

**House Subcommittee on Investigations and Oversight
and
House Subcommittee on the Environment
Committee on Science, Space, and Technology, U.S. House of Representatives
Room 2318 Rayburn House Office Building**

**“EPA Advisory Committees: How Science Should Inform Decisions”
July 16, 2019**

**Written Testimony submitted by Deborah L. Swackhamer, Ph.D.
Professor Emerita, University of Minnesota**

My name is Deborah Swackhamer, and I am a Professor Emerita from the University of Minnesota, in Minneapolis and Saint Paul, where I held appointments in Environmental Health Sciences in the School of Public Health, and in Science, Technology, and Public Policy in the Humphrey School of Public Affairs. I also co-directed the Water Resources Center in Minnesota. I am trained as an environmental chemist, with an emphasis on understanding toxic chemical movement in the environment and human exposures. I served as Chair of the U.S. Environmental Protection Agency (EPA) Science Advisory Board from 2008-2012, and served as Chair of the EPA’s Board of Scientific Counselors from 2015-2017. I continue to hold a Special Government Employee (SGE) appointment at EPA, but currently do not serve on any committees. I speak to you today as an environmental sciences and policy expert, and as a private citizen, and not on behalf of the U.S. EPA. My perspectives and statements are mine alone.

Key points of this testimony

- 1) Strong multidisciplinary science is essential for EPA to meet its mission.
- 2) External, independent expert science advice is critical to ensure that EPA is supported by the best science.
- 3) EPA and ORD science would be diminished without an effective BOSC.
- 4) Interference with scientific advisory boards at EPA will lead to the loss of scientific integrity at the agency, and is consistent with a broader pattern of science misuse at the agency.

Strong multidisciplinary science is essential for EPA to meet its mission. The EPA is charged with protecting human health and the environment. This widely encompassing mandate is highly complicated. The many issues affecting human health require understanding pollutant sources to air, water, and soil; the movement of pollutants through air, water, and soil; the exposures of these pollutants to people through breathing, eating, drinking and through the skin; then understanding the impacts to human health at the cellular, genetic, metabolic, and organ levels; and finally

the outcomes of these impacts such as illness, reproductive disorders, various diseases, cancer, etc. There are hundreds of known pollutants, and thousands of potential pollutants. While EPA regulates individual pollutants, we know that there are all kinds of interactions (environmentally and toxicologically) that increase the actual complexity of this in an exponential manner. This complexity requires many diverse fields of scientific expertise be brought to bear to help achieve EPA's mandate: environmental engineering; air and water pollutant modeling; water resource expertise; environmental biology, microbiology, and chemistry; exposure science; ecology; and human, wildlife, and aquatic toxicology. However, since people live in communities, and pollution generally correlates inversely with economic health, understanding solutions for pollution also requires expertise in economics, geography, sociology, community planning, vulnerable populations, and environmental justice.

External expert science advice is critical to ensure that EPA is supported by the best science. The Congress passed the Federal Advisory Committee Act (FACA) in 1972 in recognition of the need for Federal agencies to get expert science advice for these highly complex problems such as environmental protection. In doing so, they formalized a consistent and transparent process for agencies to follow when establishing these committees to ensure independence of the advice, public access to the advice, and accountability and transparency of the agency's use of science.

The EPA is a science-based regulatory agency. To meet its mandate it must use the most current, robust, and accepted scientific evidence available. It is understood that effective environmental policy must be based in strong science, and that without strong science environmental policy is weakened and ineffective. For EPA to meet its mandate, it is essential that it use the best scientific evidence to guide its policies and decision-making. Advice from external, independent scientific experts are key to achieving this goal.

The role of advisory committees is generally two-fold. The first role is to provide external, objective advice to EPA. They are the independent eyes looking in from outside, able to examine scientific evidence, make constructive recommendations, and provide peer review. The second role is to provide the EPA with access to an expanded pool of expertise. The EPA does not have the resources to have all the many facets of environmental science covered by agency staff, and thus having access to leaders in environmental research from outside the agency is a huge advantage to informing their own research priorities (e.g. BOSC) or reviewing their scientific evidence for regulations (e.g. CASAC, SAB). Their peer review work also makes EPA more accountable to the public. Thus, if the external science advisory role is diminished or tarnished by a lack of independence, the integrity of the science used by EPA is also diminished and tarnished. And this leads to weak environmental protections and actions.

EPA and ORD science would be diminished without an effective BOSC. EPA conducts its own research on a number of topics, to be sure that the necessary science needed to understand environmental protection is available to them. The Board of Scientific Counselors (BOSC) was created by EPA in 1996 to specifically advise the

Assistant Administrator of the Office of Research and Development (ORD) on what the scope and direction of internal research should be, and to ensure the highest quality of the research being conducted. Such on-going review allows for mid-course corrections, infusion of new and innovative ideas, as well as constructive support for the research program.

ORD is a relatively small enterprise, and thus BOSC plays an important role in keeping it “on-point”. ORD targets its research programs to fill in the gaps that external research doesn’t fill, such as the research provided by universities and other research laboratories. For example, it develops tools and models that the State environmental agencies can use to help implement the Clean Water Act or Safe Drinking Water Act – something basic research laboratories might not do. BOSC helps identify those gaps, identify where research might be duplicated elsewhere, identify potential external partnerships to maximize effectiveness, and advises on emerging issues that EPA research should get a jump-start on. Without BOSC, ORD runs the risk of getting isolated from outside research advances, being unnecessarily redundant and wasteful, and it could easily fall behind in focusing on timely issues.

Interference in the process of appointing BOSC members can be highly disruptive to the ability of BOSC to assist and advise ORD. On April 28, 2017 the members of BOSC who had served one of their allowed two terms were assured by senior ORD staff that their appointments would be renewed for a second term. On May 4, one week later, the Administrator’s Office reversed this recommendation and announced that none of these members’ terms would be renewed. The reasons given to the media for this decision were that “*The Administrator believes we should have people on this board who understand the impact of regulations on the regulated community*” (New York Times) and “*...(the Administrator) is considering new applicants, including those who may work for chemical and fossil fuel companies...*” (Associated Press). This created the perception that the intent of the Administrator’s Office was to remove independent research scientists and replace them with people having a vested interest in the regulatory actions of EPA. On June 19, 2017, all of the members of the five BOSC subcommittees who were up for a second term also had their memberships terminated. Regardless of the motive, it meant that BOSC was stripped of the vast majority of its members, all its future scheduled meetings were canceled, and thus it could not provide timely advice to ORD on a number of important pending matters – one being recommendations on how to absorb proposed budget cuts, and reprioritize research programs as a result; the other was the review of the next edition of strategic research plans for the 6 research areas in ORD. I was removed as Chair of BOSC on October 31, 2017. It took from June until November 2017 to repopulate BOSC. The newly reconstituted BOSC had their first Executive Committee meeting in early June 2019 – nearly 2 years to the day after the non-renewals. This action on the part of EPA resulted in significant disruption of the iterative and on-going process of external scientific advice provided to ORD, important time lost while EPA research and planning proceeded without the benefit of BOSC advice.

It should be noted that the Administrator took similar actions against the SAB and CASAC. Second term appointments were denied to members, and the committees were reconstituted

to create biased, non-independent committees. In addition to time lost, the politicization of these committees greatly diminishes their ability to provide robust and independent scientific advice to the agency.

Interference with scientific advisory boards at EPA will lead to the loss of scientific integrity at the agency, and is consistent with a broader pattern of science misuse by the agency. Why would the EPA Administrator's Office interfere with the science advisory committees? The aggressive changes made to the advisory committee eligibility and composition are unprecedented at EPA. It is my concern that they are populating the committees (especially SAB and CASAC) with a significant number of members who have a vested interest in EPA actions and regulations, thus co-opting the committees in order to support the overall direction of the agency to deregulate fossil fuel and other industries and loosen environmental protections, rather than provide independent advice based on solid science. The EPA administration has demonstrated a pattern of selectively cherry-picking scientific evidence, of ignoring rigorous scientific evidence, or simply politicizing science to justify its actions. While regulations can be affected by politics, science never should be. The interference with the independence and composition of the science advisory committees is a direct attack on the integrity of science, and leads to an erosion of the scientific underpinning of agency regulations. Ultimately this may result in weakened environmental protections, degradation in our country's environmental condition, and an erosion in the health and well-being of our communities.

Deborah L. Swackhamer, PhD
Professor Emerita, University of Minnesota

Dr. Deborah L. Swackhamer is Professor Emerita at the University of Minnesota in Science, Technology, and Public Policy in the Humphrey School of Public Affairs and Environmental Health Sciences in the School of Public Health. She also directed the University of Minnesota Water Resources Center from 2002 until 2014. She received a BA in Chemistry from Grinnell College, IA and an MS and PhD from the University of Wisconsin-Madison in Water Chemistry and Limnology & Oceanography, respectively. After two years post-doctoral research in Chemistry and Public & Environmental Affairs at Indiana University, she joined the Minnesota faculty in 1987. She officially retired from the University in 2015, and continues to work informally with researchers and decision makers on water resource policy.

In 2012 Dr. Swackhamer completed a 4 year term as Chair of the Science Advisory Board of the US Environmental Protection Agency, and served as a member of the Science Advisory Board of the International Joint Commission of the US and Canada from 2000-2013. She served as Chair of the US EPA Board of Scientific Counselors from 2015-2017. She served as President of the National Institutes of Water Resources in 2011-2012. She is a member of the National Academy of Sciences Board of Environmental Science and Toxicology, and a member of the Steering Committee of the Environmental Health Matters Initiative.

Dr. Swackhamer received the prestigious Founders Award from the Society of Environmental Toxicology and Chemistry for lifetime achievement in environmental sciences in 2009. She is a lifetime Fellow in the Royal Society of Chemistry in the UK. In 2014 she was named an Inaugural Fellow of the international Society of Environmental Toxicology and Chemistry. She received the Warren A. Hall Medal from the Universities Council on Water Resources in 2017 for her lifetime achievements in water resources research and education.

Curriculum Vita

DEBORAH L. SWACKHAMER

Professor Emerita of Science, Technology, and Environmental Policy,
Humphrey School of Public Affairs
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EDUCATION

- 1976 A.B. in Chemistry, Grinnell College, Grinnell, Iowa.
1981 M.S. in Water Chemistry, University of Wisconsin, Madison,
Wisconsin.
1985 Ph.D. in Oceanography and Limnology, University of Wisconsin,
Madison, Wisconsin.

POSITIONS HELD

- 3-85 to 11-86 Postdoctoral Research Associate, School of Public and Environmental
Affairs and Department of Chemistry, Indiana University,
Bloomington, Indiana.
12-86 to 6-92 Assistant Professor, Environmental and Occupational Health, School
of Public Health, University of Minnesota, Minneapolis, Minnesota.
7-92 to 7-00 Associate Professor, Environmental and Occupational Health, School
of Public Health, University of Minnesota, Minneapolis, Minnesota.
7-00 to 7-15 Professor, Environmental Health Sciences, School of Public Health,
University of Minnesota, Minneapolis, Minnesota.
9-02 to 8-03 Research Scientist Associate, Division of Science and Collections,
Science Museum of Minnesota. Stationed at the St. Croix Watershed
Research Station, Marine-on-St Croix, MN.
9-03 to 7-14 Co-director, Water Resources Center, University of Minnesota, St.
Paul, MN.
10-06 to 8-08 Interim Director, Institute on the Environment, University of
Minnesota, Minneapolis, MN.
1-09 to 7-12 Professor and Charles M. Denny, Jr. Chair in Science, Technology,
and Public Policy, Hubert H. Humphrey School of Public Affairs,
University of Minnesota, Minneapolis, MN.
1-09 to 7-15 Professor of Science, Technology, and Environmental Policy, Hubert
H. Humphrey School of Public Affairs, University of Minnesota,
Minneapolis, MN.

PROFESSIONAL ASSOCIATIONS

American Chemical Society
Society of Environmental Toxicology and Chemistry
International Association for Great Lakes Research
Sigma Xi

HONORS AND AWARDS

Grinnell College Youngers Honor Scholarship 1972-76; ACS Junior Analytical Chemistry Award 1975; Grinnell College Senior Woman Alumni Award 1976; Mortar Board Society 1975-76, President Grinnell Chapter 1976; University of Wisconsin Anna Grant Birge Summer Scholarship 1984; Clean Air Award, American Lung Association of Minnesota, 1989; Faculty Excellence Award in Environmental Health, 1988-1989; Faculty Excellence Award in Environmental Health, 1999-2000; IBC International Scientist of the Year 2001; Harvey G. Rogers Environmental Leadership Award from the Minnesota Public Health Association 2007; Fellow, Royal Society of Chemistry (UK) 2007; Founders Award, Society of Environmental Toxicology and Chemistry 2009; Ada Comstock Scholar Award, University of Minnesota 2010; Inaugural Fellow, Society of Environmental Toxicology and Chemistry, 2014; Warren A. Hall Medal for lifetime achievements in water resources research and education, the Universities Council on Water Resources 2017.

RELEVANT PROFESSIONAL ACTIVITIES

2000-2013	Member, Science Advisory Board of the International Joint Commission of the US and Canada
2002-2008	Member and Chair, Great Lakes Environmental and Molecular Sciences Center Technical Advisory Board, Western Michigan University, Kalamazoo, MI.
2003-2008	Member, Science Advisory Board of the National Undersea Research Program for the North Atlantic and Great Lakes, NOAA.
2003-2004	Fellow, Academic Leadership Program of the Commission on Institutional Cooperation.
2003-2012	Member, Science Advisory Board, US Environmental Protection Agency.
2005-2011	North American Editor, and Chair, Editorial Advisory Board. <i>Journal of Environmental Monitoring</i> , published by the Royal Society of Chemistry.
2005-2013	Member, Editorial Advisory Board, <i>Environmental Science & Technology</i> , published by the American Chemical Society.
2006-2008	Member, Board of Scientific Councilors, US Environmental Protection Agency.

2007-2016	Member, Clean Water Council for the State of Minnesota (Governor appointment).
2008-2012	Chair, US Environmental Protection Agency Science Advisory Board.
2009-2012	Appointed member, Vermillion Highlands Steering Committee, DNR and University of Minnesota.
2009-2012	Member, NAS/NRC Review Panel for the Third Cycle of the USGS National Water-Quality Assessment (NAWQA) Program.
2006-2012	Member, Board of Directors, National Institutes of Water Resources.
2010-2011	President, National Institutes of Water Resources.
2011-2013	Member, NAS/NRC Committee on Sustainability Linkages in the Federal Government.
2012-2015	Member, Advisory Board for the Environmental Engineering and Earth Science Department, Clemson University.
2012-2015	Member, Water Science Center Advisory Board, University of Michigan, Ann Arbor, MI.
2013-2015	Member, NAS/NRC Committee on Strengthening the U.S. Environmental Protection Agency Laboratory Enterprise.
2014-2016	Member, Health Effects Institute Committee on National Research Strategy for Unconventional Oil and Gas Extraction, Boston, MA.
2015-2017	Chair, US Environmental Protection Agency Board of Scientific Counselors, Washington, D.C.
2015-present	Member, standing Board of Environmental Science and Toxicology (BEST) of the National Academies of Science, National Research Council, Washington, D.C.
2019-present	Member, Environmental Health Matters Initiative of the National Academies of Science, National Research Council, Washington, D.C.

PEER REVIEWER OR GUEST EDITOR

Environmental Science and Technology
 Environmental Toxicology and Chemistry
 Journal for Great Lakes Research
 ACS Advances in Chemistry Book Series
 Science
 Proceedings of the National Academy of Sciences (PNAS)
 Aquatic Toxicology
 Journal of Microbial Ecology
 Canadian Journal of Fisheries and Aquatic Sciences
 Science of the Total Environment

GRADUATE STUDENT MENTORING ACTIVITY

Graduated Advisees: 9 PhD, 51 MS

Graduate Faculty Appointments in Environmental Health, Water Resources Science, and Science, Technology and Environmental Policy programs.

Service on Graduate Student Examining Committees: 65 PhD, 90 MS

CLASSES TAUGHT (Primary Instructor)

Environmental Chemistry

Environmental Analytical Methods

Environmental Exposure Analysis

Ethics for Water Resources Science

Our Common Waters: Making Sense of the Great Lakes

Water Policy

RESEARCH INTERESTS

Dr. Swackhamer has studied the processes affecting the behavior and fate of persistent organic compounds including PCBs, dioxins, and pesticides in the Great Lakes for the past 30 years, including sediment accumulation, source determinations, water column processes, and foodweb bioaccumulation. Her recent research is on exposures and impacts of contaminants of emerging concern in aquatic systems, and the development of science-based water and chemical management policy.

GRANTS AND CONTRACTS

"Role of Physical Chemical Properties in Controlling PCB Uptake by Algae," University of Minnesota Graduate School, 12/1/86-6/30/87, \$12,000.

"Role of Physical Chemical Properties in Controlling PCB Uptake by Algae," Biomedical Research Support Grant, National Institutes of Health, 12/15/86-12/15/87, \$8,900.

"Quality Assurance Program for Sample Collection and Analyses: Green Bay Study," U.S. Environmental Protection Agency, 12/1/86-11/30/89, \$93,000.

"Role of Physical Chemical Properties in Controlling PCB Bioaccumulation in Algae," Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 10/1/86-9/30/88, \$15,000.

"Bioaccumulation of PCB and PCDF in Lake Superior Phytoplankton," Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 10/1/87-9/30/89, \$57,800.

"Concentration and Toxicity of Pesticide Metabolites in Minnesota Drinking Water," with J.B. Stevens, Biomedical Research Support Grant, National Institutes of Health, 3/1/87-3/1/88, \$26,280.

"Identification and Characterization of DNA- and Glutathione-Hydroxyquinone Adducts," Biomedical Research Support Grant, National Institutes of Health, 6/1/87-6/1/88, \$4,984.

- "Comparison of Methodologies for Measuring PCBs in Particulate and Dissolved Phases in Green Bay Water," with S.J. Eisenreich, U.S. Environmental Protection Agency, 7/15/87-4/15/88, \$72,900.
- "Contaminant Recycling in Lake Superior Bottom Waters by Bacteria," University of Minnesota Graduate School, 12/1/87-6/30/89, \$5,000.
- "Organochlorine Compounds and Metabolites in Human Milk," Biomedical Research Support Grant, National Institutes of Health, 2/1/88-2/1/89, \$6,099.
- "Pesticide Metabolites in Minnesota Groundwater," Minnesota Water Resources Research Center, U.S. Geological Survey, 7/1/88-6/30/90, \$36,246.
- "Microbial Recycling of Hydrophobic Organic Compounds and Organic Carbon," National Undersea Research Program, National Oceanic and Atmospheric Administration, 6/1/88-12/31/88, \$5,019 plus ship and submersible time.
- "Role of Phytoplankton in Bioaccumulation of PCBs in the Green Bay Foodchain," U.S. Environmental Protection Agency, 7/1/88-6/30/91, \$158,065.
- Midwest Cooperative Park Studies Unit, Co-investigator with 37 University of Minnesota investigators, National Park Service.
- "Pesticide Breakdown Products Survey," Principal Investigator, Minnesota Department of Health and Legislative Commission on Minnesota Resources, 7/1/89-6/30/91, \$330,000.
- "Dioxin from Incinerator Emissions," Co-investigator with Professor S.J. Eisenreich, Minnesota Pollution Control Agency and Legislative Commission on Minnesota Resources, 7/1/89-6/30/91, \$296,000.
- "Role of Phytoplankton in Contaminant Behavior in Lakes," Principal Investigator, Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 1/1/90-12/31/91, \$55,450.
- "Processes Controlling HOC Recycling and Fate at the Sediment-Water Interface," Principal Investigator, National Undersea Research Program, National Oceanic and Atmospheric Administration, 4/1/90-3/31/91, \$14,984 plus ship and submersible time.
- "Data Certification and Interpretation for Green Bay Mass Balance Study," Principal Investigator, U.S. Environmental Protection Agency, 7/1/90-5/30/92, \$106,074.
- "PCB Sediment Trap Fluxes in Green Bay," Co-investigator with Professor S.J. Eisenreich, U.S. Environmental Protection Agency, 7/1/90-6/30/91, \$71,970.
- "Microbial Recycling of Contaminants at the Sediment Water Interface in Freshwater," Principal Investigator, with Professor Randall Hicks (UM-Duluth), EPA Exploratory Research Program, 1/91-1/93, \$224,337.
- "Atmospheric Deposition of Toxic Contaminants to the Great Lakes," Co-Investigator with Professors Steven J. Eisenreich and David T. Long (Michigan State University), Great Lakes Protection Fund, 1/91-1/94, \$460,354.

- "Organic and Inorganic Contaminants in the Sediments and Waters of Lakes Michigan and Ontario," Co-Investigator with S.J. Eisenreich, US Environmental Protection Agency, 8/15/91-8/14/94, \$500,700.
- "PCB Congener Analysis of Five Lakes in the Area of the Apostle Islands, Lake Superior," Principal Investigator, US Geological Survey, 7/1/91-6/30/92, \$22,084.
- "HOC Recycling within Lake Michigan, the Role of Microbial Activity," Principal Investigator, U.S. Environmental Protection Agency, 9/1/91-8/31/93, \$105,200.
- "Dynamics of PCB Bioaccumulation and Removal by Phytoplankton," Principal Investigator, Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 2/1/92-1/31/94, \$69,600.
- "Role of Algal Lipids in Bioaccumulation in Aquatic Foodwebs", Principal Investigator, Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 2/1/94-1/31/96, \$70,470.
- "Uptake and Loss of PCBs by Phytoplankton," Principal Investigator, U.S. Environmental Protection Agency, 9/1/93 - 8/31/95, \$173,070.
- "The Role of the Benthic Nepheloid Layer in Foodchain Exposure to Toxic Chemicals," Principal Investigator with David DeVault (U.S. EPA), National Undersea Research Program, National Oceanic and Atmospheric Administration, 2/94-7/95, \$35,899 plus ship and submersible time.
- "PCB Concentrations in Algae from the Milwaukee and Manitowoc Rivers", Principal Investigator, U.S. Department of the Interior, 9/1/94 to 9/30/95, \$15,500.
- "Contaminant Transfer in the Lake Michigan Lower Pelagic Foodweb", Principal Investigator, with Prof. Ed Nater (UMN), U.S. Environmental Protection Agency, 6/13/94 to 7/13/97, \$450,000.
- "Bioavailability, Trophic Transfer and Fate of Pollutants in the Aquatic Environment," Principal Investigator (part of Consortium funded by U.S. EPA headed by Prof. Herb Allen (University of Delaware), University of Delaware, 9/15/94 to 9/15/99, \$59,768.
- "PCBs and Toxaphene in Lake Superior Fishes", Principal Investigator, MN Pollution Control Agency, 9/94-9/96, \$110,000.
- "The Role of Algal Lipids in Bioaccumulation in Aquatic Foodwebs", Principal Investigator, U.S. Department of Commerce/NOAA/Sea Grant, 2/1/95-1/31/96, \$41,071.
- "PCB Congeners in Marsh Birds in Green Bay Coastal Wetlands," Principal Investigator, U.S. Department of the Interior, National Biological Service, 7/15/95-7/14/97.
- "Effect of *Bythotrephes* on PCB Biomagnification in Salmonids," Principal Investigator, Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 2/96-1/98, \$60,140.
- "Toxaphene in the Lower Foodweb of Lake Michigan," Principal Investigator, U.S. Environmental Protection Agency, 8/97 - 8/99, \$138,867.

- "Origin of Particulate Matter and Distribution of HOC in Benthic Nepheloid Layer of Large Lakes," Co-Investigator, with Profs. Joseph Atkinson and Joseph DePinto (SUNY-Buffalo), National Undersea Research Program, National Oceanic and Atmospheric Administration, 2/96-1/97, \$28,389 plus ship and submersible time.
- "Interdisciplinary Center for Ecological Risk Assessment," Co-Principal Investigator with Prof. Ken Sexton (UMN), University of Minnesota Graduate School, 7/96-6/98, \$20,000.
- "Reducing Uncertainty in Estimating Toxaphene Loading to the Great Lakes", Principal Investigator with Prof. Ronald Hites (Indiana University), U.S. Environmental Protection Agency, 9/96-8/99, \$650,151.
- "Atmospheric and NonPoint Pollution Trends in Minnesota Lakes," Co-Investigator with Drs. Edward Swain (MN Pollution Control Agency) and Daniel Engstrom (Science Museum of Minnesota), State Legislative Commission on Minnesota Resources, 7/97-6/00, \$325,000.
- "Midwest Ecological Risk Assessment Center", Principal Investigator, University of Minnesota Graduate School, 7/98-6/00, \$100,000.
- "Effects of Environmental Estrogens on Fish in the Vicinity of Metro Treatment Plant, St. Paul", Principal Investigator with Drs. Ira Aldelman and Peter Sorensen (UMN), Metropolitan Council Environmental Services, 3/99 - 3/02, \$200,381.
- "Bioaccumulation of Hydrophobic Organic Compounds by Phytoplankton", Principal Investigator, National Science Foundation, 7/99-7/01, \$200,000.
- "The Analyses of Toxaphene and Total Organic Carbon in River Sediments", Principal Investigator, Minnesota Pollution Control Agency, 7/99-9/01, \$55,528.
- "Assessing the Validity of Vitellogenin as a Biomarker of Endocrine Disruption in Populations of Fish", Principal Investigator with Drs. Peter Sorensen, Heiko Schoenfuss, and Ira Adelman (UMN), National Sea Grant College Program, National Oceanic and Atmospheric Administration, 7/00 - 6/02, \$298,000.
- "Trends in Great Lakes Fish Contaminants", Principal Investigator, U.S. EPA Great Lakes National Program Office, 7/00 - 6/03, \$305,994.
- "Bioaccumulation of Emerging Contaminants in Lake Superior Fish", Principal Investigator, Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 2/01 - 1/03, \$37,072.
- "Microbial Facilitation of Organic Carbon and Contaminant Transfers into the Lake Superior Foodweb", Co-principal Investigator with Dr. James Cotner (UMN), Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 2/01 - 1/03, \$46,458.
- "Funding for the Gordon Research Conference in Environmental Sciences"; Principal Investigator, National Science Foundation, 4/02-3/03, \$25,000.
- "Development and Evaluation of Chemical Indicators for Monitoring Ecological Risk", Principal Investigator with Matt Simcik (UMN), a subproject for "Development of Environmental Indicators of Condition, Integrity, and Sustainability in the Great

- Lakes", Gerald Niemi, Principal Investigator (UMN-Duluth), U.S. EPA Star Grant, 2/01 - 1/05, \$737,853 (\$6 million total).
- "Trends in Great Lakes Fish Contaminants", Principal Investigator, U.S. EPA Great Lakes National Program Office, 9/03 - 8/05, \$299,194.
- "Postdoctoral Fellowship Program in Environmental Chemistry", Principal Investigator with Drs. Bill Arnold and Kris McNeill (UMN), Dreyfus Foundation, 7/03-6/05, \$97,000.
- "Photochemistry of Pharmaceuticals and Estrogens in Surface Waters: Persistence and Potency", Co-principal Investigator with Drs. Kris McNeill (PI) and Bill Arnold, National Institute of Water Resources, US Geological Survey, 9/03-8/05, \$134,070.
- "Hydrophobic Organic Contaminants in Lake Michigan Water", Co-principal Investigator with Dr. Matt Simcik (PI), U.S. EPA Great Lakes National Program Office, 9/03 - 8/06, \$400,000.
- "Environmental Estrogens: Assessing their Identity and Exposure Pathways to Fish", Principal Investigator, Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 4/1/04-3/31/06, \$86,897.
- "Immunoaffinity: A Novel Approach for Identifying Biologically Active Environmental Estrogens in Great Lakes Coastal Estuaries", Principal Investigator, Minnesota Sea Grant Program, National Oceanic and Atmospheric Administration, 7/05-6/07; \$75,444.
- "Estrogenic Compounds: Tracking the Generation and Partitioning in Wastewater Treatment Plants", Co-investigator with Paige J. Novak (PI) and Michael J. Semmens, Legislative Commission on Minnesota Resources, 7/05-6/07, \$300,000.
- "Development of a Great Lakes Basin Screening Model for Emerging Chemicals", Principal Investigator, Great Lakes Commission, 5/06-7/08, \$201,680.
- "Collaborative Research: Formation of Polyhalogenated Dioxins and Furans from Triclosan and PBDEs in Rivers", Co-investigator with William Arnold (PI) and Kris McNeill, National Science Foundation, 5/06 - 5/08, \$260,000.
- "Statewide Conservation and Preservation Plan", Principal Investigator, Legislative and Citizens Commission on Minnesota Resources, 7/01/07 - 12/30/08, \$540,000.
- "Statewide Sustainable Water Resources Framework", Principle Investigator, Minnesota Legislature, 7/1/09 - 1/15/11, \$750,000.
- "Understanding Sources of Aquatic Contaminants of Emerging Concern", Principle Investigator, Legislative Citizen Commission on Minnesota Resources, 7/1/10 - 6/30/14, \$640,000.
- "Workshop to Develop a National Research Strategy for Contaminants of Emerging Concern", National Science Foundation, 5/1/10 - 12/31/10, \$40,000.
- "Reforming Risk Management of Toxic Chemicals: National Science and Policy Needs to Protect Public Health", Principal Investigator, U of M Consortium on Law and Life Sciences, 5/1/10 - 6/30/12, \$29,000.

“Identifying and Evaluating Best Practices for Adaptive Management of Water Resources”, Principal Investigator, US Army Corp of Engineers and US Geological Survey, 11/11 – 11/12, \$199,000.

“Scoping Study to Design a Water Congress”, Principle Investigator, McKnight Foundation, 11/1/11-10/31/12, \$25,000.

PEER-REVIEWED PUBLICATIONS

Armstrong, D.E. and D.L. Swackhamer. 1983. PCB accumulation in southern Lake Michigan sediments: evaluation from core analysis. In: Physical Behavior of PCBs in the Great Lakes, D. Mackay, S. Patterson, S.J. Eisenreich, M.S. Simmons, eds. Ann Arbor Science Publishers, Ann Arbor, Michigan.

Weininger, D., D.E. Armstrong, and D.L. Swackhamer. 1983. Application of a sediment dynamics model for estimation of vertical burial rates of PCBs in southern Lake Michigan. In: Physical Behavior of PCBs in the Great Lakes, D. Mackay, S. Patterson, S.J. Eisenreich, M.S. Simmons, eds. Ann Arbor Science Publishers, Ann Arbor, Michigan.

Swackhamer, D.L. and D.E. Armstrong. 1986. Estimation of the atmospheric and non-atmospheric contributions and losses of PCBs to Lake Michigan based on sediment records of remote lakes. *Environ. Sci. Technol.* 20, 879-883.

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