and directed staff of 12-15 scientists, post-doctoral students and support staff
- Managed annual budget of over \$1 million dollars annually

**Adjunct Assistant Professor of Epidemiology** **February 2006-present**  
**University of North Carolina, Chapel Hill**  
**School of Public Health**

- Train and mentor pre-doctoral epidemiology students, assist in course instruction

- Epidemiologist** **May 2005-August 2010**  
**United States Environmental Protection Agency**
- Principal investigator on a multi-year recreational water study (NEEAR study) conducted by the EPA.
  - Principal investigator on a series of epidemiologic studies to evaluate the health effects of arsenic exposure in well water in Inner Mongolia (ongoing).
- Epidemiologist/Post doctoral position** **April 2003-May 2005**  
**United States Environmental Protection Agency**  
**Mentor: Rebecca Calderon, Ph.D**
- Project Director** **Oct. 1999-April 2003**  
**Water Evaluation Trial (WET)**  
**University of California Berkeley and the California Emerging Infections Program**
- Project director of a \$3.2 million dollar, federally (Centers for Disease Control, Environmental Protection Agency) funded randomized controlled trial of in home drinking water treatment.
- Post-doctoral researcher** **May 2002-April 2003**  
**School of Public Health, University of California, Berkeley**  
**Mentor: John M. Colford, Jr., M.D. Ph.D**
- Recreational water quality and health
- Assistant Project Manager** **May 1998-May 1999**  
**University of California, Berkeley**
- Assistant project manager for a randomized controlled trial and cross-sectional survey of drinking water in HIV infected persons.
- Assistant Project Director, Data Manager, Data Analyst** **Jan. 1998-May. 2000**  
**University of California Berkeley and the California Emerging Infections Program**
- Data manager for the pilot randomized controlled trial of in home drinking water treatment. Managed day to day activities of the trial, designed and maintained databases, and conducted data analysis.
- Data Manager/Statistician** **June 1997-Jan. 1998**  
**California Environmental Protection Agency, Berkeley**
- Research Assistant** **June 1997-Sept. 1997**  
**University of California, Berkeley**
- Graduate Student Instructor (Biology)** **Aug. 1996-June 1997**  
**University of California, Berkeley**
- Biology Instructor** **1995-1996**  
**Montwood High School, El Paso Texas**

**US Peace Corps Volunteer, US Peace Corps, Lesotho****1991-1994**

- Taught biology, chemistry, general science and mathematics at a rural high school in Lesotho, Africa.

**Environmental Analyst****Sept. 1989-Sept. 1991****Lilburn Corporation and URS Corporation, San Bernardino, California**

- Conducted biological surveys; prepared Environmental Impact Reports, Environmental Impact Statements and Habitat Conservation Plans in compliance with state and federal environmental policies.

**Biology Research Assistant****May 1988-Sept. 1989****Rocky Mountain Biological Laboratory, Gothic, Colorado****Biology Laboratory Instructor****1988-1989****Joint Science Department, Claremont, California****PUBLICATIONS***Peer Reviewed Journals*

**Timothy J. Wade**, Elizabeth A. Sams, Michael J. Beach, Sarah A. Collier, Alfred P. Dufour (2013). The incidence and health burden of earaches attributable to recreational swimming in natural waters. *Environmental Health* 12:67 (**Highly Accessed**)

Gargano, J. W., V. Roberts, E. D. Hilborn, **T. J. Wade**, L. Hicks, L. Garrison, J. Carpenter, E. Adam, B. Mull and J. Yoder (2013). "Surveillance for Waterborne Disease Outbreaks Associated with Drinking Water and Other Nonrecreational Water — United States, 2009–2010." *Morbidity and Mortality Weekly Report (MMWR)* 62(35): 714-720.

**Timothy J. Wade**, Yajuan Xia, Barbara Jane George, Chris X. Le, Dong Runhe, He Lingling, Wayne Cascio, Gene Sanders, Judy Mumford. Well-water and body burden arsenic are associated with glycated hemoglobin (HbA1c) marker of diabetes risk. Submitted to *American Journal of Epidemiology*.

Benjamin F. Arnold, Kenneth C. Schiff, John F. Griffith, Joshua S. Gruber, Vincent Yau, Catherine C. Wright, **Timothy J. Wade**, Susan Burns, Jacqueline M. Hayes, Charles McGee, Mark Gold, Yiping Cao, Stephen B. Weisberg John M. Colford, Jr. Evaluation of widely used exposure and length of follow-up assumptions in recreational water studies: A prospective cohort at Malibu beach. *Epidemiology. Accepted for Publication*

Wymer, Larry J, **Wade, Timothy J** and Dufour, Alfred P (2013). Equivalency of risk for a modified health endpoint: a case from recreational water epidemiology studies. *BMC Public Health*. 13:459

Jane E Gallagher, Elaine Cohen Hubal, Laura Jackson, Jefferson Inmon, Edward Hudgens, <sup>1</sup>Ann H. Williams, Danelle Lobdell, John Rogers, and **Timothy Wade** (2013). Sustainability, Health and Environmental Metrics: Impact on Ranking and Associations with Socioeconomic Measures for 50 U.S. Cities. *Journal of Sustainability. Sustainability*. 5(2), 789-804

Reagan R Converse, Julie L Kinzelman, Elizabeth A Sams, Edward Hudgens, Alfred P Dufour, Hodon Ryu, Jorge W Santo-Domingo, Catherine A Kelty, Orin C Shanks, Shawn D Siefring, Richard A Haugland, **Timothy J Wade** (2012). Dramatic Improvements in Beach Water Quality Following Gull Removal. *Environmental Science and Technology* 46(18): 10206-13.

Reagan R Converse, Larry J Wymer, Alfred P Dufour, **Timothy J Wade** (2012). Comparison of the Means of Multiple Samples with Composite Sample Results for Fecal Indicator Bacteria Using QPCR and Culture. *Applied and Environmental Microbiology* 78(19): 7166-7169.

Colford J.M., Schiff K., Griffith J., Yau V., Arnold B., Wright C.C., Gruber J., Wade T.J., Burns S. and Hayes J. (2012). "Using rapid indicators for *Enterococcus* to assess the risk of illness after exposure to urban runoff contaminated marine water." *Water Research* 46(7): 2176-2186.

Heaney C. D., Sams E., Dufour A. P., Brenner K. P., Haugland R. A., Chern E., Wing S., Marshall S., Love D. C., Serre M., Noble R. E. and **Wade T. J.** (2012). "Fecal Indicators in Sand, Sand Contact, and Risk of Enteric Illness Among Beachgoers." *Epidemiology* 23(1): 95.

Hlavsa M. C., Roberts V. A., Anderson A. R., Hill P.V., Kahler A. M., Orr M., Garrison L. E., Hicks L. A., Newton A., Hilborn E. D., **Wade T. J.**, Beach M. J. and Yoder J. S. (2011). "Surveillance for Waterborne Disease Outbreaks and Other Health Events Associated with Recreational Water --- United States, 2007--2008." *Morbidity and Mortality Weekly Report (MMWR)* 60(ss12): 1-32.

Brunkard J. M., Ailes E., Roberts V. A., Hill V., Hilborn E. D., Craun G. F., Rajasingham A., Kahler A., Garrison L., Hicks L., Carpenter J., **Wade T. J.**, Beach M. J. and Yoder J. S. (2011). "Surveillance for waterborne disease outbreaks associated with drinking water---United States, 2007--2008." *Morbidity and Mortality Weekly* 60: 38-68.

Mo, J., Xia Y., **Wade T. J.**, DeMarini D. M., Davidson M. and Mumford J. (2011). "Altered Gene Expression by Low-Dose Arsenic Exposure in Humans and Cultured Cardiomyocytes: Assessment by Real-Time PCR Arrays." *Int J Environ Res Public Health* 8(6): 2090-2108.

Gibb H., Haver C., Gaylor D., Ramasamy S., Lee J.S., Lobdell D., **Wade T.J.**, Chen C., White P., and Sams R.. Utility of Recent Studies to Assess the National Research Council 2001 Estimates of Cancer Risk from Ingested Arsenic. *Environmental Health Perspectives*. 2011: 119(3): 284–290.

Griffin S.M., Chen I.M., Fout G.S., **Wade T.J.** and Egorov A.I.(2011). Development of a multiplex microsphere immunoassay for the quantitation of salivary antibody responses to selected waterborne pathogens. *Journal of Immunological Methods*. Volume 364, Issues 1-2. Pages 83-93

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Colford J.M., Saha S.R., **Wade T.J.**, Wright C.C., Vu M., Charles S., Jensen P., Hubbard A., Levy D.A., Eisenberg J.N.S. 2005. A pilot randomized, controlled trial of an in-home drinking water intervention among HIV+ persons. *Journal of Water and Health*. 3(2): 173-184

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**Wade T.J.**, Pai N., Eisenberg J.N.S., Colford J.M.. 2003. "Do US EPA water quality guidelines prevent gastrointestinal symptoms? A systematic review and meta analysis". *Environmental Health Perspectives* 111(8): 1102-1109.

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### **Book Chapters**

Dufour, A.P., **Wade, T.J.**, and Kay D. 2012. Chapter 11: Epidemiological studies on swimmer health effects associated with potential exposure to zoonotic pathogens in bathing beach water – a review. In *Animal Waste, Water Quality and Human Health*. Alfred Dufour, Jamie Bartram and Robert Bos, Editors. World Health Organization and IWA Publishing, London.

**T. Wade**, A. P. Dufour, J.A. Soller and L. Wymer (2012). “Microbial Regulations” in Encyclopedia of Environmetrics, Second Edition, A.-H. El-Shaarawi and W. Piegorisch (eds). John Wiley & Sons Ltd, Chichester, UK, pp. 1605-1613. DOI: 10.1002/9780470057339.vnn005

Heaney C. D., **Wade T.J.** and Dufour A.P. (2012). Health Effects Associated with Beach Recreation. The Praeger Handbook of Environmental Health. R. H. Friis. Santa Barbara, California, Praeger. 3: 119-142.

Wymer L.J. and **Wade T.J.** 2007. "The Lognormal Distribution and Use of the Geometric Mean and the Arithmetic Mean in Recreational Water Quality Measurement" in Statistical Framework for Recreational Water Quality Criteria and Monitoring , John Wiley & Sons Ltd., Chichester

Stewart J., Santo Domingo J.W., and **Wade T.J.**. 2007. Introduction to Microbial Source Tracking. In *Microbial Source Tracking*, M. J. Sadowsky and J. W. Santo Domingo (ed.). ASM Press, Washington. DC

### **Reports**

**Wade, T. J.**, E. A. Sams, R. Haugland, K. P. Brenner, Q. Li, L. Wymer, M. Molina, K. Oshima and A. P. Dufour (2011). Report on 2009 National Epidemiologic and Environmental Assessment of Recreational Water Epidemiology Studies, US EPA. EPA Report Number: EPA/600/R-10/168.

**INVITED SEMINARS AND APPOINTMENTS**

**Editorial Board:** Frontiers in Epidemiology (2013-present)

**Invited Participant and Presenter, Ocean Studies Board, National Academies of Science.**

“Linking novel and rapid indicators of recreational water quality to human health effects”. Woods Hole, MA. July 25, 2012.

**Session Chair, International Society for Environmental Epidemiology.** Health effects associated with drinking water infrastructure. Columbia, SC. August 2012.

**Planning Committee, International Conference on Emerging Infectious Disease.** Conference planning committee member. Chaired session on waterborne disease. Atlanta, GA. March, 2012.

**Invited Participant, Inter American University of Puerto Rico, Center for Environmental Education, Conservation and Research.** “US EPA epidemiological studies at Boquerón Beach: data for development of National Regulations.” February, 2012.

**Invited Participant, University of Stirling and National Environment Research Council, Delivering Health Water.** Molecular technology for bathing water regulation, London, United Kingdom. March, 2012.

**Invited Participant, US EPA Office of Research and Development.** Experts Scientific Workshop on Potential Human Health Risks from Exposure to Fecal Contamination from Avian and Other Wildlife Sources in Recreational Waters, November 2011.

**US EPA Office of Water. Invited Speaker. Stakeholder meeting on the development of new or revised recreational water quality criteria.** “Epidemiology studies”. New Orleans, LA. May, 2011.

**Invited Contributor, Encyclopedia of Environmetrics.** “Microbial regulations”, 2011-2012.

**Advisory Panel, Water ReUse Foundation.** Advisory panel for epidemiological studies. 2011

**Session Chair, International Statistical Institute Conference, Dublin Ireland.** “Approaches to estimate the burden of waterborne disease”. August, 2011

**Invited Speaker, AIDIS (Inter-American society for Environmental and Sanitary Engineering).** “Water quality and illness symptoms at Boquerón Beach, Puerto Rico”. Punta Cana, Dominican Republic, November 7-10, 2010

**Grant Review Panel, Centers for Disease Control and Prevention.** Provided scientific merit review for CDC Program Announcement Number CD09-001, Translating Research to Protect Health through Health Promotion, Prevention and Preparedness. August, 2009.

**Advisory Panel, US EPA Office of Water.** Advisory workgroup member for development of recreational water quality criteria. 2009-2012

**Session Chair, EPA National Beaches Conference.** Epidemiology Section (2009 & 2011)

**Peer Reviewer, Water Environment Research Foundation (WERF).** Peer reviewer for WERF-sponsored epidemiology studies of illness resulting from contact with secondary treated, but unchlorinated sewage discharge in the Chicago-area waterway system, 2006-2011.

**Invited Speaker, Gordon Research Conference, Oceans and Human Health.** “Water quality and health effects at Marine Beaches”. June 29 - July 4, 2008, Tilton, New Hampshire.

**Expert Witness, US EPA.** Provided expert deposition on behalf of US EPA recreational water studies. June 4, 2008.

**Workgroup Member, US EPA Office of Research and Development.** Participating member in developing the “Critical Path Science Plan for the development of new or revised recreational water quality criteria”. August 2007.

**Invited Participant, US EPA Office of Water.** Pellston-Style Conference on setting recreational water quality standards. Invited expert on acceptable risk panel. March, 2007.

**Advisory Board, American Water Works Association Research Foundation (AwwaRF). AwwaRF project 4166** “Water Industry Contribution to Epidemiological and Health Effects Studies Involving Distribution System Water Quality”. 2007-present.

**Invited Contributor, US EPA Region 5.** Provided critical support to region by reviewing microbial risk assessment of the effects of sewage discharge to recreators in the Chicago Area Waterways. 2007.

**Invited Referee, Cochrane Infectious Disease Group.** Referee of systematic review/meta analysis on water intervention trials. 2006.

**Invited Contributor, Michigan State Saginaw Bay Coastal Initiative.** Invited expert on panel for the State of Michigan on evaluation of health risks associated with exposure to “muck” and algae in Saginaw Bay on Lake Huron. Dec. 2006-June 2007

**Technical Advisory Committee, State of California.** Advised state of California in their development of new standards for recreational water criteria, 2006.

**Technical Advisory Board, Southern California Coastal Water Research Project.** Technical advisory board member for a series of epidemiologic studies examining swimmers’ health. 2006-present.

**Session Chair, International Society of Environmental Epidemiology.** Recreational water. 16<sup>th</sup> Annual Conference of the International Society for Environmental Epidemiology, New York, August 1-4, 2004.

**Invited Book Review.** Cryptosporidium: from molecules to disease. Elsevier Press. Book review for Emerging Infectious Diseases. September 2004, Volume10(9). Available from: <http://www.cdc.gov/ncidod/EID/vol10no9/04-0566.htm>

**Invited Participant, World Health Organization.** "Guidelines for Recreational Water Quality: Guidelines for Safe Recreational Water Environments". Provided feedback on the revised safe recreational water guidelines. Fall, 2002

#### **CONFERENCE PRESENTATIONS AND POSTERS**

Elizabeth Hilborn, Cynthia Lin, Elizabeth Sams , Andrew Chapman , Alfred Dufour , **Tim Wade.** Health effects associated with cyanobacteria exposure among beach attendees in Puerto Rico. August 11-16, Johannesburg, South Africa.

**Timothy J. Wade,** Reagan R. Converse, Elizabeth A. Sams, Ann H. Williams, Edward Hudgens, Alfred P. Dufour. Gastrointestinal symptoms among swimmers following rain events at a beach impacted by urban runoff. Society for Epidemiological Research. June 19-21, 2013. Boston, MA

Lin CJ, Heaney CD, **Wade TJ,** Noble RT, and Wing S. A repeated-measures study of recreational water exposure, non-point source pollution, and risk of illness. Society for Epidemiological Research. June 19-21, 2013. Boston, MA

Jyotsna Jagai, Cynthia Lin, Genee Smith, and **Timothy J. Wade**. Sanitary sewer overflows and emergency room visits for gastrointestinal illness. Society for Epidemiological Research. June 19-21, 2013. Boston, MA

Kaneatra J. Simmons, Clarissa Curioso, Tarsha Eason, Shannon Griffin, G. Shay Fout, **Tim Wade**, S. Jason Augustine. A Rapid and Sensitive Saliva-based, Multiplex Immunoassay to Measure Human Exposure to Waterborne Pathogens. International Society for Exposure Science. October 28-31, 2012, Seattle WA.

Jagai JS, Smith GS, Schmid J, **Wade TJ**. Trends in Gastroenteritis-Associated Mortality in the United States, 1985 – 2005. Water and Health Conference. *Poster presentation*. October 29, 2012, Chapel Hill, NC.

**Wade TJ**, Sams EA, Dufour, AP. Health burden of gastrointestinal symptoms resulting from swimming in fecally-contaminated recreational waters. Water and Health Conference. *Poster presentation*. October 29, 2012, Chapel Hill, NC.

**Timothy J. Wade**. Swimming-associated exposures and health risks in children. Water and Health Conference. *Invited oral presentation*. October 29, 2012, Chapel Hill, NC.

Alissa Cordner, **Timothy J. Wade**, Elaine Cohen Hubal, Edward E. Hudgens, Stephen W. Edwards, Jane E Gallagher. Impact of environmental chemicals, sociodemographic variables, depression, and clinical indicators of health and nutrition on self-reported health status. *Oral presentation*. 140th American Public Health Association Annual Meeting. October 27 -31, 2012, San Francisco, CA.

**Timothy J. Wade**, Jyotsna S. Jagai, Quanlin Li, Elizabeth D. Hilborn. Emergency room visits for acute gastrointestinal illness following flooding: A case-crossover study. *Poster presentation*. International Society for Environmental Epidemiology. August 26-30, 2012. Columbia, SC

Jagai JS, Li Q, Messier K, **Wade TJ**, Hilborn E. Association between Gastrointestinal Illness and Precipitation in Areas Impacted by Combined Sewer Facilities: Analysis of Massachusetts Data, 2003-2007. *Oral presentation*. International Society for Environmental Epidemiology. August 26-30, 2012. Columbia, SC

**Timothy J. Wade**, Elizabeth Sams, Alfred P. Dufour . Incidence and burden of earaches due to recreational swimming: Results from a nationwide study of over 50,000 respondents. *Accepted poster presentation*. International Society for Environmental Epidemiology. August 26-30, 2012. Columbia, SC

S Hatcher, C Heaney, **T Wade**, E Prevet, J Stewart. Multidrug-Resistant Staphylococcus sp. Isolated from Sand at a Tropical Beach and a Beach Impacted by Non-Point Source Pollution. 112th General Meeting of the American Society of Microbiology. *Accepted poster presentation*. June 16-19, 2012. San Francisco, CA

RR Converse, JL Kinzelman, E Hudgens, EA Sams, AP Dufour, **TJ Wade**. Reductions in Gull Populations Improve Beachwater Quality. 112th General Meeting of the American Society of Microbiology. *Poster presentation*. June 16-19, 2012. San Francisco, CA

G. N. Stelma, Jr., L. C. Wymer, **T. Wade**, A. P. Dufour. Molecular Versus Culture Methods For Monitoring Recreational Waters. 112th General Meeting of the American Society of Microbiology. *Poster presentation*. June 16-19, 2012. San Francisco, CA

Christopher Heaney, **Timothy J. Wade**. Microbial Exposure Assessment of Beach Sand and Exposure-Response Analysis with Symptoms of Enteric Illness. 21st Annual International Society for Exposure Science Conference. October 23-27, 2011. Baltimore, MD

S. Augustine, C. Curioso, T. Eason, S. Griffin, S. Fout, **T. Wade**, K. Simmons. Development of a Rapid and Sensitive Saliva-based, Multiplex Immunoassay to Measure Human Exposure to Waterborne Pathogens. 21st Annual International Society for Exposure Science Conference. October 23-27, 2011. Baltimore, MD

**Timothy J. Wade**, Judy Mumford, Yajuan Xia, Gene Sanders. Arsenic Exposure and Health Effects in Inner Mongolia. American Public Health Association Annual Meeting. November 1, 2011. Washington DC.

JS Jagai, Hilborn E., **Wade T.J.**, Rates of Gastrointestinal Illness Among areas Impacted by Combined Sewer Facilities: Analysis of Massachusetts Data, 2003-2007. Water and Health Conference: Where Science Meets Policy. October 3-7, 2011.

**Timothy J. Wade**, Alfred P. Dufour, Larry Wymer. Modeling indicators of water quality and swimming associated illness. International Statistical Institute Conference. August 21-26, 2011. Dublin, Ireland.

**Timothy J. Wade**, Rich A. Haugland, Larry Wymer, Elizabeth Sams, Kevin Oshima, Kristen Brenner. Alfred P. Dufour. Indicators of water quality and health effects at a tropical and a runoff impacted beach. 2011 National Beaches Conference. March 15-17, 2011. Miami, Florida

Gallagher, J.; Cohen-Hubal, E.; Inmon, J.; Jagai, J.; Lobdell, D.; Jackson, L.; **Wade, T.** Correlates of Health, Sustainability and Environmental Metrics for 50 of the Most Populous U.S. Cities. In *Proceedings of the 1st World Sustain. Forum*, 1-30 November 2011; Sciforum Electronic Conferences Series, 2011.

**Timothy J. Wade**, Rich A. Haugland, Larry Wymer, Alfred P. Dufour. Molecular measures of fecal indicator bacteria and swimming-associated gastrointestinal illness. Water and Health Conference: Where Science Meets Policy. October 23-26, 2010. Chapel Hill, NC.

Prevette, EB, CD Heaney, **TJ Wade**, E Sams and JR Stewart. Beach Sand Analysis for Indicators of Microbial Contamination. 2010 Water and Health Conference: Where Science Meets Policy. October 23-26, 2010. Chapel Hill, NC.

**Timothy J. Wade**. Gulf of Mexico Alliance. Gulf Of Mexico Alliance Coastal Pathogens Risk Assessment Workshop. Oct 13-15, 2010. Sarasota, Florida.

**Timothy J. Wade**. US EPA Region 4 State Beach Program Managers Meeting. Water quality and health effects at a runoff impacted beach. February 28, 2010. Jekyll Island, GA.

**Timothy J. Wade**, Rich A. Haugland, Larry Wymer, Elizabeth Sams, Kevin Oshima, Kristen Brenner. Alfred P. Dufour. Indicators of water quality and health effects at a tropical and a runoff impacted beach. 2011 National Beaches Conference. March 15-17, 2011. Miami, Florida

**Timothy J. Wade**, et al. International Society for Exposure Science. Recreational water exposure: Duration, intensity and ingestion. November 2-5, 2009. Minneapolis, MN.

**Timothy J. Wade**, Alfred P. Dufour, et al. National Beaches Conference. Water quality and health effects at Marine Beaches. April 20-22, 2009. Huntington Beach, CA.

**Timothy J. Wade**. Gulf of Mexico Alliance. Pathogen Workshops Threesome. EPA Beaches Epidemiology Studies February 10-13, 2009. St. Pete Beach, Florida.

AI Egorov, GS Fout, **TJ Wade**. Salivary antibody as a novel indicator of incident waterborne infections. Can it help to evaluate the beneficial health effect of improvements in water treatment? US EPA Human Health BOSC review, Long Term Goal Four RTP, NC, January 13-15, 2009.

Shannon Hunt, G. Shay Fout, Ing Chen, **Tim Wade**, and Andrey Egorov. (2008). Application of a multiplex immunoassay for detection of salivary antibody responses to selected potentially waterborne pathogens. International Society of Environmental Epidemiology and International Society for Exposure Analysis, Pasadena, CA, October 12-16 2008.

**Timothy J. Wade**. *Invited Speaker*. Water quality and health effects at Marine Beaches. Gordon Research Conference Oceans and Human Health, June 29 - July 4, 2008, Tilton, New Hampshire.

Judy Mumford, **Tim Wade**, Gene Sanders, Yajuan Xia, Jinyao Mo. Cardiovascular and other health effects associated with arsenic exposure in Inner Mongolia, China. Annual Meeting of the Society of Toxicology, Seattle Washington, March 16-17, 2008.

Shannon Hunt, **Tim Wade**, G. Shay Fout, Andrey Egorov, Salivary antibody responses as an indicator of waterborne infections: pilot community study before and after installation of UV treatment. Poster presentation at the Public Health Applications of Human Biomonitoring workshop sponsored by USEPA and International Council of Chemical Associations September 24-25, 2007, Research Triangle Park, NC

**Timothy J. Wade**. *Invited Speaker*. Recreational Waters. Federal-State Toxicology and Risk Analysis Committee Meeting. October 17-19, 2007.

**Tim Wade**. 2007. *Invited Speaker*. Swimming-Associated Illness and Rapid Measures of Water Quality at a Gulf Beach. Invited Speaker. National Environmental Health Association Annual conference. June 25-27, Atlantic City, New Jersey.

Shannon Hunt, G. Shay Fout, Mary Rothermich, **Tim Wade**, Andrey Egorov . Evaluation of salivary antibody immunoassay for detection of Cryptosporidium infections. Poster presentation at the 2007 annual meeting of the American Society of Parasitologists. June 22-24, 2007, Merida, Yucatan, Mexico.

Dingwall M, Wool M, Jasim-Hanif, **Wade T**, Egorov A, Williams AJ. 2007. Recruitment and Retention for a Hispanic Population: Results from a Community Health Study. American Association for Public Opinion Research, Annual Conference. Anaheim, California May 20, 2007.

**Wade TJ**, Calderon RL, Brenner KP, Sams E, Beach M, Haugland R, Wymer LJ and Dufour AP, Rapid Measurement of Water Quality – Will it Make a Difference?, at the 2007 Bacteria/Microbe EPA Region 10 Conference, sponsored by the Washington State Department of Ecology and the US Environmental Protection Agency, Tacoma, WA., May 2007.

**Wade TJ et al**. 2006. A Faster Method Of Measuring Recreational Water Quality For Better Protection Of Swimmers' Health. National Beaches Conference, Niagara Falls, NY, October 10-13, 2006.

Heaney C, **Wade TJ et al**. 2006. Exposure to sand during beach recreation and risk of illness: Results from the National Epidemiological and Environmental Assessment of Recreational (NEEAR) Water Study. National Beaches Conference, Niagara Falls, NY, October 10-13, 2006.

Sams E, **Wade TJ et al**. 2006. Illness severity and burden among Great Lake beach visitors. National Beaches Conference, Niagara Falls, NY, October 10-13, 2006.

**Wade TJ**. 2006. Mortality and morbidity due to arsenic exposure in Inner Mongolia, China International Society for Environmental Epidemiology. Paris, France, September 2-6, 2006.

**Wade TJ.** 2006. *Invited Speaker.* Non-human sources of recreational water contamination: What we know and don't know about human health risk. Co-Regulator Pathogens Workshop: Bacteria Criteria for Inland Waters. Dallas, TX. May 2-3, 2006

**Wade TJ.** 2006. *Can faster methods of measuring recreational water help prevent swimming associated illness?* International Society for Environmental Epidemiology. Paris, France, September 2-6, 2006.

**Wade TJ.** 2006. *Can faster methods of measuring recreational water help prevent swimming associated illness? Invited speaker.* American Society of Microbiology. Orlando, Florida, May 21-25 2006.

**Wade TJ.** 2005. Are new and faster ways of measuring recreational water predictive of swimming associated illness? An epidemiologic investigation at four Great Lake Beaches. *Invited speaker.* Annual Public Health Days (JASP), Quebec City, Canada, November 15, 2005

**Wade TJ.** 2005. Can Faster Methods of Measuring Recreational Water Prevent Swimming Associated Illness? Presented at the US EPA Science Forum, May 17, 2005, Washington DC.

Jinyao Mo, Yajuan Xia, Zhixiong Ning, **Tim Wade** and Judy Mumford. 2005 Increased *OGG1* expression in peripheral blood cells of individuals exposed to arsenic-contaminated drinking water. Annual Meeting of American Association for Cancer Research, held in Anaheim, CA, April 16-20, 2005.

**Wade TJ.** *Invited Speaker.* The National Environmental and Epidemiologic Assessment of Recreational Water: The relationship between novel indicators of water quality and health. WEF/AWWA/IWA/AWPCA Disinfection Specialty Conference. Phoenix Arizona, February 7, 2005.

**Wade TJ,** The National Environmental and Epidemiologic Assessment of Recreational Water: The relationship between novel indicators of water quality and health. Presented at the National Beaches Conference. October 14, 2004.

**Wade TJ,** The National Environmental and Epidemiologic Assessment of Recreational Water: The relationship between novel indicators of water quality and health. Presented at the 16<sup>th</sup> Annual Conference of the International Society for Environmental Epidemiology, New York, August 1-4, 2004.

Sams E, Calderon R, **Wade TJ,** Beach M Brenner K, Williams A, Dufour A. GIS analysis for epidemiological recreational water studies. Poster presentation, 16<sup>th</sup> Annual Conference of the International Society for Environmental Epidemiology, New York, August 1-4, 2005.

Colford J, **Wade TJ,** Schiff K, Brookhart A, Arunajadai, S, Burns S, Hayes J, Sandhu S, Wright C, Weisberg S. The correlation between indicator organisms and health in recreational water in a cohort of beachgoers at Mission Bay, California during the summer of 2003. Presentation at the 16<sup>th</sup> Annual Conference of the International Society for Environmental Epidemiology, New York, August 1-4, 2005.

**Wade TJ,** The National Environmental and Epidemiologic Assessment of Recreational Water: The relationship between novel indicators of water quality and health. Presented at USEPA Science Forum. June 3, 2004. Washington DC

Colford JM, **Wade TJ,** Sandhu SK, Wright C, Burns S, Benker A, Lee S, Brookhart A, van der Laan M, Levy D. A randomized, blinded, crossover trial of an in-home drinking water intervention

to reduce gastrointestinal illness. Presented at the International Society of Environmental Epidemiology. September 26, 2003. Perth, Australia

**Wade TJ**, Calderon RL, Colford JM. Studying endemic waterborne disease through randomized trials of in home drinking water treatment. Presented at the USEPA's Research on Microorganisms in Drinking Water conference. June 6, 2003.

Colford JM, Wade TJ, Pai N, Eisenberg JNS. 2002. Empiric Evidence for Associations between Indicator Organisms and Health Effects in Recreational Water. Invited presentation to the National Academies of Science, National Research Council, Indicators for Waterborne Pathogens Committee. September 4, 2002. Washington DC.

Dufour A., Calderon RL, Beach MJ, **Wade TJ**, Sams E: National Epidemiological and Environmental Assessment of Recreational Water Study. Great Lakes Beach Annual Meeting. October 22, 2003. Muskegon, Michigan.

**Wade TJ**, Pai N, Eisenberg JNS, Colford JM. Do US EPA water quality guidelines prevent gastrointestinal symptoms?. American Public Health Association. November 2003. San Francisco, CA.

Colford, JC, Saha S, Scott H, Wright CW, **Wade TJ**, Eisenberg JNS. Sonoma Water Evaluation Trial (SWET): A randomized, controlled cross-over trial of in home drinking water intervention in persons over age 55. American Public Health Association. November 2003. San Francisco, CA.

**Wade TJ**, Sandhu SK, Wright CC, Lee S, Katz LM, Shaw SE, LeChevallier MW, Levy DA, Colford JM, Jr. An increase in gastrointestinal illness associated with historic flooding of the Mississippi River: Disease surveillance from a randomized trial of in-home drinking water treatment. International Conference of Emerging Infectious Disease, Atlanta GA. March 24-27, 2002.

Rees JR, **Wade TJ**, Mills DS, Levy DA, Colford JM Jr. Approaches to the analysis of the health effects of HPC bacteria: Results from a randomized, controlled trial of home drinking water treatment. International Conference on HPC bacteria in drinking water, Geneva, Switzerland, April 2002

#### **AD HOC JOURNAL REVIEWS**

American Journal of Epidemiology  
American Journal of Public Health  
Bulletin of the World Health Organization  
Canadian Journal of Public Health  
Emerging Infectious Diseases  
Environmental Science and Technology  
Environmental Health  
Environmental Health Insights  
Environmental Health Perspectives  
Epidemiology and Infection  
Journal of Environmental Management  
Journal of Infection and Public Health  
Journal of Ocean Technology  
Journal of Toxicology and Environmental Health  
PLoS One  
Scientific World Journal  
Toxicology and Applied Pharmacology

Water  
Water Research  
Society for Epidemiological Research-Abstract Reviews.

#### AWARDS

**EPA Office of Water Bronze Medal, 2011:** Exceptional service to Office of Water in development of recreational water quality criteria

**EPA Office of Research and Development Honor Award, 2010.** Exceptional/Outstanding ORD Technical Assistance to the Regions or Program Offices. Beaches Field Team.

**Level III EPA STAA award recipient, 2010.** For publication: “High sensitivity of children to swimming associated gastrointestinal illness”. Epidemiology, 2008

**EPA Office of Research and Development Bronze Medal, 2007:** For work with the Office of Water on developing the “Critical Path Science Plan for the development of new or revised recreational water quality criteria”.

**Office of Research and Development Honor Award, 2006.** Exceptional/Outstanding ORD Technical Assistance to the Regions or Program Offices. Individual award for superior technical support to the Office of Water and EPA Regions to improve recreational water quality and protect human health.

**Level I EPA STAA (Science to Achieve Results) award recipient, 2006 :** Protecting Swimmers’ health with faster ways of measuring water quality.

**Warren Winklestein Award, Outstanding Epidemiology Doctoral Student, 2002:** Selected by Epidemiology faculty at UC Berkeley as the outstanding doctoral student of 2002.

**Outstanding Graduate Student Instructor, 1999:** Selected by students and faculty as an Outstanding Graduate Student Instructor, for teaching of Public Health 250B, Advanced Epidemiological Methods.

**Universitywide Aids Research Program Scholarship recipient, 1998:** Competitive scholarship, selected by UARP committee. Awarded financial assistance to travel and attend the UARP yearly conference and disseminate information to colleagues at UC Berkeley.

#### TEACHING AND MENTORING

**Lecturer-Environmental Epidemiology. Gillings School of Public Health, University of North Carolina, Chapel Hill.** Yearly guest lecturer and contributor for waterborne disease material. 2003-present.

**Lecturer-Advanced Epidemiological Methods. School of Public Health, University of California, Berkeley.** Yearly guest lecturer for Public Health 250B, Advanced Epidemiological Methods. Subject: power calculations, statistical sampling and study design. Yearly guest lecturer for Epidemiology/Biostatistics MPH seminar. Subject: randomized controlled trials and water intervention trials. 1999-2003.

**Advanced Epidemiological Methods Instructor. School of Public Health, University of California, Berkeley.** Graduate Student Instructor for Public Health 250B, Advanced Epidemiological Methods. Prepared weekly two hour lectures. Voted by faculty and students as an Outstanding Graduate Student Instructor. 1999-2000.

**Graduate Student Instructor (Biology). University of California, Berkeley.** 1996-June 1997  
**Biology Instructor. Montwood High School, El Paso Texas.** 1995-1996.

**Dissertation Committee, University of North Carolina, Chapel Hill. Department of Epidemiology. Department of Environmental Sciences and Engineering, Yvonne Yuen.** Studies on approaches to measure coliphage in the environment. 2011-Present

**Dissertation Advisor and Mentor, University of North Carolina, Chapel Hill. Department of Epidemiology, Christopher Heaney.** Studies of the microbial quality of sand and association with health. 2006-2010.

**Thesis Advisor and Reader. University of North Carolina, Chapel Hill. Department of Environmental Sciences and Engineering, Kaida may R. Liang.** “Evaluation of biosand filter in rural Cambodia”. 2007

**Thesis Advisor and Mentor, North Carolina State University, Department of Statistics, Justin Telech.** Advised and guided Mr. Telech in his Master’s Thesis in Statistics on modeling fecal indicator bacteria concentrations at beach sites. 2006-2007.

**University of North Carolina, Chapel Hill. Department of Environmental Sciences and Engineering. Thesis advisor and reader, Emylee Privette.** “Beach Sand Analysis for Indicators of Microbial Contamination”. 2008-2010.

**Dissertation Reader. Monash University, Monash Australia, Shelly Rodrigo.** “Health Risk Associated with Consumption of Untreated Rainwater in Metropolitan South Australia.” 2011.

#### **PROFESSIONAL AFFILIATIONS**

International Society of Environmental Epidemiology (member)

Society for Epidemiological Research (member)

**REFERENCES**

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