

Appendix B2

Groundwater Stewardship
Committee October 2011
Summary of Findings and
Recommendations



GROUNDWATER STEWARDSHIP COMMITTEE

October 2011 Summary of Findings and Recommendations Cadiz Groundwater Conservation, Recovery and Storage Project

The Groundwater Stewardship Committee (GSC) is a multi-disciplinary panel of earth science and water professionals assembled to provide advice and comment on the proposed Cadiz Conservation, Recovery and Storage Project (Project). The GSC specifically reviewed:

- 1) Project operating strategies to maximize the beneficial use of groundwater without causing harm to the resource, natural and built environment and community, and
- 2) proposed monitoring and mitigation strategies to be incorporated into a groundwater management plan for the Project.

Maximizing beneficial use of groundwater is defined as reducing the loss of groundwater to evaporation from the dry lakes by pumping and delivery of this water to meet Southern California water demands. The roster of the GSC members is attached.

Project background.

The Project site is located at the base of the Fenner Valley Watershed and Orange Blossom Wash upgradient of the Bristol and Cadiz Dry Lakes. The combined area of these watersheds is in excess of 1,300 square miles. Cadiz, a private company, owns land, under which the bulk of the groundwater flows, and on which the Project facilities will be located. The GSC understands that the Company has access to the ARZC Railroad right of way that provides private pipeline access to the Colorado River Aqueduct. The GSC understands that Cadiz actively farms approximately 1,500 acres under prior land use approvals and could expand the operation to as many as 9,600 acres.

As proposed, the Project would be implemented in two phases. The first phase emphasizes control of hydraulic gradients by groundwater pumping that would provide for:

- 1) active capture of natural recharge, within the watershed, and
- 2) recovery of groundwater, presently in storage, that would otherwise continue to flow under natural gradients toward the dry lakes and be lost to evaporation.

The Project would withdraw an average of 50,000 acre-feet per year (AFY) over a 50-year period, with individual annual extractions varying in any year between 25,000 to 75,000 acre feet to suit the needs of the people of Southern California. The GSC understands that future water conservation would benefit from the dewatered storage in the aquifer (effectively a “subsurface reservoir”) and hydraulic control that will allow deep and secure storage of large quantities of imported water. Imported water can be stored as the volume of dewatered storage increases and elimination of hydraulic gradients away from the well field toward the dry lakes. The GSC did

not evaluate the technical proposals for future conservation. However, the GSC supports the general concept and is willing to review or comment upon any such proposals.

GSC findings and recommendations.

The GSC was presented with historical and new technical investigations of geology, hydrogeology, climatic data, groundwater recharge, groundwater conditions, water quality, air quality, and plant and vegetation surveys. These reports document no observed plant or wildlife that relies upon groundwater (except springs in the mountains, which are not dependent upon the alluvial aquifer from which the Project wells will extract groundwater). The GSC reviewed technical reports prepared by Cadiz consultants to evaluate potential impacts for the first phase of the Project in four specific areas including: (1) subsidence; (2) springs; (3) air quality; and (4) water quality degradation.

The most recent evaluation of natural recharge estimate is 32,500 acre-feet per year; however, a range of recharge estimates, higher and lower, has been developed by previous investigators. Therefore, to assess the potential magnitude of impacts, the modeling and impact analysis employed three different recharge scenarios; 5,000 AFY, 16,000 AFY and 32,000 AFY. The Project is designed to extract an average of 50,000 AFY regardless of actual natural recharge, so this range of natural recharge was assessed to examine the impacts of the Project extraction, allowing for conservative natural recharge estimates and assessment of potential impacts.

The anticipated withdrawal of groundwater in the proposed well field will intercept natural recharge and retrieve groundwater in storage that is currently escaping to the dry lakes. The range of potential evaporation from the dry lakes has been estimated to be between 12,000 AFY on the low end and as high as 143,000 AFY on the high end. However, actual evaporation is expected to balance actual recharge, so that long-term average annual recharge is equal to the long-term average annual evaporation off the dry lakes. Although there is some variability in the projected evaporation rates from the dry lakes, assuming the highest evaporation over a 100-year period, as much as 2.2 million acre-feet could be saved from evaporation, and used for public benefit if the Project is implemented as proposed. To achieve this objective, there will be potential drawdown in well-field groundwater levels that may range from 70 feet to 270 feet depending upon the actual quantity of natural recharge, variations in aquifer hydraulic properties, and well-field design. Based on the information available, the committee finds that the average annual extraction of 50,000 AFY for 50 years is feasible and that total average annual extraction of 50,000 AFY can be applied to the cumulative agricultural and Project demands. The GSC understands that if the Project is carried out as proposed, to produce an annual average of 50,000 AFY for delivery to Project participants, the agricultural use of groundwater is expected to cease.

The GSC reviewed and discussed the methods of investigation and evaluation and concludes that these analyses are reasonable and consistent with standard professional practice and adequately assess the four identified areas of potential impacts from the proposed Project, as described below.

Subsidence. Significant subsidence is not expected in any of the scenarios. The Fenner Gap area is underlain by sediments that are not rich in clays and silts, which are normally associated with subsidence. There is increasing silt and clay content in the alluvial aquifer sediments nearer the dry lakes, which is where subsidence, if any, is projected to be 2.7 feet under the lowest natural recharge scenario which creates the highest groundwater drawdown. Permanent compaction due to subsidence would not significantly impact the alluvial aquifer's storage capacity as consolidation of the aquifer will occur in clay and silt intervals, which do not contribute to the useable storage capacity anyway. However, we recommend that the Project managers consult with the railroad and pipeline companies and include extensive monitoring for early warning in the interest of safety. Monitoring through the use of extensometers, designated bench marks, In-SAR (interferometric synthetic aperture radar), and the ability to manage pumping patterns in concert with the monitoring in the event significant subsidence is observed would mitigate problems.

The springs. The springs in the watershed area rely on rainfall recharge of shallow fractured bedrock, and there is no evidence that the springs are dependent on the deep alluvial groundwater system from which the Project proposes to pump groundwater or that they will be affected in any way by the pumping. All of the springs are more than 11 miles away and are located in fractured crystalline (granitic and metamorphic) rocks at substantially higher elevations than the alluvial aquifer from which the Project wells will pump groundwater. Therefore, pumping in the alluvial aquifer in the Project well field should not affect groundwater levels in these crystalline rocks, so it will not adversely impact springs. Nevertheless, the GSC supports ongoing observation of the springs and the flow conditions as proposed, including the closest spring (Bonanza Spring), and several more distant springs (such as Whiskey and Vontrigger) for comparison and to account for climatic changes.

Air quality. The GSC reviewed the technical reports provided on the Bristol and Cadiz Dry Lakes that conclude that these dry lakes do not pose a substantial risk of elevated dust levels arising from the underlying sediments being dewatered. High concentration of chloride salts in the surface soils act to bind the surface soils so as to minimize soil becoming airborne as dust. The GSC also reviewed the technical report on the dry lakes that revealed that plant life in the area of the dry lakes is precipitation and runoff fed and does not rely upon groundwater. The evidence presented in these reports seems conclusive. However, verification monitoring is strongly recommended to confirm these conclusions. Monitoring can be relaxed if these findings are further proven during Project operations.

Water quality. The migration of saline (> 1,000 mg/l) groundwater towards the well field is predicted by modeling to be less than 12,000 feet. The modeling demonstrates that the movement is not increased under the higher drawdown levels that are associated with the lower recharge rates, as these scenarios have low aquifer transmissivity. There are no known or projected beneficial users of fresh (<1,000 mg/l) groundwater in the affected area. However, monitoring and mitigation elements of the groundwater management plan are proposed to monitor this condition. If necessary and appropriate, the migration could potentially be stabilized through either extraction of saline groundwater (which possibly could be used by the salt mines), injection of fresh water to create a barrier to mitigate further migration, or alteration of pumping patterns. These approaches are reasonable.

Concluding summary

The GSC finds that the average annual extraction of 50,000 AFY for 50 years is feasible. The GSC concludes that the monitoring, proposed action criteria, and mitigation elements are reasonable and, if adopted, should provide assurance against harm resulting from the conservation, recovery, and beneficial use of groundwater as proposed in the Project. The GSC recommends that proposed monitoring elements be adopted and incorporated into a groundwater management plan for the Project.

GROUNDWATER STEWARDSHIP COMMITTEE MEMBERS

- Jack Sharp, Professor of Geology, University of Texas (Chair)
- Terry Foreman, CH2M Hill
- Dennis Williams, Geoscience
- Bill Blomquist, Indiana University
- Andrew Stone, American Ground Water Trust
- Greg Thomas, Natural Heritage Institute
- Bob Wilkinson, The Bren School of Environmental Science and Management, University of CA at Santa Barbara
- Steve McCaffrey, University of the Pacific, McGeorge School of Law
- Rod Banyard, Australia Water Policy Branch, Department of Environment and Water Resources
- Tim Parker, Parker Groundwater
- Toby Moore, Golden State Water Company
- Charles Groat, Director of the Center for International Energy and Environmental Policy, University of Texas

Dr. John M. Sharp, Professor Geology, University of Texas

EDUCATION:

Ph.D., 1974, M.S., 1974, University of Illinois. Ph.D. dissertation: An Investigation of Energy Transport in Thick Sequences of Compacting Sediments.

32 semester hours, Midwestern University. Business Administration (attended nights while in the U.S. Air Force). Emphasis on economics and management science.

B. Geological Engineering with Distinction, 1967, University of Minnesota (emphasis on rock mechanics, porous media flow, and site development). B.Geol.E. thesis: Eastern Minnesota Copper Prospects, 43p.

PROFESSIONAL EXPERIENCE:

The University of Texas, Austin, Texas: 1982-present, currently David P. Carlton Professor of Geology

C.S.I.R.O. Centre for Groundwater Studies, Adelaide, Australia, 1994, visiting scientist

U.S. Geological Survey, Reston, Virginia, 2010, visiting scientist

University of Missouri, Columbia, Missouri: 1974 -1982, associate professor

University of Illinois, Urbana, Illinois: 1971-1974, Teaching Assistant and Research Fellow

U.S. Air Force: 1967-1971 – Captain (civil engineering)

SELECTED SERVICES TO PROFESSION:

Geological Society of America: President and Councilor; Executive Committee; Finance Committee; GSA representative to the Council of Scientific Society Presidents; Editor, Environmental and Engineering Geoscience; GSA Representative to U.S. Committee, International Assoc. of Hydrogeologists; Associate Editor, Geological Society of America Bulletin; Chairman, Hydrogeology Division

American Institute of Hydrology: Chairman, Board of Registration; Executive Committee; Vice President for Academic Affairs; Registration Board; Editorial Board: Hydrological Science and Technology

National Research Council: Advisory Committee on the Waste Isolation Pilot Plant (WIPP)

International Association of Hydrogeologists: Scientific Advisory Committee, 2012 International Conference on Groundwater in Fractured Rocks, Prague, Czech Republic; North American Scientific Advisory Committee, 2012 39th Congress, Niagara Falls, Canada; Executive Committee & Finance Committee (US National Committee); Treasurer; Chairman (US National Committee); co-editor, Selected Papers Volume 9, Groundwater in Fractured Rocks; Vice Chairman, Commission on Education and Training; Vice President; Associate editor, Journal of Hydrogeology

Council of Scientific Society Presidents; 2010 Treasurer; 2009-2011 Board of Directors

Other miscellaneous services to profession:

Editor board, Aqua mundi

Biological Advisory Team for the Barton Springs/Edwards Aquifer Conservation District
Edwards Aquifer Authority, Aquifer Sciences Advisory Panel

Luminant Energy (formerly Texas Utilities Co.) Environmental Steering Committee

Terry Foreman, Vice-President, CH2M Hill, Thousand Oaks, CA

Terry Foreman's roles at CH2M HILL include Senior Hydrogeologist, Vice President and the Thousand Oaks Area Office Manager. Mr. Foreman's technical expertise is in the management and development of groundwater resources, including water supply development, conjunctive use of surface waters, groundwater, and recycled water, remediation of contaminated groundwater, and regulatory support. Mr. Foreman has over 30 years of consulting experience in water resources projects, mostly in the Southwestern United States. Mr. Foreman has served as project manager for the Las Posas Basin ASR project, the largest ASR project in California, the West Basin Water Recycling Program Injection Barrier Project, which involves injection of highly treated wastewater into the 9-mile long West Coast Basin Seawater Intrusion Barrier, the Dominguez Gap Seawater Intrusion Barrier Extension project. Mr. Foreman has authored over 30 technical papers and presentations. Mr. Foreman received his Bachelors and Masters degrees in Geology from the University of Missouri – Columbia. He is a Registered Geologist and Certified Hydrogeologist in California. He is on the Board of Directors of the American Ground Water Trust, where he has held offices of Secretary, Vice Chairman, and Chairman (2002). He is the President of the Central Coast Branch of the Groundwater Resources Association of California.

Dennis Williams, Geoscience

Dr. Dennis E. Williams, founder and president of the Southern California based firm GEOSCIENCE Support Services, Inc. has over 35 years of experience in ground water hydrology. During that time he has directed geohydrologic investigations domestically and worldwide which includes the design and supervision of construction of over 800 deep large-scale municipal and irrigation water supply wells. Dr. Williams also pioneered the use of slant wells for desalination feedwater supply. He has been a consultant to the United Nations and several foreign governments and is currently a part-time research professor at the University of Southern California's Civil and Environmental Engineering Department where he has taught graduate level courses in geohydrology and ground water modeling since 1980. Dr. Williams is currently directing research on ground water and wells at USC's geohydrologic laboratory which houses the largest sand-tank model in the world. Dr. Williams is author of over 30 publications on ground water and wells and was the principal author of the Handbook of Ground Water Development (John Wiley & Sons, 1990); the Handbook was awarded Honorable Mention in the

Engineering Category of the Fifteenth Annual Awards for Excellence in Professional and Scholarly Publishing by the Association of American Publishers. Dr. Williams was also chief reviewer for the American Society of Civil Engineers (ASCE) Manual of Water Well Design, Construction, Testing and Maintenance and primary author for two chapters, Water Well Construction, and Developing and Testing, and of Appendix Example of Water Well System Design (currently in press). Dr. Williams is a contributor for three entries in the Encyclopedia of Water: "Radial Wells", "Well Tests", and "Well Screens" published by John Wiley and Sons. Dr. Williams is a technical consultant to the American Water Works Association (AWWA) Standards Committee for Wells (ANSI/AWWA A100-04).

William Blomquist, Dean, School of Liberal Arts, Indiana University

William Blomquist is Dean of the School of Liberal Arts, Professor of Political Science, and Adjunct Professor of Public and Environmental Affairs, at Indiana University Purdue University Indianapolis (IUPUI). He is also an affiliated faculty member of the Workshop in Political Theory and Policy Analysis, and the Center for Earth and Environmental Science. The focus of his teaching is American government and public policy.

He received his B.S. in Economics (1978) and M.A. in Political Science (1979) from Ohio University, and his Ph.D. in Political Science (1987) from Indiana University. He joined the IUPUI faculty in 1987.

His research interests concern governmental organization and public policies, with a specialization in the field of water institutions and water management. He is the author or co-author of several publications related to these topics, including the books *Dividing the Waters* (1992), *Common Waters, Diverging Streams* (2004), and *Integrated River Basin Management through Decentralization* (2006), and articles in *Society and Natural Resources*, *Political Research Quarterly*, *Water Resources Research*, and *Natural Resources Journal*, among others.

His research has been supported by the United States Geological Survey, the United States Advisory Commission on Intergovernmental Relations, the National Water Research Institute, the National Science Foundation, the United States Environmental Protection Agency, and The World Bank. He serves on the Board of Directors of the American Ground Water Trust, the Research Advisory Board of the National Water Research Institute, and a study committee of the National Research Council on sustainable underground water storage.

He has provided formal and informal consultation to the United States Advisory Commission on Intergovernmental Relations, the U.S. Bureau of Reclamation, Sandia National Laboratories, the International Center for Self-Governance, and local agencies involved in the management of water supplies in Southern California. He led an inter-agency planning process involving 33 agencies in Orange County, California, and has facilitated workshops for the Santa Ana Watershed Project Authority, the University of California-Davis, and the University of California-Irvine.

Andrew Stone, Executive Director, American Ground Water Trust

Andrew Stone is a hydrogeology graduate from London University with additional academic qualifications in geology, geography and education. He has over thirty five years of ground

water experience in Africa and the U.S. as a university professor, ground water consultant and ground water advocate & educator. He has first-hand experience of ground water exploration, well design and source protection in a wide variety of geologic environments. As the director of the AGWT's education programs he has convened and coordinated over one hundred conference programs related to geothermal technology, well design, ground water management, aquifer storage recovery, conjunctive use, water banking, and asset management. From 1990 to 2003 he taught an annual course on Groundwater Protection Policy at Antioch New England University. In recognition of his work in promoting ground water resource education in the US, he received the 1998 National Ground Water Association "Oliver Award" for outstanding contributions to the ground water industry.

The American Ground Water Trust (AGWT) is a non-profit education organization with programs that include teacher training, and conferences and workshops that focus on resources, technology and environmental issues. The AGWT promotes sustainable use and resource protection. AGWT programs provide science-based information to professionals, the public and decision-makers.

Gregory Thomas, Founder and President, Natural Heritage Institute

Gregory A. Thomas, J.D., is the founder and president of the Natural Heritage Institute. Greg has practiced natural resources law since 1974, primarily for non-profit conservation organizations. In the 1970's, he played a central role in the enactment of much of the foundational federal laws in the energy and environmental field. He was a senior staff attorney with the Natural Resources Defense Council's international program, and became the managing attorney of its San Francisco office. He was a Fulbright Professor and advisor to the national environmental ministry of China, and he taught law at UCLA and UC Berkeley. Greg's practice has encompassed many areas of natural resource management, including water resources, energy, air quality, biodiversity, environmental planning, and international conservation. He has 35 years experience in litigation, administrative trials, legislative advocacy, policy analysis, institutional design, and consensus building processes. At NHI, he develops and manages large-scale projects in California, throughout the United States and internationally.

Dr. Robert C. Wilkinson, The Bren School of Environmental Science and Management, University of CA at Santa Barbara

Dr. Robert C. Wilkinson is Director of the Water Policy Program at the Bren School of Environmental Science and Management at the University of California, Santa Barbara, and he is a Lecturer in the Environmental Studies Program at UCSB. Dr. Wilkinson's teaching, research, and consulting focus on water policy, energy, climate change, and environmental policy issues. Dr. Wilkinson is also a Senior Fellow with the Rocky Mountain Institute. Dr. Wilkinson advises businesses, government agencies, and non-governmental organizations on water policy, climate research, and environmental policy issues. Additionally, Dr. Wilkinson advises various federal agencies including the, US DOE National Renewable Energy Laboratory and the US EPA on water and climate research, and he served as coordinator for the climate impacts assessment of the California Region for the US Global Change Research Program and the White House Office of Science and Technology Policy. He has worked extensively in Western Europe, every country of Central Europe from Albania through the Baltic States, and throughout the former Soviet Union including Siberia and Central Asia.

Stephen McCaffrey, University of the Pacific, McGeorge School of Law

Stephen C. McCaffrey is a Distinguished Professor and Scholar at the University of the Pacific, McGeorge School of Law in Sacramento. Professor McCaffrey served as a member of the International Law Commission of the United Nations (ILC) from 1982-1991 and chaired the Commission's 1987 Session. He was the ILC's special rapporteur on the Law of the Non-Navigational Uses of International Watercourses from 1985 until 1991, when the Commission provisionally adopted a full set of draft articles on the topic. The ILC's draft articles formed the basis for the 1997 United Nations Convention on the same subject. Professor McCaffrey served as Counselor on International Law in the Office of Legal Advisor, U.S. Department of State, from 1984-1985. He was counsel to Slovakia in the *Gabcikovo-Nagymaros Project* case decided by the International Court of Justice in 1997 and currently serves as counsel to Nicaragua in the *Navigational and Related Rights* case (Costa Rica v. Nicaragua). He also advised India in the *Bagihar HEP* case, before the Neutral Expert appointed under the 1960 Indus Waters Treaty. He has served as Legal Adviser to both the Nile River Basin Negotiating Committee and the Palestinian Authority/PLO and was a member of the U.S. National Research Council's Committee on the Scientific Bases of Colorado River Basin Water Management. Professor McCaffrey's publications include *The Law of International Watercourses* (Oxford University Press, 2d ed. 2007), *Understanding International Law* (Lexis Publishing, 2006) and *International Environmental Law & Policy*, with Edith Brown Weiss, Daniel Magraw and A. Dan Tarlock (Aspen, 2d ed., 2007).

Rod Banyard, Australia Water Policy Branch, Department of Environment and Water Resources

Rod is a civil engineer who has worked in the Western Australian public sector as an engineer, administrator, legal advisor and policy developer for forty years. Rod has recently worked in the Commonwealth public sector, responsible for the development of legislation to implement the National Plan for Water Security. He has extensive experience in the areas of water engineering, groundwater development, water resource management, policy development, legislative drafting and administration that allows him to develop practical solutions to water resource management problems.

Tim Parker, Parker Groundwater

Tim Parker is a nationally recognized groundwater expert and currently is with Parker Groundwater in Sacramento, California, a firm he founded in 2009. He has worked in private and public sector, was formerly with Schlumberger, Law, Dames & Moore, and has worked for California Department of Water Resources, California Geological Survey, and Department of Toxic Substances Control. Mr. Parker's groundwater experience spans more than 25 years and includes water policy analysis, groundwater resources development, groundwater recharge, groundwater management, modeling, monitoring, contaminant hydrogeology, and geologic carbon sequestration. He is a California Professional Geologist, Certified Engineering Geologist, and Certified Hydrogeologist. Tim serves the Groundwater Resources Association of California as a Director and Legislative Committee Chair, the California Groundwater Coalition as Director, and American Ground Water Trust as Chair. He is a member of the Public Advisory Committee for the development of the 2013 California Water Plan, and the Oversight Work Group for Pilot Projects for the Nationwide Ground Water Monitoring Network, under the Subcommittee on Ground Water, Advisory Committee on Water Information, U.S. Department of the Interior. Mr. Parker recently served as a Director on the National Ground Water Association-Association - Scientists and Engineers Division. Mr. Parker coauthored the books

California Groundwater Management published by GRA in 2005, and *Potential Groundwater Quality Impacts Resulting from Geologic Carbon Sequestration* published by the Water Research Foundation in 2009.

Toby Moore, PhD, PG, CHG, Golden State Water Company

Dr. Moore is the Water Resources Manager and Chief Hydrogeologist for Golden State Water Company, a California based investor-owned water utility and subsidiary of American States Water Company. GSWC operates 38 water systems and has a diverse portfolio of water rights managed by Dr. Moore's department. This includes groundwater extractions in 17 groundwater basins throughout California. Toby has a multidisciplinary background in geology, geochemistry, hydrogeology, and biology. He received his Bachelor's degree in Biology and his Doctorate in Geology, both from UCLA. He also holds registrations in the State of California as a Professional Geologist and Certified Hydrogeologist. With over 18 years of professional experience in Water Resources and environmental consulting, Toby has been focusing his expertise on water resource development, water quality and contaminant fate and transport. Toby also currently serves as a Director on the California Groundwater Coalition, a Director on the Pomona Valley Protective Association, Technical Advisory Member of the Southern Branch of the California Groundwater Resources Association and a committee member of the Joint Management Committee of the Alamitos Barrier Project.

Charles G. Groat, PhD, Director of the Center for International Energy and Environmental Policy, University of Texas

Chip Groat is Director of the Center for International Energy and Environmental Policy, Associate Director of the Energy Institute, and Director and Graduate Advisor of the Energy and Earth Resources Graduate Program. He holds the John A. and Katherine G. Jackson Chair in Energy and Mineral Resources in the Department of Geological Sciences, Jackson School of Geosciences, and is Professor, LBJ School of Public Affairs at The University of Texas at Austin. He assumed these positions in June 2005 after serving 6 ½ years as Director of the U.S. Geological Survey, having been appointed by President Clinton and retained by President Bush. He served as interim dean of the Jackson School of Geosciences at UT from July 2008 to August 2009.

Prior to his position with the U.S. Geological Survey, he was Associate Vice President for Research and Sponsored Projects at The University of Texas at El Paso following a term as Director of the Center for Environmental Resource Management and Professor of Geological Sciences there. His previous experience includes Associate Director and Acting Director of the Bureau of Economic Geology and Associate Professor of Geological Sciences at The University of Texas at Austin; Chairman of the Department of Geological Sciences at The University of Texas at El Paso; State Geologist and Director of the Louisiana Geological Survey; Assistant to the Secretary of the Louisiana Department of Natural Resources administering the Coastal Zone Management and Coastal Protection programs; Professor of Geology and Geophysics and Director of the

Center for Coastal, Energy and Environmental Resources at Louisiana State University; and Executive Director of the American Geological Institute.

He has been a member of the National Research Council Board on Earth Sciences and Resources and the Outer Continental Shelf Policy Board. He is a past President of the Association of American State Geologists and of the Energy Minerals Division and Division of Environmental Geosciences of the American Association of Petroleum Geologists.

His degrees in geology are from the University of Rochester (A.B.), University of Massachusetts (M.S.), and The University of Texas at Austin (Ph.D.)

His current interests focus on advancing the role of science and engineering in shaping policy and informing decisions, and on ways to increase the integration of the science disciplines as a means of improving the understanding of complex resource and environmental systems.