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2007 C. V. THEIS AWARD

Dr. Phillip B. Bedient, Recipient

This award was established in 1986 to honor the charter member of AIH, C.V. Theis - the founder of modern groundwater hydrology. The award is presented annually, on the recommendation of the AIH Awards Committee, for a major contribution to the field of groundwater hydrology. The first C.V. Theis Award was presented to Rodger J. M. DeWiest at the AIH Conference on Application of Recent Advances in Hydrosciences in San Francisco on March 26, 1987.

Citation by: *E.C. Witt, U.S. Geological Survey*

The AIH C.V. Theis Award Committee recommends that the 2007 Award be given to Dr. Philip Bedient, Herman Brown Professor of Engineering, in the Department of Environmental Engineering at Rice University, for his notable contributions to ground water hydrology through his research, teaching, and interest in technology transfer.

Dr. Bedient's contributions to the field of ground-water hydrology primarily have been in the areas of contaminant transport mechanisms in ground water, aquifer remediation strategies, modeling, and geographical information and decision support systems. His additional expertise in both floodplain management and flood alert systems enables him to bring a comprehensive set of skills to bear on a variety of hydrologic problems. As an example, his students have recently applied a combination of GIS and NEXRAD (next generation radar) to ground-water recharge problems, as well as to flood prediction problems.

His earliest groundwater research focused on characterizing hazardous waste sites and modeling contaminant transport at such sites. He used the substantial knowledge gained from this work to direct the development and application of BIOPLUME II, a widely used model for simulating aerobic biodegradation of organic contaminants in groundwater.

In the early 1990s, Dr. Bedient contributed his expertise in biodegradation to the National Academy of Engineers (National Research Council) as a member of the Committee on In Situ Bioremediation; a committee formed to provide direction for decision makers. In the mid-1990s, he contributed to the Academy as a member of the Committee on DOE Environmental Management Technologies, which made recommendations to ensure that the Department of Energy meets its goals of cost effectiveness, safety, and decreased risk.

To date, Dr. Bedient has overseen monitoring, modeling, and remediation studies at more than 25 hazardous waste sites nationwide. He has written over 180 articles on ground water or surface water hydrology and has been continuously supported by federal research grants for the past 30 years. He has authored or co-authored several textbooks. Of greatest note to the field of groundwater hydrology is the 1999 textbook, *Ground Water Contamination: Transport and Remediation (2nd ed.)*, by Bedient, Rafai, and Newell.

His research program continues to be relevant to some of the most pressing questions of the day. Currently, he brings his experience with controlled contaminant releases to a team that is studying ethanol transport in ground water associated with fuel spills. He has, in fact, become a leader in bridging laboratory and field studies of contaminant degradation as a result of his work with the Experimental Controlled Release System (ECRS), a pilot-scale tank designed to test environmental remediation techniques on a scale that more closely resembles that in the field.

In addition to his research, Dr. Bedient has taught environmental engineering courses at Rice since the mid-1970s, and served as Chair of the Department of Environmental Science and Engineering from 1992 – 1999. He was recognized with the Shell Distinguished Chair in Environmental Science from 1998 – 1993.

Dr. Bedient has a deep interest in technology transfer. He has taught short courses for government, university, and private sectors through Rice University Continuing Education and the Superfund University Training Institute. He has also provided faculty support for Rice-Engineers Without Borders (Rice-EWB), a student-run non-profit that enables students to gain real world experience through completion of engineering service projects in the developing world.

Dr. Bedient's career was recognized in 2006 through election as a Fellow of the American Society of Civil Engineers (ASCE). He is a member of the American Institute of Hydrology (AIH), as well as several other scientific societies.

In summary, Dr. Bedient exemplifies leadership in the field of ground-water hydrology, especially where it comes to the application of ground-water hydrology to real-world problems. As a result, we recommend that the Executive Committee of AIH honor him with the 2007 C.V. Theis Award.

AIH 2007 C.V. Theis Award Committee
Sandra M. Eberts, Chairperson
Bill Fetter
Gil Cochran

2007 C. V. Theis Award Recipient: *Dr. Phillip B. Bedient, Rice University*

I am pleased and delighted to accept the C.V. Theis award from the American Inst of Hydrology for significant contributions to the field of ground water. This is a very humbling to be honored in this way given that C.V. Theis did so much to advance the field of GW hydraulics so long ago. His equation literally revolutionized the field of ground water hydrology and provided the basis for using well mechanics to understand and evaluate aquifer systems.

I originally learned about GW as a graduate student at University of Florida in the 1970s from texts by DeWiest and Bear, although I mostly did research on surface water hydrology in the 1970s. After my Ph.D. at the University of Florida in Environmental Engineering, I started as assistant professor at Rice University in 1975 and originally began my career in the area of urban stormwater quality and modeling.

Rice was fortunate to land the EPA Center for GW Research about 1980 time frame and I decided to take the plunge into ground water (GW) research and certainly needed some in-depth training, so I attended an amazing short course taught at Princeton that winter. I returned to Rice to teach a similar course in GW Contamination in 1981, a course that would eventually lead me into research at a Texas hazardous waste site, that inspired a team of us to propose a project to better understand the mechanisms of contaminant transport that could biodegrade in the subsurface. The work in the 1980s at that Texas waste site and later in Michigan eventually lead to the development and application of a model called BIOPLUME II, with funding from EPA laboratory at Ada, OK.

Without some rather stellar colleagues and student workers around me, I would not be standing before you now accepting this award. Our work in GW was at a very exciting time and represented a truly interdisciplinary effort of faculty and students in the EPA GW Center. They provided a treasure of inspiration and assistance to me over the years. Dr. Herb Ward and Dr. Mason Tomson at Rice and Dr. John Wilson at EPA were instrumental in helping me better understand the mechanisms of biodegradation and sorption, so important at that early time in our understanding of GW contamination.

One of my graduate students walked in one day in 1985 and said that he thought we could model an aquifer just like we modeled wastes in a stream using the concept of assimilative capacity – the same concept that started the environmental field 20 years earlier. The work resulted in about a dozen papers from six graduate students including Dr. Bob Borden at N.C. State and Dr. Hanadi Rifai at University of Houston and Dr. Chuck Newell with GSI. Our lives were busy with field work then, but not without fun. For example, it is never a good idea to drop rent car keys down an open borehole in the middle of nowhere.

Three of us were sitting around in Denver Airport after a conference with some time on our hands, and we discovered that between us we had about six chapters of a textbook on Groundwater already completed. So with a little effort we could write six more chapters and end up with one of the first engineering textbooks on Groundwater Contamination: Transport and Remediation. This work culminated the end of a decade of research, and was largely supported by the Shell Chair in Environmental Science, for which I am truly grateful. Freeze and Cherry's text influenced us all

The field of GW contamination has taken a new direction in the past five years or so, with a distinct move away from detailed site studies and plume delineations to one more involved in risk assessment, natural attenuation, and long-term monitoring. So while I have spent time at over 30 hazardous waste sites from coast to coast, either monitoring or modeling the ground water for biodegradation (Traverse City MI), or attempting to remediate a non aqueous phase liquid (Hill AFB), I

have learned a great deal about the GW in the United States. I have also had the pleasure of watching some 65 graduate students go on to successful careers in the hydrology field, a statistic that I am proud to increase each year.

In closing, ground water is a vital and important resource for the future of water supply in the U.S. and must be carefully monitored, evaluated, and modeled for both quantity and quality. We have entered an era in Texas, where rapidly growing cities are going to come up against major obstacles to meet water demands of the future. One city stands out above many others in this regard - San Antonio, which used to be solely dependent on the Edwards aquifer for their entire municipal supply of water. Up until the 1990's, there was no legislation for San Antonio to develop alternative water sources, and in fact, encouraged the city to increase its use of the Edwards aquifer.

Between 1997 and 2001, the Regional Water Planning Group developed and submitted their final plan to the State that offered many options for meeting the region's water needs for the next 50 years, including a proposal for the use of the Carrizo-Wilcox aquifer, a very productive aquifer to the east of San Antonio. So there are proposals to obtain water permits in other surrounding counties and pump groundwater out, and then pipe it back to San Antonio for long-term water supply. Obviously, complex and detailed computer models of these aquifers must be shown to be accurate and stand the test of time and be able to properly address hydrologic variability like drought, recharge and pumping issues. This debate is on-going now in the State and will be for many years to come as various options are tested out.

Thus, the efforts of C.V. Theis more than 70 years ago and his important observations and development of his famous equation will form the basis for evaluating the future of water supply for the 10th largest city in the U.S. Again, I am deeply honored that you have chosen me for this award. Thank you.