ENVIRONMENTAL ENGINEER & SCIENTIST

Volume 49, Number 4
Fall 2013

Jay L. Banner, Ph.D., BCES

Page 18

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News and Features

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PRESIDENT'S PAGE

Pasquale S. Canzano, P.E., BCEE
psc@dswa.com

The Definition of Volunteerism

Along with millions of others, I watched the NFL playoff games this year and the teams' bids for a berth in the Super Bowl. Since my team had already been eliminated, I watched the remaining games with transitory interest. However, in one particular game, a number of plays occurred in the end zone area and it was difficult not to notice in letters probably 2 feet high, the word "volunteerism" along the fenced area. In fact, without necessarily thinking about it, I noticed it several times during the game. I thought to myself, what an appropriate coincidence as I was about to begin my year as the Academy's new president, because volunteerism is crucial to the Academy's ability to perform its Mission.

According to the Merriam Webster dictionary, the first use of the word "volunteerism" was in 1844. The dictionary further defines the word volunteerism to mean, "the act or practice of doing volunteer work in community service". Clearly, volunteers in all walks of life undertake work that transcends only work in community service. Case in point, the tremendous amount of work that the Academy's members undertake each year starting with the Board of Trustees (BOT), the Chairs, and a multitude of voluntary members comprising more than 30 various committees and functional workgroups, not to mention the collaborative efforts between the Academy and its affiliates and sponsoring organizations. All of which complement the work of a small, but exceptional, full-time staff operating at the Academy's corporate offices in Annapolis, Maryland.

I could write volumes accounting the efforts and work put forth by the Academy's volunteers, but I want to highlight the efforts of one particular group of volunteers. It is that of the Academy's State Representatives (SRs). A primary duty of the SRs is to arrange and perform the examinations for applicants seeking the Academy's certification. In addition, the SRs provide the single point of contact within their respective states for prospective applicants. They also promote the Academy through recruiting efforts and arranging local workshops and seminars of interest to the environmental engineering and environmental science communities. Over the past three years, I have had the privilege of speaking to many of the Academy's SRs to discuss their important work, to determine any special needs or resources, which the Academy and its staff could provide, and more importantly,

to obtain their suggestions and feedback. Invariably, I received positive comments, particularly on the necessity to constantly update our examinations to reflect the latest technology and regulatory framework. I was most impressed that the majority of our SRs has performed their duties quietly, efficiently, and exceptionally for more years than many of them could actually remember. Their dedication to the Academy and commitment to their duties epitomizes volunteerism! On behalf of myself and our BOT, ***thank you*** to all of our SRs for your outstanding work and contribution to the Academy.

Of course, I would be remiss if I did not acknowledge the fine work that all of our volunteers do in their support of the Academy. Likewise, you have my thanks and appreciation. I personally embrace and practice volunteerism and urge all of our environmental engineering and environmental science colleagues to become a volunteer within your profession and your community. Imagine what has been accomplished through volunteerism since 1844!

On behalf of myself and our BOT, ***thank you*** to all of our SRs for your outstanding work and contribution to the Academy.

ACADEMY NEWS

2014 Excellence in Environmental Engineering and Science (E3) Competition

AAEES is extremely excited to announce the call for entries for the 2014 E3 competition! This is your chance to show off your unparalleled expertise in your area of environmental engineering and science. This year's ceremony is already proving to be our most exciting and prestigious competition to date.

In commemoration of the 100th anniversary of the Activated Sludge process, the E3 competition encourages the submission of Activated Sludge process (and its variants) projects in all categories. These projects will be judged within their submitted category and also in a new ***one time only*** category "100th Anniversary of Activated Sludge". Double your chances of winning!

If your best environmental engineering or environmental science projects deserve more recognition by the profession and the public, enter the 2014 E3 competition program. The entry deadline is February 1, 2014.

Entry guidelines, submission forms, and previous winning entries are available at http://www.aaees.org/e3competition.php.

2014 Environmental Communications Awards Competition

Successfully communicating complex and challenging issues to the public and its stakeholders who need to understand the value, the benefits, and the process of environmental engineering and environmental science projects aimed at benefiting the public health is paramount. With this in mind, in cooperation with the International Water Association and the PIA Awards, AAEES offers the Environmental Communications Awards.

This award is designed to recognize outstanding environmental communication efforts by industry; municipal, state and federal governments; and consulting firms to convey their important environmental messages to the public and other stakeholders. The winner of this award is automatically qualified to enter the International Water Association's Project Innovation Award competition for Marketing and Communications-North American Category.

The deadline for entering the Environmental Communications Awards Competition is March 1, 2014. Entry details and previous winning entries are available at http://www.aaees.org/environmentalcommunicationsawards.php

Specialty Certification Renewals

It's time to renew your specialty certification! The first renewal notices for 2014 were emailed in September. To renew electronically, simply log in to the AAEES Center (or by clicking on the Log In button on aaees.org) and click on **Renew Now**. If you are unable to renew your specialty certification online, you may download a form from aaees.org to send with your renewal fee.

Even if you do not renew online, you are still encouraged to review your information. Simply log in to the AAEES Center (https://netforum.avectra.com/eWeb/DynamicPage.aspx?Site=AAEES) and click on **My Information**. If you need assistance or have any questions regarding your specialty certification, please contact Joyce Dowen at jdowen@aaees.org.

PDH Online

AAEES is partnering with PDH Online to provide members with professional development hour education. All AAEES certification holders and members who use the code AAEE25 receive a 25 percent discount from any of PDH Online's 2,000+ courses, including live webinars. Members can search courses and sign up at www.pdhonline.org or www.pdhcenter.com.

PDH Online is among the leading online course providers and underscores that it is an approved sponsor by many state licensing boards for professional engineers. More than 100 of its courses have been developed by BCEEs. AAEES has designated PDH Online as its Preferred PDH Provider to help AAEES colleagues meet their bi-annual PDH requirement.

You can contact Joyce Dowen at JDowen@aaees.org if you have any questions.

Environmental Scientists - New Specialty

AAEES is pleased to announce a new certification for Environmental Scientists: Solid Waste Management. The specialty, separate from the Solid Waste Management specialty offered to environmental engineers, has been added for environmental scientists who specialize in solid waste management facilities, such as sanitary landfills and waste-to-energy facilities. Whether you are a BCES who wishes to be certified in an additional specialty or someone who is applying for Board Certification in Science for the first time, you are encouraged to submit your application. Applications received by March 31, 2014, will be in the inaugural examination cycle for this new and exciting certification.

Shining the Spotlight...*on You*

The Academy has special features on its website and in electronic and print publications in recognition of you, **the Academy's honored professionals**. If you want to toot your own horn, or someone else's, here are two ways to do it:

Volunteer of the Month

Part of the Academy's success lies with the selfless work of its members. Do you know of a member that always goes above and beyond? Then send a nomination for **Volunteer of the Month**. Email the 350-word nomination to YMoulden@aaees.org.

Side Tracks

Interested in knowing about the extracurricular activities of your fellow Academy members? Or do you have fun (or possibly funny) stories you'd like to share? Side Tracks is intended to provide a vehicle for learning about the outside interests of your colleagues. Email your submissions to YMoulden@aaees.org for a chance to be featured in a future issue of *Environmental Engineer and Scientist.*

Coming February 2014, a special Winter issue of *Environmental Engineer & Scientist.*

To commemorate the 100th Anniversary of Arden and Lockett's 1914 paper on the Invention of Activated Sludge, *Environmental Engineer & Scientist* will publish a special issue dedicated to Activated Sludge.

Featuring articles on:

- Original 1914 Arden & Lockett Paper on the Invention of Activated Sludge
- Secondary Clarification
- P Removal
- Future of Activated Sludge
- Prehistory of activated sludge development
- Nitrogen Removal
- Complete mixed activated sludge
- Sludge and its significance

For more information or advertising opportunities, email YMoulden@aaees.org.

UPCOMING EVENTS & REMINDERS

November 8-9, 2013

AAEES Fall Board of Trustees Meeting

November 14, 2013

4th Annual Women's Leadership Legacy Conference

December 31, 2013

Specialty certification renewal deadline for 2013

February 1, 2014

Entry deadline for the Excellence in Environmental Engineering and Science Competition

March 1, 2014

Entry deadline for the Environmental Communications Awards

March 31, 2014

Application deadline for Board Certification

For the full AAEES Events Calendar, go to http://www.aaees.org/aaeescalendar.php

MEMBER NEWS

Awards and Honors

Dr. Paul F. Boulos, BCEEM, Hon.D.WRE, Dist.D.NE, F.ASCE, has been elected to the Board of Trustees of the Academy of Coastal, Ocean, Port & Navigation Engineers (ACOPNE) of the American Society of Civil Engineers (ASCE). Dr. Boulos, President and Chief Operating Officer of Innovyze, is an expert on water resources and navigation engineering and has received numerous national and international scientific and engineering honors including the U.S. Ellis Island Medal of Honor, the Lebanese American Foundation's Pride of Heritage Award, the Lebanese American University Alumni of the Year Award, and induction into the University of Kentucky College of Engineering Hall of Distinction.

In addition to AAEES, Dr. Boulos is an Honorary Diplomate of the American Academy of Water Resources Engineers, has Distinguished Diplomate status in Navigation Engineering by ACOPNE, and is a Fellow of the American Society of Civil Engineers.

He has been a Board Certified Environmental Engineering Member in Water Supply and Wastewater Engineering since 2011.

In Memoriam

Robert E. McQuade, P.E., BCEE, passed away on January 25, 2013. Mr. McQuade was born in Somerville, Massachusetts, and was a WWII and Korean Marine Veteran, where he earned the rank of Sergeant. He received his BS in Civil Engineering from the University of Rhode Island and his MS in Civil Engineering from Northeastern University. Mr. McQuade served as Andover's first Director of the Public Works Department, for whom the Water Treatment Plant was dedicated in 1991.

In addition to AAEES, Mr. McQuade was also a member of the American Society of Civil Engineers, the American Water Works Association, and the New England Water Works Association.

He had been a Board Certified Environmental Engineer in Sanitary Engineering since 1967 and was a Life member.

Carl Niizawa, P.E., BCEE, passed away on October 2, 2012. He was a native of Los Angeles, California. He served as the Deputy General Manager/District Engineer of the Marina Coast Water District Engineering Department (Marina, CA).

In addition to AAEES, Mr. Niizawa was also an active member of the American Public Works Association and the California Water Environment Association.

Mr. Niizawa had been a Board Certified Environmental Engineer in Solid Waste Management since 1999. He received a second certification in Water Supply and Wastewater Engineering in 2011.

Robert P. Stearns, P.E., BCEE, passed away on August 1, 2013. Mr. Stearns was a Founding Principal, Former President, and Chairman of the Board of SCS Engineers. He was born in Villa Park, Illinois, but grew up on the family farm located just a few miles west of Rockwell City, Iowa.


Robert P. Stearns

An aptitude test taken in his senior year at Rockwell City High School inspired Mr. Stearns' decision to enter engineering. He graduated from the University of Iowa in 1960 with a BS in Civil Engineering. He worked his way through college, including with the City of Los Angeles Department of Water & Power, a job that shaped the rest of his professional and personal life. Following graduation and a stint in the U.S. Marine Corps, he accepted a job with the Bureau of Sanitation of the City of Los Angeles and was assigned to the Research & Planning Division and spent most of his time on solid waste problems.

Mr. Stearns continued his education, earning his MS in Engineering Management from UCLA in 1970. That same year, he, along with Tom Conrad and Curt Schmidt, co-founded SCS Engineers.

In addition to AAEES, Mr. Stearns was also an active member in the American Society of Civil Engineers, the Solid Waste Management Association of North America, as well as a number of educational and cultural foundations in Southern California.

Mr. Stearns had been a Board Certified Environmental Engineer in Solid Waste Management since 1996.

A. Gordon Wheler, P.E., BCEE, passed away on May 6, 2013. He was born in Tignall, Georgia, but grew up in Syracuse, New York.


A. Gordon Wheler

He served in the Fifth Army Air Corps in the Pacific Theater during World War II. He earned his BS in Civil Engineering and Physics from Syracuse University in 1950 and his MS in Sanitary Engineering from Massachusetts Institutes of Technology in 1952.

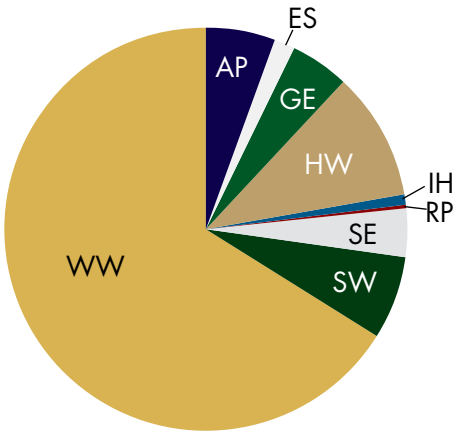
In 1955, together with Donald E. Stearns, Gordon formed the consulting engineering firm of Stearns & Wheler, Environmental Engineers of Cazenovia and retired as Partner Emeritus in 1989. He received the Engineer of the Year award in 1989 from the NY State Society of Professional Engineers. In 2003, he was one of the inaugural inductees into the NY Water Environment Association Hall of Fame based on his commitment to improving the quality of the waters of New York State. Mr. Wheler served on the boards of Cazenovia College, Cazenovia Public Library, Empire State Airlines, Onondaga Venture Capital, and Planned Parenthood. He was a registered professional engineer in eight states, a director of the Consulting Engineers Council of NY State, and served as an officer of the NY State Section of the Water Pollution Control Federation. He was a member of the Cazenovia Club, Willow Bank Yacht Club, Finance and Property committees of the Episcopal Diocese of CNY, and a member of St. Peter's Episcopal Church Vestry.

Mr. Wheler had been a Board Certified Environmental Engineer in Sanitary Engineering since 1962 and was a Life Member.

DID YOU KNOW?

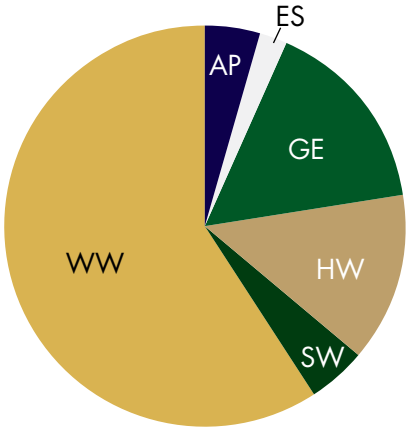
Board Certified individuals by the numbers...

BOARD CERTIFIED ENVIRONMENTAL ENGINEERS



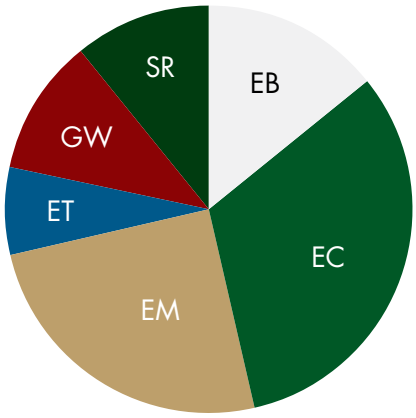
AP	Air Pollution Control	6%
ES	Environmental Sustainability	1%
GE	General Environmental Engineering	5%
HW	Hazardous Waste Management	10%
IH	Industrial Hygiene	1%
RP	Radiation Protection	0.5%
SE	Sanitary Engineering	4%
SW	Solid Waste Management	7%
WW	Water Supply and Wastewater	66%

BOARD CERTIFIED ENVIRONMENTAL ENGINEERING MEMBERS



AP	Air Pollution Control	4%
ES	Environmental Sustainability	2%
GE	General Environmental Engineering	16%
HW	Hazardous Waste Management	14%
IH	Industrial Hygiene	0%
RP	Radiation Protection	0%
SE	Sanitary Engineering	0%
SW	Solid Waste Management	5%
WW	Water Supply and Wastewater	59%

BOARD CERTIFIED ENVIRONMENTAL SCIENTISTS



AR	Air Resources	0%
EB	Environmental Biology	15%
EC	Environmental Chemistry	32%
EM	Environmental Microbiology	25%
ET	Environmental Toxicology	7%
GW	Groundwater and the Subsurface Environment	11%
SM	Solid Waste Management	0%
SR	Surface Water Resources	11%
SS	Sustainability Science	0%

Featured Product

The New AAEES Shirt

The superb feel of interlock knit and the subtle glow of jacquard knit shadow stripes make this the best quality shirt ever offered by AAEES, and is suitable for business casual events. These easy care polos are 58/42 cotton/poly, flat knit collar, 3 button placket and open hem sleeves. They are available in small to XXL sizes for both men and women.

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The American Academy of Environmental Engineers and Scientists can help move along your candidate search. By posting a job on the **AAEES Career Center** at **careers.aaees.org**, you will get unparalleled exposure within the engineering and scientific communities. As a part of the Engineering & Science Career Network, AAEES ensures that your job posting will be seen by thousands of qualified candidates relevant to your industry. And with access to all resumes posted to the network, you can widen your reach to find the right candidate today!

When it comes to making career connections in the **Environmental Engineering** and **Environmental Science** industries, more and more job seekers are turning to the AAEES Career Center to find their next position. Where better to post a job and search for qualified candidates? Visit the AAEES Career Center to post your Environmental Engineering and Environmental Science jobs today!

The ESCN is a strategic industry alliance formed by AAEES and other top trade and professional associations that serve companies searching for engineering and science professionals.

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ENGINEERING & SCIENCE CAREER NETWORK

A Sustainable Water Management Program for the Valley of Mexico

by
Ernesto Espino de la O[1],
Héctor Mendoza Márquez[2]

Program

This paper is a sequel of an article published in the Winter 2013 issue of *Environmental Engineer & Scientist* on the subject of the Atotonilco wastewater treatment plant and reuse of Mexico City metropolitan area wastewater in agricultural irrigation in the Valley of Tula, and it deals with the wider issue of a sustainable water management program for the Valley of Mexico (VofM).

The stock of water in the VofM has been steadily decreasing over the last 30 years due, mainly, to an overdraft of local aquifers and large wastewater transferences to an adjacent valley: the Tula Valley. Estimates of the rate of aquifer depletion vary between 28 and 31 m^3/s (713,000 and 787,000 acre-feet per year) (Ref. 1, p. 99, and Ref. 2, p. 11, respectively). The subject of this paper is a proposed sustainable water management program for the VofM developed at the National Water Commission (Comisión Nacional del Agua, CONAGUA) during years 2008-2012, at which time the principal author was Water and Sanitation Manager for the VofM Special Projects Office at CONAGUA.

The main objectives of a water management program for the VofM are: (1) development of sufficient, reliable, and sustainable water supplies for the city; (2) redress overdraft of local aquifers; (3) prevent soil and groundwater pollution due to improper wastewater management practices; (4) insure proper health conditions in agricultural zones that presently use raw wastewater for irrigation; and (5) reduce present dependence on imported water from neighboring basins.

The program is composed of four major tasks that can, and should, be concurrently undertaken. The four tasks that make up the program are herein summarily described.

Task 1. Wastewater Reclamation For Agricultural Irrigation

Large groundwater volumes are presently used for agricultural irrigation in the VofM; agricultural water needs can be supplied in a safe, economic, and sanitary way with treated municipal effluents; ground water recovered through this exchange will be in the order of 4 to 6 m^3/s (102,000 to 153,000 acre-feet per year). With drip-irrigation of treated wastewater, less water will be required, and agricultural productivity would most likely be improved, allowing better and faster molecular oxygen access to plant roots, as compared to present flood irrigation practices.

A new wastewater recovery plant has been proposed in the area known as El Caracol that would provide treated effluent to agricultural areas within the VofM presently using groundwater. A second phase of the El Caracol wastewater recovery plant

1 Private consultant, former Water and Sanitation Manager for the Valley of Mexico, Special Projects Office at Comisión Nacional del Agua, México, ernesto.espino@hotmail.com
2 Operations Director, Water Business Group, CH2MHill, México, hector.mendoza@ch2m.com

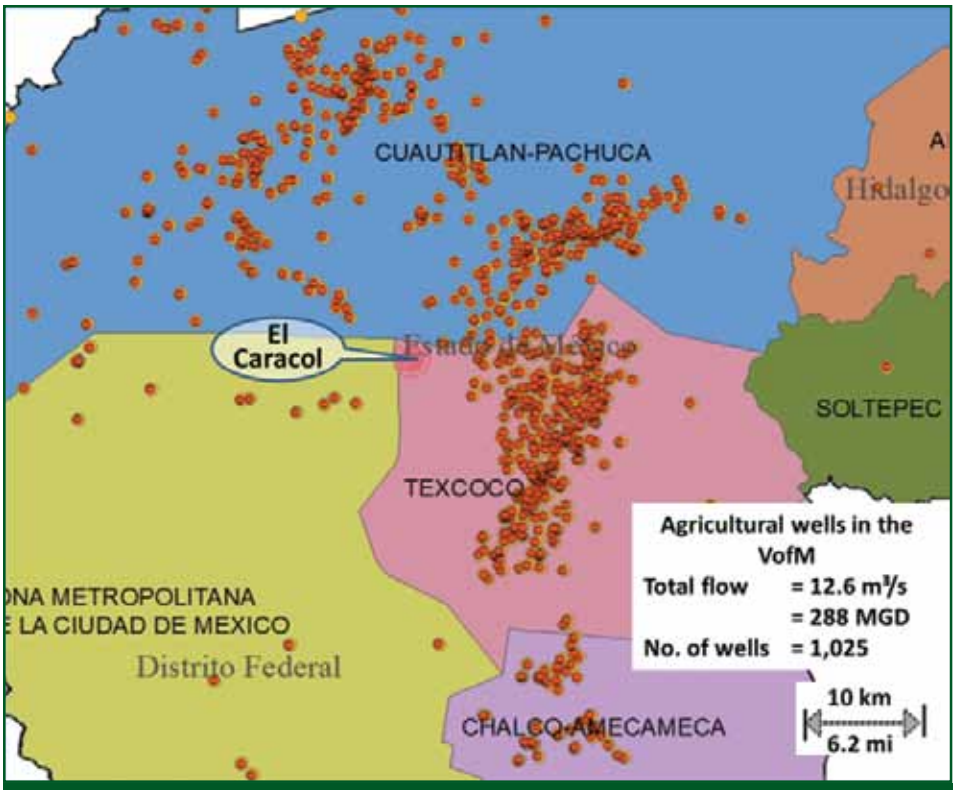

Figure 1: Aquifers and Agricultural Wells in the Recharge Study Area

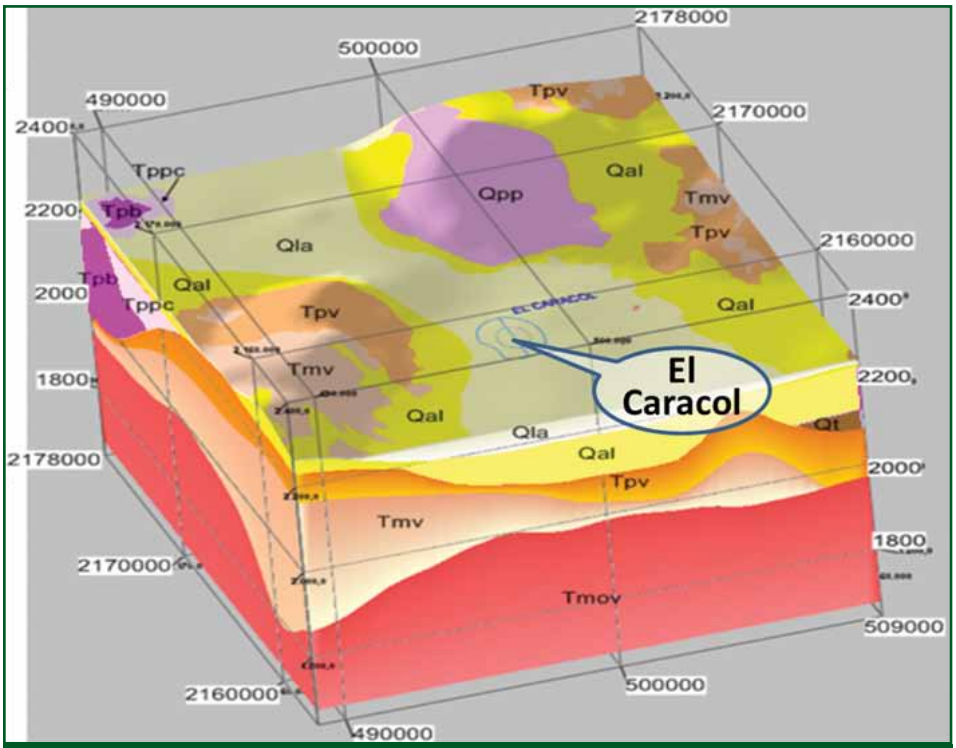

Figure 2: Geological model of the study area, 20 km by 20 km and 600 m deep

(WWRP) is scheduled for tertiary treatment and aquifer recharge. Design flow of Phase I is 2 m³/s (46 MGD) and treated effluent is to be used in irrigation of agricultural and green areas in Texcoco and Atenco Municipalities; total treatment cost of the El Caracol plant is 1.67 Mex$/m³ (0.52 US$ per thousand gallons). Agricultural wells in the VofM registered in the National Register of Public Water Rights (Ref. 1, p. 100, REPDA-2004) numbers 1,025, although many of those might be either inactive or un-workable, due to lowering of the ground table, with total water extraction of 12.6 m³/s (307,000 acre-feet per year). Figure 1 (Ref. 3, Annex 3.1 F) shows location of the El Caracol WWRP and agricultural wells within a 20 miles radius.

Task 2. Aquifer Storage and Recovery.

Enhanced aquifer recharge with rain water is a desirable goal, but urban spread and the need for prompt evacuation of storm flows to prevent urban flooding in the lower central areas of Mexico City make it an exceedingly difficult proposition; however aquifer storage and recovery (ASR) of advanced treated municipal wastewater is possible since large volumes of underground storage have become available due to the above-mentioned aquifer overdrafts. Mexican regulations for direct aquifer recharge with treated effluents (Ref. 4) establish, among others things, total removal of enteropathogens, less that 1 mg/L of total organic carbon and set limits on the concentration of a number of other water constituents; the limits set are well within the reach of proven wastewater treatment technologies.

Bench-scale treatability studies of municipal wastewater were conducted for CONAGUA by the Instituto de Ingenieria of Mexico's National University on Mexico City wastewater (Ref. 5). Tests conducted included biological nutrient removal and tertiary treatment processes such as: ozonation, membrane filtration, carbon adsorption, etc. Results of these studies, as well as review of similar experiences at other WWRPs in the USA and other countries, provide ample grounds to assume that all technical regulations for direct aquifer recharge with treated effluents can be achieved in a reliable way and at a reasonable cost with existing, proven wastewater treatment technologies. Preliminary cost analysis (prepared with the assistance of an experienced and specialized US environmental engineering firm), yielded total treatment costs in the order of 12 Mex$/m³ (3.63 US$ per thousand gallons).

A number of field studies were conducted between 2010-2012 (Ref. 3, 6, 7, and 8) to evaluate the ASR potential in an area of 20 km by 20 km, in the same general area of the El Caracol plant, on top of two of the three

Figure 3: Location of Recharge Test Wells in El Caracol WWTP Site

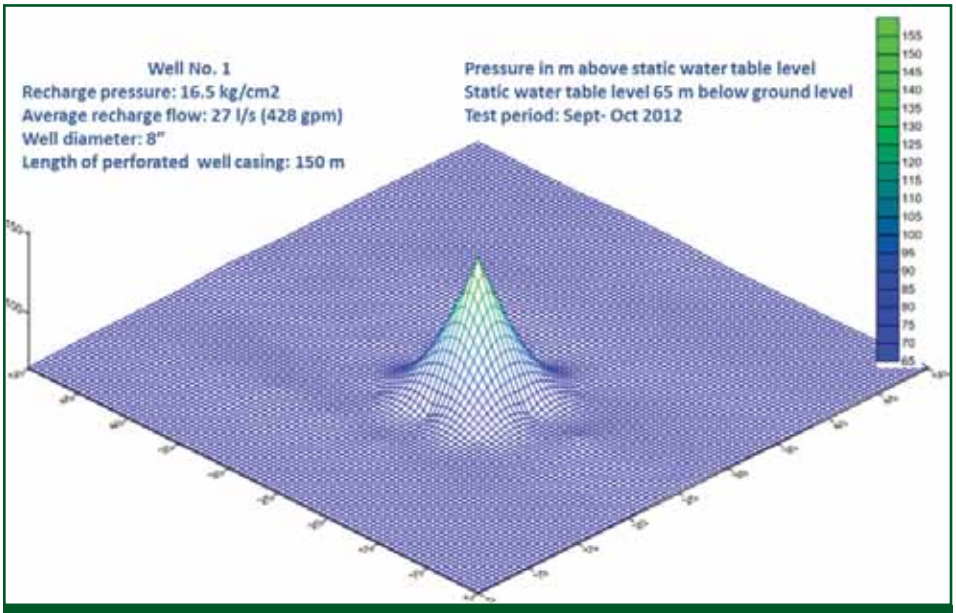

Figure 4: Aquifer Recharge Pressure Dome on Well No. 1 (45 m by 45 m)

main aquifers in the VofM: the Texcoco and the Cuautitlan-Pachuca aquifers. The third major aquifer, the Mexico City Aquifer, sits right below the urban area, making it an unlikely area for ASR. Field studies included (1) data collection and evaluation of operational results of 525 wells in the study area, (2) geophysical explorations, (3) groundwater geochemistry, (4) 3-D geology models, and (5) experimental recharge wells. A brief summary of some of the findings of these studies is presented next.

Wells in the study area show hydraulic conductivity values of up to 200 m/day in fractured volcanic strata, but more common values are between 2 and 20 m/day, and 40 to 75 m/day in sedimentary deposits and pyroclastic material, respectively. Complementing and confirming these findings, a geological model of the study area (Fig. 2, Ref. 3, Annexes 6.8, and 6.10), with a depth of 600 m, showed the strata with the most recharge potential, identified as Qpp, with a thickness of 300 m and hydraulic conductivity of more than 50 m/day. There is similar recharge potential for the strata Qal and Tpv with thicknesses of 150 m and hydraulic conductivities of 25 to 50 m/day (Ref. 3, p 5ff).

With TDS of 400 to 700 mg/L, groundwater quality can overall be considered good, although some sites show concentrations of Cl^{+}, $NH4^{+}$, $SO4^{=}$ and hardness above drinking water standards, due to either soil-water reactions or related to improper solid or liquid waste disposal practices. Worth noting is an increase between 1995 and 2007 of sodium, the main cation; the average concentration of sodium in the groundwater of the study area increased from 95 to 126 mg/L in this time period, coupled with a reduction in chloride from 94 to 84 mg/L (Ref. 6, p. 138ff).

Artificial recharge of the aquifer with ground water was conducted for three months (September through November 2012) in two 8-inch diameter trial wells. Recharge tests were made with water extracted from one of the wells and injected into the other well; tests were then repeated reversing the direction of the water flow. Location of the test wells is shown in Fig. 3.

Injection tests were conducted at gravity pressure and at pressures of 11.5, 13.5 and 16.5 kg/cm^2 (Ref. 8, Annex II). The pressure dome for Well No. 1 operating with a recharge flow of 27 L/s (428 gpm) and a pressure of 16.5 kg/cm^2 (235 psi) is shown in Figure 4.

To establish the sustainable water recharge potential for the study area would require further studies, but a conservative estimate of that potential is 6 to 10 m^3/s (153,000 a 255,000 acre-feet per year). Phase II of the El Caracol project has the

Figure 5: Atotonilco WWTP, under construction
Photo credit: Aguas tratadas del Valle de México, S.A.

Figure 6: Demonstration agricultural plot drip irrigated with treated effluent; cauliflower in front, cabbage in back, both high-nutrient demanding crops.

objective of recharging the Texcoco and Cuautitlán-Pachuca aquifers with a treated wastewater flow of 1 m^3/s (22.83 MGD) and a subsequent increase of the recharge flow and selection of new recharge sites according to the results obtained.

Task 3. Recycling VofM Wastewater and CSO's Exported to Tula Valley

For more than 25 years, large volumes of wastewater and combined sewage overflows (CSO) have been transferred north of the VofM to the adjacent Valley of Tula. These actions have been prompted to prevent flooding of urban areas within the VofM. Currently, wastewater export flow rates average on the order of 50 m^3/s (1,277,000 acre-feet per year). Water transferred to Tula Valley is used in agricultural irrigation of 80,000 hectares (198,000 acres). These huge volumes of water result in a surplus of water in Tula Valley with overflows going down to the Tula river and, eventually, to the Gulf of Mexico. Whereas, the water table in the VofM goes down every year between 1.5 and 2 m, in the lower areas of Tula Valley, ground water emerges and floods the terrain, causing soil salinity due to surface water evaporation.

A large wastewater treatment plant (WWTP), the Atotonilco WWTP (Fig. 5), is presently under construction and will treat around 60% of all wastewater exiting the VofM; this plant has a 23 m^3/s (525 MGD) conventional secondary treatment train for dry weather flows and an additional 12 m^3/s (274 MGD) chemical treatment line for CSOs. The plant will not only correct present unsanitary practices of agricultural irrigation in the Tula Valley, but should also gradually improve groundwater quality. A number of studies have been conducted by the National Water Commission to document water quality evolution and treatability of aquifers in Tula Valley. Available results give reasonable grounds to assume that, with appropriate drinking water treatment processes, ground water from Tula Valley could become a new water source for Mexico City with sustainable yields of 6 to 8 m^3/s (153,000 to 204,000 acre-feet).

It is important to note that, in year 2012, a 0.5 L/s (8 gpm) wastewater demonstration plant was built next to the Atotonilco plant, replicating the large plant processes. The specific purpose of the demonstration plant was to illustrate to local farmers the benefits of drip irrigation with treated effluents, as compared with present practices of flood irrigation with raw wastewater. Figure 6 shows a May 2013 image of the irrigation plots, the crops shown in the photograph are cauliflower and cabbage, both crops selected because of their high nutrient demand; it should be noted that no chemical fertilizers were used in the experimental plots.

Tests on this site are being conducted under the advice and supervision of the National Irrigation Specialists Association (Asociacion Nacional de Especialistas en Irrigacion). The demonstration plant is a key element of an ongoing public outreach campaign designed to allay fears of local farmers that agricultural productivities might fall with treated wastewater. Drip irrigation with treated wastewater will not only bring health and environmental benefits to the local population and their families, but will also substantially reduce water consumption.

Task 4. Environmental Sanitation and Agricultural Reclamation of Wastewater Within the VofM

Although continuously threatened by urban spread, large areas within the VofM are still used in agricultural production; a portion of this area is irrigated with raw wastewater. For health and environ-

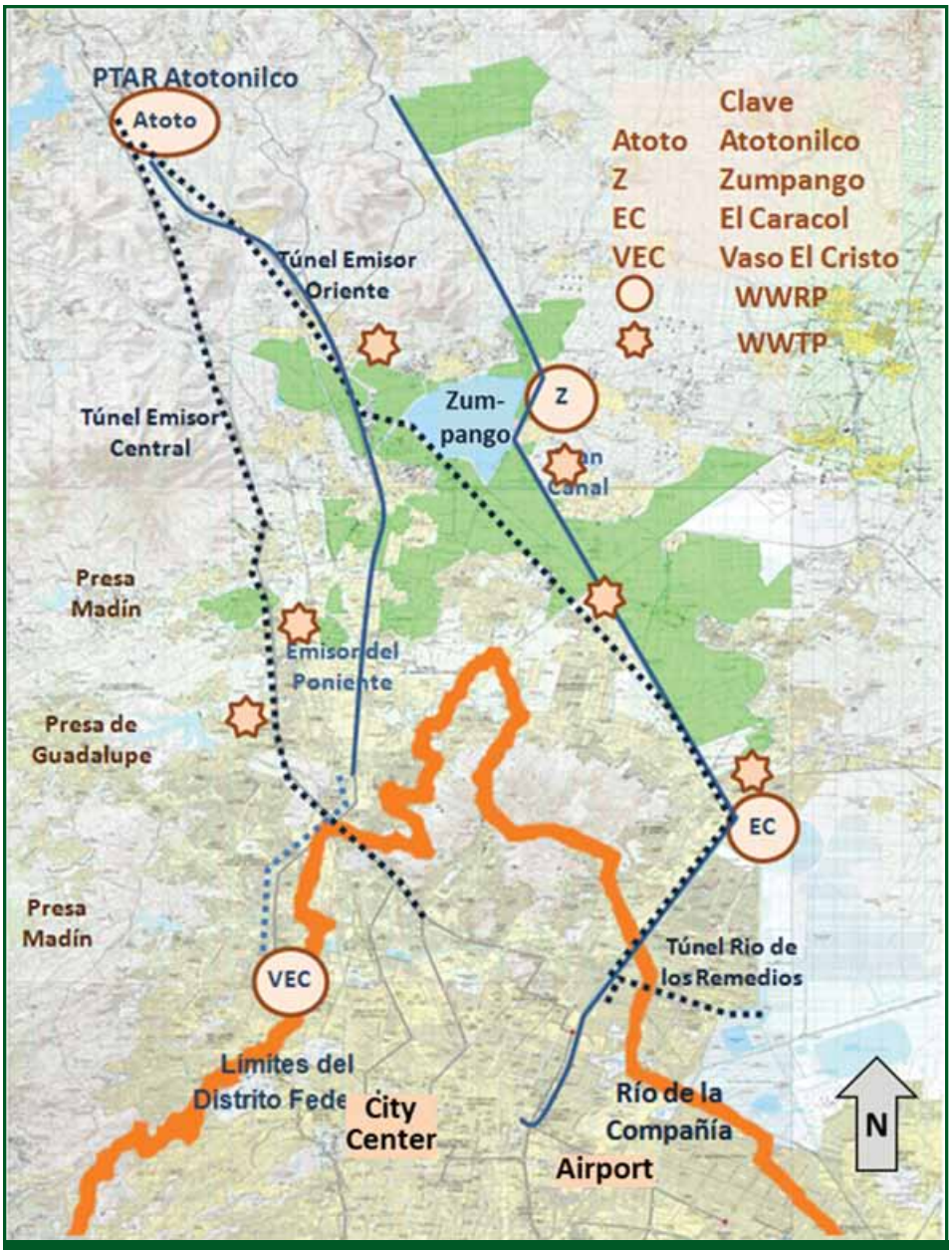

Figure 7: WWTP (stars) and WWRP (circles) in the VofM; agricultural areas in green.

mental sanitation reasons, raw wastewater should be treated prior to agricultural irrigation. The fourth group of actions of the Program addresses this issue with a number of WWTP. On a similar vein, for the 40% of the VofM wastewater that would remain untreated after completion of the Atotonilco plant, a portion would be used for the agricultural water exchange and the ASR mentioned in Tasks 1 and 2, but the remaining wastewater will still be exported through the Gran Canal (Fig. 7) and used on irrigation of Tula Valley agricultural lands and must be treated in a similar manner as will take place at the Atotonilco plant.

To achieve the goals set for Task 4, a number of wastewater treatment plants (WWTP) are included in the program. Figure 7 shows the schematic location of the proposed plants. This figure shows, with stars, the WWTPs that are being designed to improve health and environmental conditions, but without modifying water balances in the valley and, with circles, the WWRPs, that will help alleviate water unbalances of the VofM aquifers.

Capital Investment

Estimated capital investment in new wastewater treatment and reclamation infrastructure is shown in the Table 1.

Water Management, Energy and Climate Change

Dwindling yields of existing wells make it necessary to look for alternative ways to satisfy existing water demands in the VofM. A case in point is México City´s airport (located near the site selected for the El Caracol WWRP) that increasingly depends on trucked water to satisfy its needs; trucked water, sometimes at a rate of up to 20 45-m³ trucks a day (Ref. 9), is supplied at a cost many times greater than city water, resulting in large energy expenditures, more air pollution, and large Green House Gas (GHG) emissions. Transferring water from other hydrological basins to the VofM has been done extensively in the past and is presently being considered in new projects. However, besides the obvious environmental and social impacts derived from moving water from other basins to satisfy Mexico City needs, transferring water means high energy expenditures, as compared with wastewater reclamation programs that can free local groundwater for potable use.

Other than costs and benefits, other variables that must be taken into consideration in a holistic evaluation of alternatives should include energy expenditures, GHG emissions, long term sustainability, and environmental and social impacts. The VofM must learn and profit from successful experiences of aquifer storage and recovery with advanced treated wastewater reclamation plants in California, Texas, Florida, and other states of the USA, and in other countries. These experiences warrant ASR and wastewater recovery as valuable water management tools. Table 2 compares energy expenditures and GHG emissions between trans-basin water transfers and wastewater treatment and reclamation for the VofM.

As can be seen in Table 2, energy consumption and GHG emissions can be five or more times larger for water transfers than for wastewater reclamation.

Further benefits of ASR and wastewater reclamation projects derive from the fact that these kinds of projects, as compared with water transfer projects, can grow and be modified as needs arise, allowing more flexibility in design and operation, capitalizing on on-going experiences, and time-scaled investments. Besides the obvious benefit of lessening its present dependence

Table 1. Capital Investment in Wastewater Treatment and Reclamation

Name of Project		Wastewater Treatment Level	Design Flow m^3/s	Project Cost Million $US* (as of August 2012)
Wastewater Recovery Plants (WWRP)	El Caracol, Phase II**	Advanced	1.0	78
	Zumpango, Line 2**		1.0	78
	Zumpango, Line 1	Secondary	1.0	39
	Vaso El Cristo		4.0	156
	Sum		8.0	351
Wastewater Treatment Plants (WWTP)	Gran Canal	Secondary	3.3	136
	Gran Canal (Nextlalpan)		7.7	293
	Huehuetoca		0.5	20
	Berriozábal		1.0	39
	Sum		12.5	488
Total			20.5	839

Notes:
* Exclusive of land costs, construction supervision, project management, legal, taxes, and financial costs.
** Wastewater flows might significantly increase depending on aquifer recharge results.

Table 2. Energy Consumption and GHG Emissions in WWTP, WWRP, and Importation of Water From Other Basins

Process		Energy Consumption kw-hr/m^3	GHG Emissions From Energy Consumption* kg $CO_{2\,Eq}/m^3$	Cost** $US per thousand gallons		
				Energy	GHG**	Sum
WWTP	Conventional secondary treatment with energy recovery	0.3	0.16	0.164	0.006	0.170
WWRP	Advanced treatment with nutrients removal	0.5	0.27	0.273	0.009	0.282
Water transfer from other basin with a dynamic pumping head of 900 m		3.0	1.62	1.635	0.048	1.684

* For a country-wide average emission rate of 0.54 kg of $CO_{2\,Eq.}$ per kw-hr of energy produced.
** @ $0.144/kw-hr and $8/ton of $CO_{2\,Eq.}$ credits.

of outside water sources, ASR and wastewater recovery have some quite evident benefits from a social and environmental prospective, as compared with transferring large volumes of water from one basin to another.

Conclusions

Like dishes that, after every meal, are washed so that they be clean and ready for the next meal, water should be cleaned after being used so that it can be ready when needed again; to treat water like a disposable commodity, something to be thrown away after being used, like a paper handkerchief, is just an inadmissible practice. For the VofM, wastewater recovery is the single, most powerful, flexible, economic, and environmentally sound tool to achieve a balanced water management.

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Less is More: Jay Banner Finds Balance in Teaching and Research

Jay L. Banner, Ph.D., BCES

by Marc Airhart

> *"I always knew from as far back as I could remember that I wanted to do something in science."*

When Jay Banner accepted his first faculty position, at The University of Texas at Austin, teaching was just something he had to do so he could do what he really loved -- research. In particular, studying the processes by which ocean sediments become rock, tracing underground flow paths of water, and using cave formations to reconstruct past climate. His first teaching assignment was an undergraduate course in sedimentary geology.

"I somehow felt compelled in those 15 weeks to teach them everything I had learned in 16 years [of post-secondary education]," says Banner, professor in the Jackson School of Geosciences and director of the university's Environmental Science Institute. "That works out to about four months per lecture. So I was talking non-stop at too high a level, about too much stuff."

His students got the last word, though, when it came time for evaluations. One comment has stuck with him through all those years: "Banner should be giving these lectures to the other faculty."

He took those harsh student evaluations as a challenge. When attending seminars and lectures at the university and at professional conferences, he now found himself not just listening to the scientific results but also considering what made a speaker effective or not. Building on this insight for his next course, he put a more focused effort into planning each lesson. Eventually he realized he actually liked teaching.

He had discovered one of four keys to great teaching, which he sums up with the mantra "less is more." Instead of trying to fill students up with facts, help them develop critical thinking and problem solving skills. Those fundamental skills will last much longer than mere facts as they go on to work in the real world.

"Each semester I throttle back a little more," he says. "I think I'm finally getting there."

He recently received three of the university's highest teaching awards: a Board of Regents' Outstanding Teaching Award (2013), a Friar's Centennial Teaching Fellowship (2011) and membership in

the university's Academy of Distinguished Teachers (2011). He's also won the Knebel Distinguished Teaching Award from the Department of Geological Sciences (three times) and the Outstanding Educator Award from the Jackson School of Geosciences.

Second Key: Get Them Out in the Field

Jay Banner grew up in Queens, New York, but he still managed to spend a lot of time outdoors in his backyard, in parks and greenbelts in the city and, in the summer, on hiking and camping trips in Upstate New York. He also played a lot of basketball, stickball, and baseball. His love of the outdoors, coupled with a deep curiosity about how things work, led him to science.

"From a young age, science was something that always held a special fascination for me," he says. "I always knew from as far back as I could remember that I wanted to do something in science."

As an undergraduate at the University of Pennsylvania, he majored in chemistry because that's the subject he did best at on the New York Regents Exam, a test taken before high school graduation.

After a couple of years of college, he was having second thoughts. He just couldn't see the applications of chemistry to real life problems. When he went to buy the textbook for his physical chemistry class and flipped it open to a random page, there was a big hairy equation with multiple integrals. That sealed it.

"I slammed it shut and said no," he recalls. "I went right to the bookstore and got a refund, and from there I went directly to the geology department, knocking on doors and saying I want to talk to someone about becoming a geology major."

He already had all the math and chemistry course requirements needed for geology, so he was able to catch up quickly.

Near the end of his bachelor's, he had to take a capstone field course designed to integrate what he'd learned throughout his degree and reinforce all those facts and textbook illustrations with concrete, so-that's-what-it-looks-like examples. His university didn't offer a capstone field course, so he headed to West Texas to join the group at Sul Ross State University. It was his first time west of the Mississippi and his first time in the desert.

They would set out from the Sul Ross campus on trips to Big Bend National Park and other parts of Trans-Pecos Texas. One day, he came up over a hill and saw an igneous ring dike, a wall of magmatic rock standing above the surrounding land due to its resistance to erosion.

"I thought Holy Cow, it was a textbook just jumping to life," he says.

He kept having these light bulb moments.

"Up until then, I wasn't convinced about my decision to switch to geology," he says. "After a couple of weeks, I had an epiphany. Oh yes, this is what I was meant to do."

Not only did it confirm his choice of major, it taught him the second key to great teaching: get students out in the field. By getting out of the classroom and engaging all their senses, students absorb the concepts more vividly and, if they're lucky, find their passion.

Many years later, Banner chaired the committee that drew up UT Austin's first degree plan for a B.S. in environmental science, which was approved in 2010. As part of the core requirements for that degree, he designed and now teaches an environmental field course taken in the second semester of college, not a capstone course taken at the end of the degree.

"I think what makes a good teacher is that you share with your students your excitement of scientific discovery, what gets you jazzed about science."

Jay has unquestionably made a sustained and significant contribution to teaching at the university, particularly at the undergraduate level, but also through graduate teaching, research supervision, curriculum and course development, and outreach. His approach to teaching is innovative, engaging, and enthusiastic. It's not surprising students love him and consistently give him top marks in evaluations. It's been a personal pleasure and source of pride to work with him for more than 20 years.

Sharon Mosher
Dean, Professor and William Stamps Farish Chair, Jackson School of Geosciences
University of Texas at Austin

Jay, age 8 (right), and friend and next-door neighbor, Jeffrey Dauman, on 213th Street in Bayside, Queens. Banner and Dauman played for the Pittsburgh Pirates Little League team, but did not go on to the Major Leagues.

Jay, age 24, playing Ultimate Frisbee for the team from the State University of New York at Stony Brook. Jay founded and played for the team while pursuing his M.S. and Ph.D. degrees.

Jay and his sister Lynne Banner, ages 3 and 6, eyeing the shoreline along the south shore of Long Island.

Jay has been a great mentor since I started four years ago at UT Austin. His research group has been monitoring caves in central Texas for an impressively long period of time (more than a decade). As a researcher who monitors seasonal change, I can tell you that keeping these sorts of monitoring projects going for longer than a couple of years is very difficult - especially when you have to crawl underground to do it! The long records Jay has produced are extremely valuable for understanding modern processes occurring in caves and also for understanding how stalagmites preserve information about past climate and environmental change. I'm not aware of such long, detailed records from any other caves in the world. Jay's work on modern caves nicely complements his tree ring and stalagmite-based paleoclimate research. Perhaps among his most societally important research involves the record of extreme droughts in Texas. Longer and more severe than the historical droughts on which water management policy is currently based, these recurring 'mega' droughts pose a serious risk for the exploding population of central Texas.

Daniel Breecker
Assistant Professor, Jackson School of Geosciences
University of Texas at Austin

Jay Banner and undergraduate Sarah Cunningham at the university's Brackenridge Field Lab examine invasive species of fire ants to determine habitats they favor as part of the Environmental Science and Sustainability field seminar course.

"The idea is that if you get students as jazzed as I was on my field course, but do it early in their career, it might serve them better so that when they're suffering through math and chemistry and physics, they'll understand why," he says. "They'll see the value of having those quantitative skills and the fundamental technological know-how."

Each week during the class, he takes students out for a five or six hour field trip to learn about environmental science and sustainability. The field trips are truly interdisciplinary, integrating hydrogeology, biology, engineering and public policy. For example, they visit an urbanized watershed and a less developed watershed to see how they differ in terms of water quality and presence of invasive plant and animal species. Another trip takes them to the Mueller Development, a neighborhood in Austin built on top of the city's old airport. Students take a bike tour and learn first-hand from one of the project's architects, Jim Robertson, how sustainability was woven into every aspect of the development.

Becoming a Geochemist

Ironically, when Banner went to graduate school to study geochemistry at the State University of New York, one of the first things he had to do was take physical chemistry, the course he'd run away from as an undergraduate. He bought the same textbook again. He had a great professor and he finally saw how what he was learning in class applied to the geology he saw on that capstone field course. It turned out to be his best class that semester. Today, as a geochemist, his research builds on principles of chemistry as much as it does on principles of geology.

For his PhD, he used isotopic tracer techniques to study how ancient marine sediments are transformed -- from the time they are deposited as sediments, become buried, interact with fluids flowing through them and eventually become carbonate rocks -- a process known as diagenesis. He focused on Mississippian-age marine limestones deposited by an ancient interior

Tight fit in Harrison's Cave, Barbados.

ocean in present-day Iowa, Illinois and Missouri approximately 350 million years ago.

Later, as a professor, he and master's student MaryLynn Musgrove, now a hydrologist with the US Geological Survey, were surprised to discover that, based on isotopic analyses, water discharging from springs in Missouri had originated over a thousand kilometers away in the Front Range of Colorado.

They also solved a long standing mystery. The groundwater in this part of Missouri is nearly as salty as seawater. Earth scientists agreed that the salts originally came from seawater, but they disagreed about what happened to the salts and the water on their way to becoming briny groundwater. One camp said it began as seawater, became concentrated into a salty brine by evaporation and then was buried. Another camp said it began as seawater which evaporated even more, leaving behind evaporite minerals such as halite and gypsum, these minerals became buried and then, much later, freshwater moving through the subsurface dissolved these minerals out of the rock to form a salty brine.

Writing in the journal *Science*, Banner and Musgrove showed the salty groundwater resulted from both processes.

"When you're looking out at 240 faces, if all you're doing is standing still next to the PowerPoint and clicking through, eventually those faces are going to fade."

"If you think about it, wherever you'd have evapo-concentrated seawater, you should also have evaporite deposits," says Banner. "If you're going to be making evaporite minerals, among the most soluble minerals in the world, they should later be dissolved by freshwater migrating through that system. So in hindsight, it makes sense you'd have both processes happening at once."

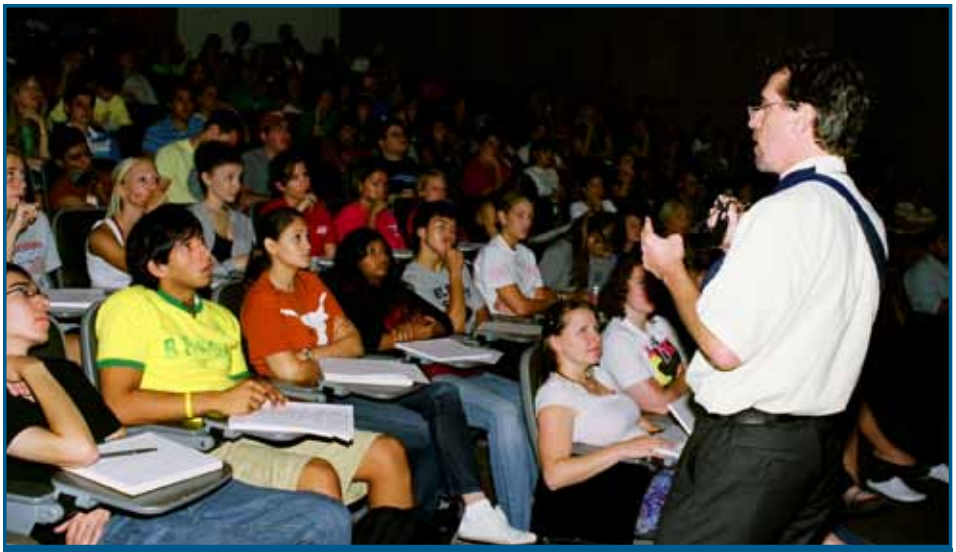
Time Machines

Before coming to Austin, Banner spent part of his time as a post-doctoral researcher studying groundwater chemistry in a popular tourist cave in Barbados. His work was aimed at helping islanders better understand how their groundwater system worked, a system which provided the growing nation's only source of freshwater.

I've known Jay since I was a graduate student at Virginia Polytechnic Institute, over 25 years ago. We were both working on the origin of massive dolomites, the units that commonly form oil and gas reservoirs today. I recall long conversations with him face-to-face or by phone -- the internet was but sci-fi at the time. Jay effectively became my academic big-brother. He has produced several benchmark papers over the past two plus decades. His dissertation work contributed to our fundamental understanding of fluid-rock interaction in the subsurface and the elusive process of dolomitization. He has been one of the leaders in the study of geochemical tracing of regionally widespread fluid flow in subsurface aquifers and how such fluids evolve during their long history of flow in these aquifers. Most recently, he and a litany of talented graduate students and post-doctoral fellows have focused on a holistic study of the carbonate geochemical system in caves and the controls on carbonate formation (speleothems). Jay and his group are undisputed leaders in this country in this area of research. Jay remains -- after 28 years -- a very close friend. He is also among the handful of geoscientists I most admire and respect. He has a wonderfully dry sense of humor nicely balanced with empathy and concern for those around him. He's also pretty awesome on the basketball court.

Isabel Montanez
Professor of Geology
University of California, Davis

One day he was squatting in a low-ceilinged room in the cave collecting water dripping from the ceiling, being very careful not to bump into a stalagmite right behind him. Stalagmites, you'll remember, are rocky towers that form on the floors of caves, growing upward as water dripping from above deposits microscopic layers of minerals. He stared at the stalagmite and wondered, could this formation tell me something about past climate?



Jay Banner teaching "Sustaining a Planet," the first of the university's signature courses.

Jay Banner teaching an environmental science field course along a highway in Austin, Texas.

He suspected strontium isotopes might hold the key. He knew, for example, that the limestone rocks containing the caves had a different strontium isotope signature than the soils above and that rainwater usually has essentially no strontium. Just like your clothes when you walk through a room full of cigar smokers or a chocolate factory, water moving through the soil and limestone should pick up a whiff of the places it's been. Banner reasoned that during rainy periods, water moves quickly through the system and doesn't have time to get an imprint from the limestone, whereas during periods of low rainfall, water has time to pick up the limestone strontium signature.

Jay is tenacious and stubborn. Two great qualities to have when trying to develop a new undergraduate major in Environmental Science across three (yes three) big colleges at a major research university. Despite all odds and a plethora of personalities and egos, Jay managed to develop a cross-disciplinary degree in Environmental Science. Clearly, a great legacy for our academic program at UT-Austin.

Dr. Kenneth H. Dunton
Professor, Department of Marine Science
Marine Science Institute
The University of Texas at Austin

He and his colleagues studied several Barbados speleothems, a catchall term for stalagmites and other cave formations. From their new way to apply strontium isotopes (limestone signature = dry; soil signature = wet), they interpreted changes in strontium isotope ratios as changes in wetness over time going back 5,500 years. It was the first time the technique was applied to speleothems.

They identified an extremely dry period about 1,200 years ago which coincided with other evidence of a major drought in the Mesoamerican tropics and which some experts have linked to the collapse of Mayan civilization.

"This is what got me started looking at speleothems and I've never looked back," he says.

An Eye on Texas Droughts

Since coming to Austin in 1990, Banner has extended his research with speleothems, and also with tree rings, to address one of the biggest concerns on the minds of Texans -- drought. The state is still in the grips of a drought that began in Fall 2010. The state experienced its worst single-year drought in 2011. Agricultural losses in that year alone were more than $7 billion. Rather than see their herds starve, cattlemen sold off their stock in record numbers. The water supply to rice farmers on the lower

I have worked with Jay since 2006; he was my advisor for my masters and doctoral degrees. Jay has an incredible passion for research and teaching in the earth sciences. His genuine intentions, devoted work ethic, and high standards motivate those around him to take on larger challenges and achieve more. His story telling, dry wit, and use of humor work well to engage a wide range of audiences in topics otherwise viewed as sterile and overly complicated. Jay has been an incredible mentor. I have benefitted immensely from all the professional opportunities that he has generated for me.

Corinne Wong, PhD
California Presidential Postdoctoral Fellow
University of California at Davis

Jay Banner at Inner Space Cavern, Georgetown, Texas

Jay served as my instructor for a few courses in the Environmental Science degree program at UT Austin, however he was truly helpful as a mentor with regards to my academic interests and career goals. He initially sparked my interest in pursuing an Environmental Science degree and enhanced my learning experience throughout my undergraduate career. He achieved this in part through his genuine effort to foster a close-knit peer community in the program. He ultimately facilitated the development of a small cohort of like-minded, yet diverse students within the larger university community. This dynamic greatly shaped my experience at UT Austin and proved extremely useful in the context of solving difficult environmental problems. In fact, this same practice is heavily emphasized in my Master of Environmental Management graduate program at Yale University. Similar to Jay's approach, the Yale School of Forestry & Environmental Studies stresses the importance of the community dynamic to address complex environmental challenges. These problems can be defined, discussed, and solved with efficacy when members of the discourse have established rapport and can work collaboratively as a team. Jay's mentorship revealed the importance of this model and inspired me to continue to engage in it beyond my studies and experience at UT Austin.

Michelle Camp
Master's Student in Environmental Management
Yale School of Forestry & Environmental Studies

Colorado River was entirely cut off to save water for cities such as Austin.

Banner warns it could get a lot worse.

He and his colleagues used tree rings to reconstruct the history of Texas droughts for the past five centuries. Their study, in combination with others, found a number of droughts longer and more severe than the six-year 1950s drought, the worst multi-year drought in the historical record. Some droughts in the pre-historic tree-ring record lasted 20 or 30 years. Since the 1500s, droughts lasting a decade or more have occurred in Texas at least once a century. As if that weren't ominous enough, some climate models predict more frequent and severe droughts in Texas during the coming century.

At Westcave, a small cave about an hour from Austin, Banner and his colleagues are now trying to understand what triggers droughts and what turns an ordinary drought into a record-busting mega-drought.

Thanks to thick insulating rock walls and small openings to the surface, the air inside most Texas caves hovers around the same temperature year round. It's what makes them so refreshing on a hot summer day, but not very useful for gauging past temperatures. Fortunately, Westcave isn't like most caves. Because it's small and has big, wide open entrances, the temperature inside is always about the same as the temperature outside. That makes it one of the few caves in Texas where speleothems could possibly record real outside air temperatures.

Working with Banner, graduate student Richard Casteel, postdoctoral fellow Weimin Feng, and undergraduate student Ayla Heinz Frye have shown -- using natural and experimentally-grown speleothems in the cave -- that oxygen isotope measurements

Jay Banner, teaching the course "Sustaining a Planet," demonstrates his psychic ability to determine geographic connections between people and bodies of water.

I have known Jay since his arrival at UT, and he and I have worked closely together for the past 9 years on a wonderful project funded by the National Science Foundation for science in public education, the GK12 Program. During that time, I have had opportunities to observe his classroom teaching, his personal interactions with undergraduate and graduate students, and his work with teachers in the public schools of Texas. Throughout our associations, I have been inspired by Jay's passion for conveying important scientific ideas to learners of all ages. Jay is a highly effective communicator, one who is able to illustrate complex ideas in ways that engage his students and develop depth of understanding. I believe that his skill in this regard is grounded in the fact that he is a first-rate scientist who is able to deftly explain the most fundamental aspects of his discipline in multiple ways that reach learners from a wide range of backgrounds -- young children, undergraduate nonscientists, legislators, and colleagues in the sciences. He possesses a particular talent for getting to the heart of the matter in ways that energize thinking and stimulate curiosity.

Robert Duke
Director, Center for Music Learning
University of Texas at Austin

in speleothems from Westcave indeed are consistent with their recording changes in air temperature over the past decade. Now, their objectives include going back thousands of years with high enough resolution to see not just individual years, but changes from season to season, and to combine such a temperature record with drought records from tree rings to better understand whether severe droughts are driven more by heat or lack of rainfall.

Hot Science

As a professor, Banner has managed to strike a balance between teaching and research without sacrificing either. As director of the university's Environmental Science Institute (ESI), he's also been at the forefront of public outreach at the university.

In 1999, he began organizing a series of public lectures that have become the most highly visible and successful of the institute's

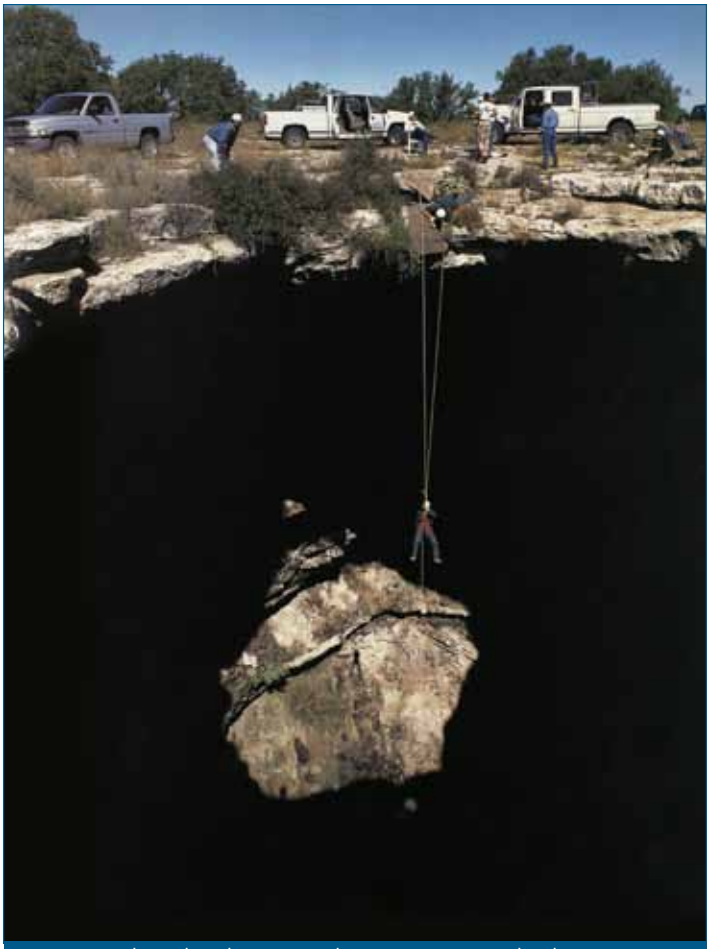
I first met Jay in 1990, when he was a new professor at UT Austin and I was a new graduate student. He became my thesis advisor and I became his first student. Twenty-three years and many research projects later, our scientific collaboration still continues and I'm proud to call him a friend and colleague. Early on, Jay once told me that he would be doing scientific research regardless of if he was getting paid for it or not. I remember thinking at the time that that was a bit much, especially coming from a professor at a prestigious university to a struggling student. But I came to believe that it was true - there he was in the field or lab with me late at night processing samples, there he was offering edits on a paper to get it just right, there he was offering opportunities for new and interesting research directions. His unwavering enthusiasm and love for science was contagious and continues to inspire me.

MaryLynn Musgrove, Ph.D.
Research Hydrologist
U.S. Geological Survey

"If you can get students involved in research, they get excited about it and more of them choose to go into it."

projects. *The Hot Science - Cool Talks* series invites K-12 teachers, their students and the general public to hear from dynamic scientists doing groundbreaking research.

Hot Science talks typically draw more than 400 people -- occasionally reaching overflow crowds of 600 or more -- an impressive turnout given that they're usually held on a Friday evening. The talks, held six times a year, are also webcast live for those who can't attend in person. Talks scheduled for this fall include "Human Mating Strategies," "The Roving Search for Life on Mars," and "Now You See Me, Now You Don't: Colorful Strategies for Surviving in Nature."



Entering Devil's Sink Hole, near Rock Springs, TX. From book "Texas Caves" by Blair Pittman.

As a freshman at the University of Texas, I was rather lost to say the least in the beginning. I did not know what courses to enroll in, or have even a vague idea of what I wanted to become in the future. Somehow, I was registered for the signature course "Sustaining a Planet." Dr. Banner's lectures, supplemented by outside activities, showed the way to research, study and evaluate the processes of the world. I was invited to assist him with his research in the caves to see what hands on research is like and, at the time I was debating going to graduate school, invited to assist him and his graduate students to New Mexico to see what it is like in graduate school, and for further research. Each trip I made, I felt welcomed and more than that so very excited as the landscape came to life with each new fact presented. Upon graduation, my resume was full of activities I participated in with Dr. Banner. I immediately received a job at the Center of Environmental Excellence and was responsible for monitoring the Consumer Confidence Reports for all the public drinking water systems in the state of Texas. I would never have that job if I was not inspired my freshman year or if I was not invited to partake in the numerous research projects in which Dr. Banner was involved. I was by no means a science major; I was the purest of the liberal arts majors, a government major, and remained that way. The impressive factor, though, is that a scientist, Dr. Banner, was able to cross that border between science students and non-science students and inspire all the students to partake in science. I will forever be thankful for the inspiration Dr. Banner gave me over the past few years, and for opening my eyes to worlds of education and science I would never have stumbled into without him.

Kimberly Horndeski
Graduate Student in Natural Resources Management
Ohio State University

Teachers receive free classroom materials that enable them to give their own lessons on the featured topic. So far, 83 events have been held and more are in the works.

Through the ESI, Banner is also the principal investigator for a National Science Foundation-funded project called Research Experience for Undergraduates (REU) in The Science of Global Change and Sustainability. The program brings about 10 students to UT Austin every summer and pairs them with faculty mentors such as Banner to work on 10-week research projects. Many of the students, such as Heinz Frye, come from smaller universities with few research opportunities and facilities.

Summer REU research projects address major societal challenges such as climate change, loss of biodiversity, and threats to water resources and food supplies. Students learn how to do research, design their own short research project and present their results in an end-of-summer student symposium.

Banner notes that fewer and fewer students are choosing careers in science, engineering and math, a trend that does not bode well for the future of a country long seen as innovative in science and technology.

"If you can get students involved in research, they get excited about it and more of them choose to go into it," he says.

That's precisely why he says a third key to great teaching is to give students a chance to do real research.

Fourth Key: Get Their Attention

We've heard about three keys to great teaching: keep it simple, get them out in the field and give them research experience. Last but not least, Banner says a fourth key is to make it vivid.

"When you're looking out at 240 faces, if all you're doing is standing still next to the PowerPoint and clicking through, eventually those faces are going to fade," he says. "They're not going to continue to pay attention."

You can see many of his strategies for making teaching more vivid if you drop by Sustaining a Planet, an interdisciplinary class he created with engineering professor David Allen in 2006. He continues to co-teach the class every year.

Jay at Jones Beach, Long Island, age 16.

Banner enhances his presentations with videos, animations, and pop music, all designed to help reinforce concepts presented in a given lecture. He invites a student to run across the room and throw a football to demonstrate the Coriolis Effect. He models atmospheric circulation by heating a laundry bag full of air and letting it rise to the ceiling of a large lecture hall. He shows students clips of a psychic on the TV show Crossing Over and then demonstrates his own psychic ability to randomly pick students out of the lecture hall and reveal their relationships to bodies of water.

"I challenge them to use the scientific method to prove that either I have special abilities or I'm full of it," he says.

Sustaining a Planet was the first of the university's signature courses, interdisciplinary classes taught by the most engaging faculty and part of every student's core requirements. Many of the students do not have a background, or even an expressed interest, in science and the environment. While Banner's primary goal is to help students develop the ability to think critically about scientific concepts, it's just as important to him that he gets them fired up about science. He admits he's come a long way since that very first class in 1990 when he wanted to teach students everything he knew.

"I think what makes a good teacher is that you share with your students your excitement of scientific discovery, what gets you jazzed about science," he says. "If I can impart some of that to students, then I think I'm doing a good job as a teacher."

About the Author

Marc Airhart is a Science Writer for the University of Texas at Austin's Jackson School of Geosciences.

I have known Jay since my sophomore year of school at UT Austin when he accepted me into the burgeoning Environmental Science Degree program. Shortly after this I started as an undergraduate research assistant with his team, and have been doing this for about two and a half years. In this time I have begun a research project with Dr. Banner as the mentor. His biggest strengths as a teacher stem from the fact that he believes in small class sizes and regular interactions with students; this facilitates a learning that cannot be accomplished in the standard model of UT classes. As a mentor, his biggest strength is that he is one of the few that I have encountered that holds undergraduate research at just as high of a level as any other research done on campus; to him good research is good research, regardless of your school standing.

Barbara Wortham
Undergraduate Student in Environmental Science
University of Texas at Austin

Jay is an extremely likeable guy: a dry sense of humor, self-deprecating wit, a burning curiosity about nature, and a clear no-nonsense style. He was important to my efforts to get the Academy's BCES program off the ground- offering good advice and emotional support, during what was a difficult experience. I serve as the Vice-Chair of Jay's Environmental Advisory Council for his Environmental Science program at the University of Texas at Austin. His Environmental Science program at UT is turning out hard-science non-engineering science majors. For example, geologists trained to do environmental geology. This is something the field really needs. I had a hand in converting dozens of geologists to environmental work in the 80s and therefore know how valuable it is to have them already trained. The only thing wrong with Jay's program is that it came twenty years too late - for me!

Brian P. Flynn, P.E., BCEE
President, MRE Associates

Dr. Banner's longstanding commitment to undergraduate education begins in the classroom. I have been able to witness Dr. Banner's hard work in this regard most closely as a teaching assistant for the UT signature course, "Sustaining a Planet." Dr. Banner consistently embraces the challenge of engaging a lecture hall of 250 undergraduate -- primarily freshmen -- students and works hard to develop interesting approaches to teaching fundamental scientific concepts. Many great teachers work to find successful teaching strategies and exercises, but what sets Dr. Banner apart is his continuous commitment to improving his teaching. Combining honest self-assessment with formal and informal input from his peers, teaching assistants, and students, Dr. Banner critically evaluates the effectiveness of a specific strategy or exercise and regularly devotes time to the creative development of new teaching tools.

Ellison Milne Carter
Graduate Student in Civil Engineering
University of Texas at Austin

2013 EDITORIAL BOARD SURVEY RESULTS

In April 2013, a survey of AAEES's Board Certified Environmental Engineers, Board Certified Environmental Engineering Members, Board Certified Environmental Scientists, AAEES Members, and Student Members was conducted to get feedback and insight on how to make *Environmental Engineer & Scientist* more compelling. Following are the results of the survey. We thank the 340 respondents who were able to participate.

Question 1: What affiliation do you currently have with the AAEES?

Of the respondents, 86.4% were BCEEs; 3.9% were Student Members; 3.6% were BCESs; 3.3% were AAEES Members; and 3% were BCEEMs.

Question 2: Following are some messages AAEES is communicating. Please rank the "messages" in terms of their importance TO YOU:

A full break-down is shown in the diagram under **Question 2 Results**. Other comments provided by you include:

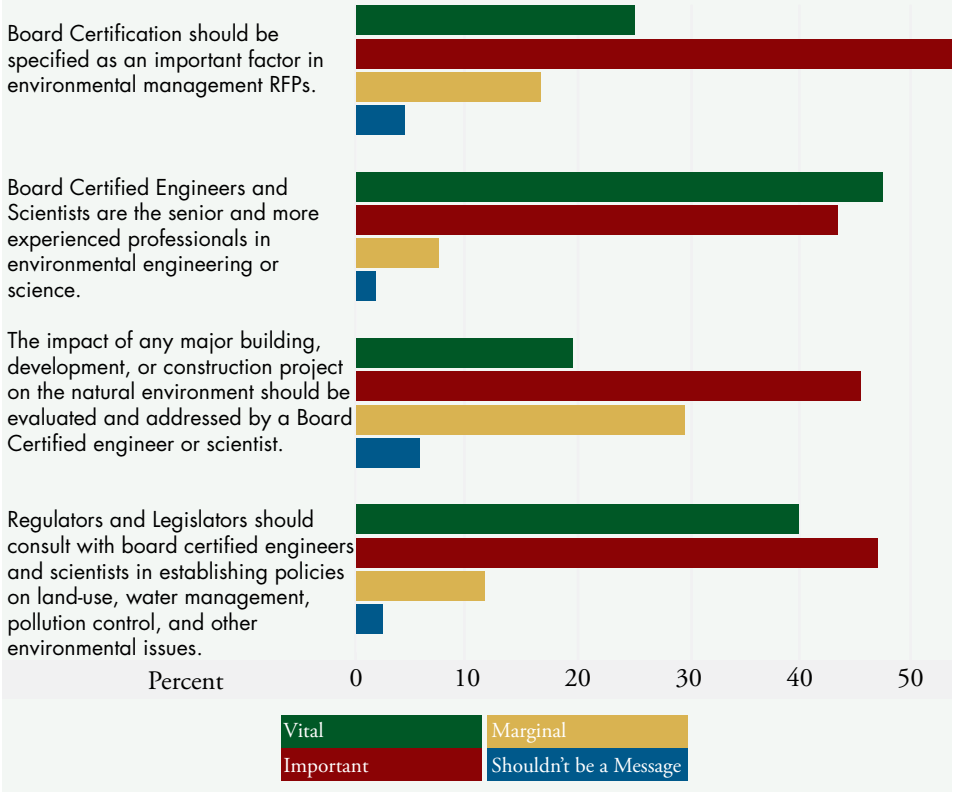
- Clients should be educated in the benefits of using Board Certified professionals.
- BCEE and BCES should be consulted more heavily outside the traditional water/wastewater industry and include more prominent requirements for credentials in the haz waste and environmental impact industry.
- BCEE designation has proven to be essential in the private sector but has been very slow to progress in the public arena. I would like to see more public sector engineers and scientist certified in the future.
- Value of certification to manufacturers and industry.
- None of the above criteria should be 'shoulds'. Certainly regulators and legislators should be made aware of the expertise available for consulting on relevant policies.

Question 3: Can you describe in a few words an article you would like to read or a specific subject you would like to read about in *Environmental Engineer & Scientist*:

The responses include:

- How AAEES interfaces with other professional associations
- Importance of Riparian Buffers in water quality
- Articles that combine a multi-faceted redevelopment project, for example a contaminated site cleanup that was performed to make way for a bridge, building, sewer, or other type of design/build project. Also, highlighting federal or DOD projects to add some emphasis on use of Board-certified engineers in that sector.
- Applied inter-discipline science and experience transfer from other fields particularly chemical/petro/nuclear/pharmaceutical/bio engineering and science.
- Good technical articles in EE&S tend to get my attention. For example, the one that Stenstrom and Rosso wrote a few years ago on the advantages of BNR processes for wastewater treatment.
- Profiles of Board Certified leaders in the environmental community, what they are doing to help solve environmental problems, and why they consider being Board Certified is important.
- Current public policy issues and how they impact the profession; pros and cons of different positions on environmental issues.
- I would like to see an historical article on some of the early leaders in the environmental field.
- Updates published when new/revised regulations are issued by regulators including commentary on the regulations would be helpful.

Question 2 Results



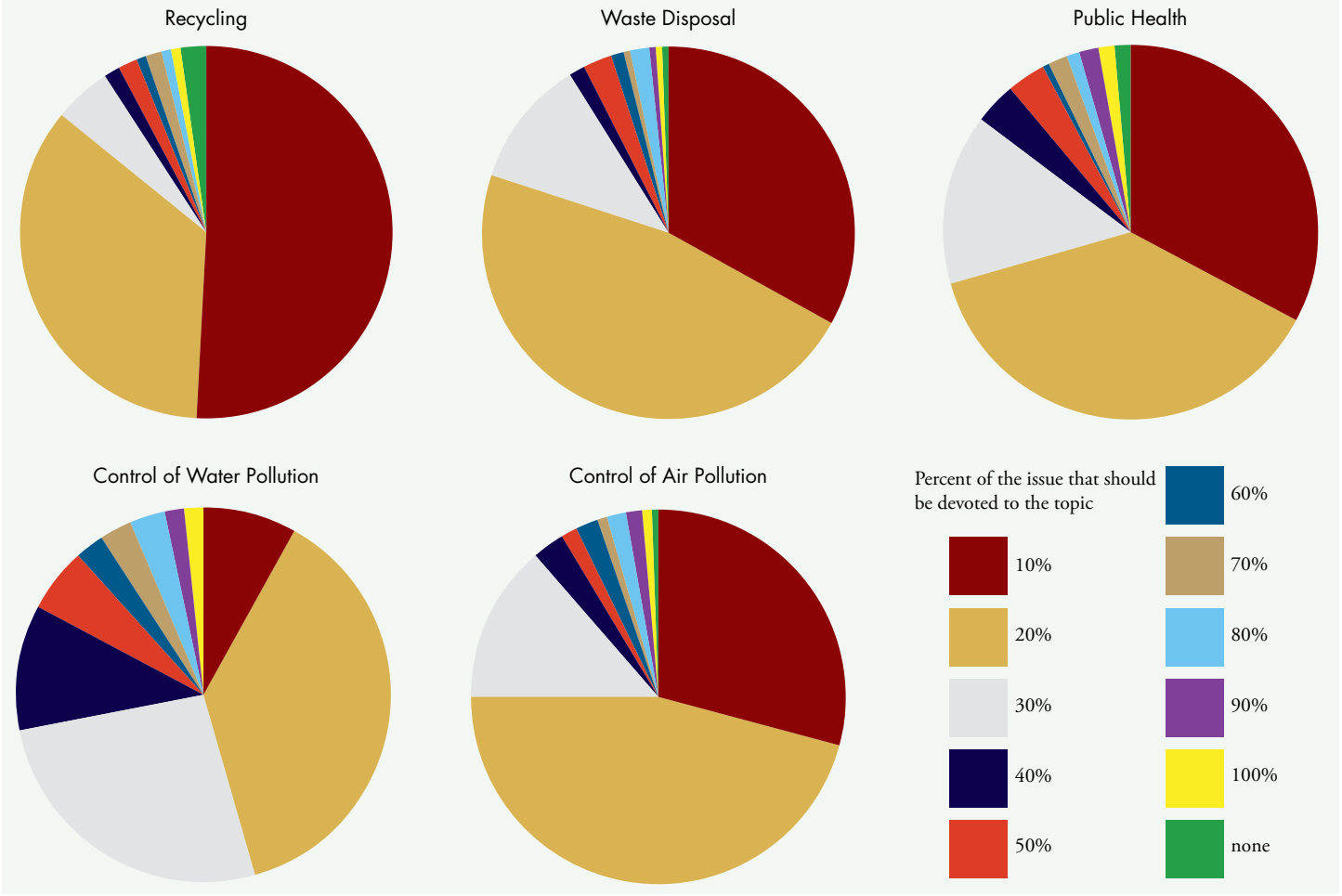
- Green Infrastructure
- Impacts of climate change and what the Academy can offer in terms of (1) public education and (2) training for environmental professionals
- An article on the need for reviews of efficacy of current regulations (perhaps every decade) is worthwhile.
- Both sides of the global warming issue.
- Small scale environmental impacts. Point-of-use treatment options like septic systems and water well treatment technologies.
- Case studies on major projects, with emphasis on what the key decisions were made and how they turned out.

Question 4: Environmental engineers and scientists use the principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems. They are involved in efforts to improve recycling, waste disposal, public health, and control of water and air pollution. What percent of the pages of *Environmental Engineer & Scientist* should be devoted to each of these topics?

Results are presented in the diagram under Question 4 results. Other comments include:

- Trying to make a list is missing the boat. What about, fluid mechanics, mathematics, computers, drawing, computer-aided design, management, basics of law, contracts, working with landscape architects, philosophy, ad infinitum? Environmental engineers should have the basic education for continuous career-long learning.
- Sustainability - 10%, Stormwater - 10%, Integrated Water Master Planning - 10%, Water Supply - 10%
- I suggest that you analyze the specialization demographics of the membership and use this information to dictate half to two thirds of the editorial content. The remainder should be determined by watching what is hot. You don't list EPA and state regulatory developments. But [there] have been times when funding and rule making were very important and some interviews with key opinion leaders, both in and outside government, would have been very informative.
- Don't forget contaminated site remediation.
- A good balance is important, but especially critical in all reports is relevance to health of people and the environment.
- To reach a younger audience (current college students and recent graduates) AAEES should have some discussion of how the profession is addressing environmental engineering within less developed and developing countries. These students are looking for something

Question 4 Results



beyond Engineers without Borders and other organizations to make a real and sustained change in the lives of others through environmental improvement.
- Sustainability
- Involvement in the more holistic LEED/ISI type approach.
- Sanitation - 50%

Question 5: Following are some typical "elements" of an association journal. Please indicate your interest in seeing these in *Environmental Engineer & Scientist*.

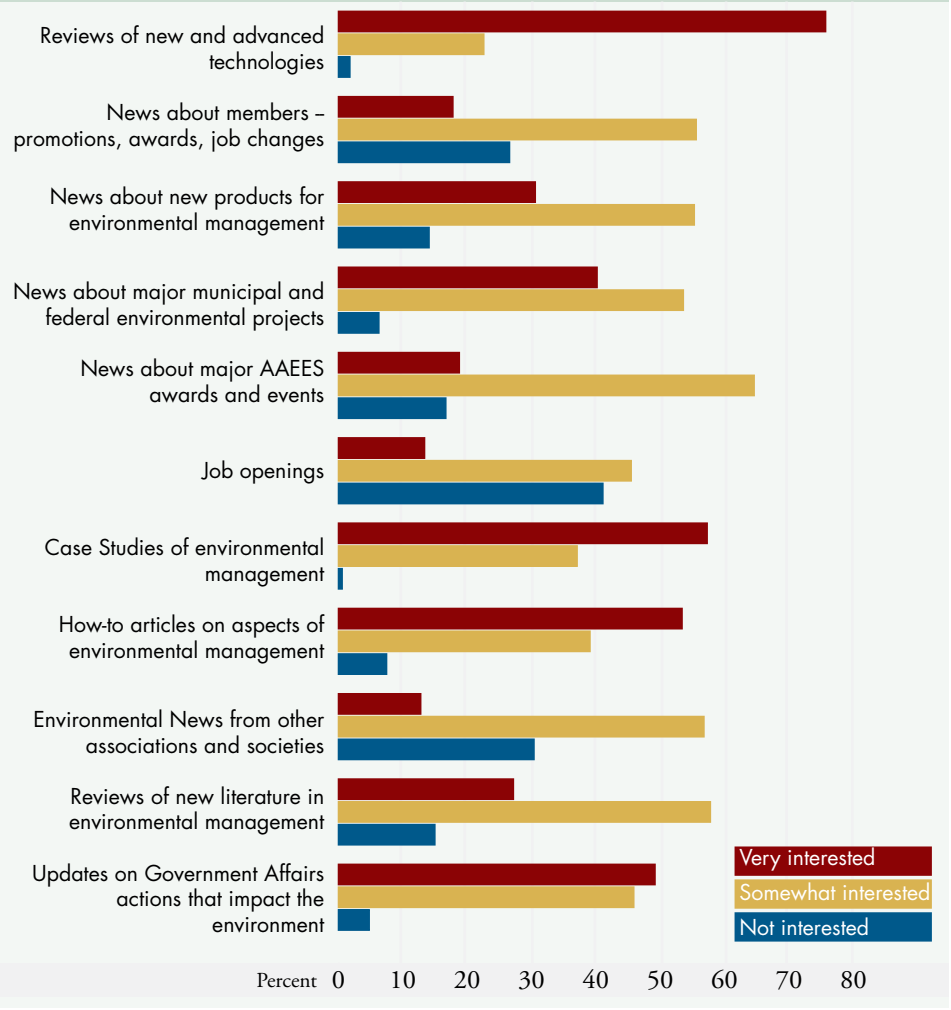
Results are presented in the diagram under Question 5 Results. Other comments received include:

- Lessons learned from mistakes would be beneficial for the profession as well as the public.
- I have to say I am more for the "cutting edge" technical stuff done by members of the Academy, if possible. If there are great things happening in environmental engineering and science that are not done by Academy members, that is OK as well.
- STEM activities, opportunities and support by the AAEES
- Most, if not all members, get publications and e-newletters from other organizations in their field of interest, so should not try to duplicate the reporting of info done by others.
- Status of programs to encourage HS/college students to major in AAEES related practice areas and status of new membership

Question 6: What do you read now (other print or online publications) to keep abreast of developments in environmental engineering and/or science?

An extensive list of magazines, journals, and online resources were cited, including: Environmental Engineer & Scientist, Water Environment & Technology, Environment Science and Technology, Water Science and Technology, AEESP Newsletter, ASCE Journal, Water Environment Research, Landscape Architect, Environment News Record, OpFlow, AWWA Streamlines, USEPA notices and documents, IWA Water, American Oil & Gas, Discover Magazine, Municipal Waste Management, Chemical Engineering Progress, LinkedIn Groups, AIHA Journal, and PE Magazine.

Question 5 Results



Question 7: How do you prefer to receive and read *Environmental Engineer & Scientist*?

in print	37.2%
online	42.0%
both	20.5%
other	0.3%

Question 8: How many people (including yourself) read or look at *Environmental Engineer & Scientist*?

1	68.2%
2	14.8%
3	5.6%
4	2.5%
5	1.5%
>5	7.4%

Question 9: *Environmental Engineer & Scientist* currently comes out quarterly. How often would you like to receive it?

Quarterly, as I do now	81%
6 times a year	14%
12 times a year	3.9%

- Quarterly is good; by then I'm looking for it.
- 3/year would be fine
- I think quarterly is right. Depends on what the Academy is trying to accomplish. Maybe we need to move toward more electronic communications. I think in the age, that has to happen to maintain or enhance relevance and to tell the environmental engineers' [or scientists'] story.
- An improvement plan should consider frequency increase, but quality should be focused on first.
- or triannually

Question 10: Some have suggested that *Environmental Engineer & Scientist* should include peer-reviewed articles. Others have suggested that it should be contemporary, with copy aimed at outside audiences. What do you think?

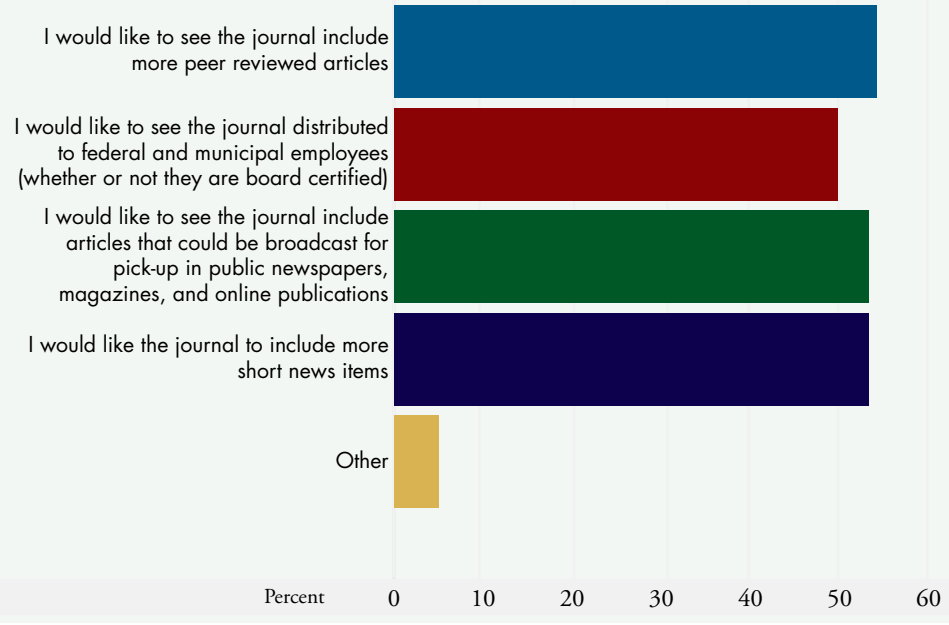
Results are show in the diagram under Question 10 Results. Other comments and suggestions include:

- Let's see more engineering practice articles as opposed to research oriented articles.
- I don't see the need for AAEES to compete with well established peer reviewed journals
- I lean strongly toward contemporary. There are hundreds of journals out their in the peer-reviewed literature world. I would not pick *Environmental Engineer & Scientist* as a place for a 'peer-reviewed" article. There is a lot of care and feeding of such an approach and great infrastructure that would need to be created. I worked for many years (maybe 12) as an Associate Editor for the *Journal of Environmental Engineering* and it was very worthwhile, but I do not think the World needs another Peer Reviewed Journal.
- I suggest staying away from peer reviewed articles. There are very good journals that are able to manage the (very tedious) peer reviewing process. Stay fast on your feet and get timely articles by reliable authors out to the membership ASAP.
- Journal format & distribution should be to inform people involved with work that could utilize the information to benefit the environment and sustainability of resources.
- The more the better subject to budget constraints
- EE&S should be devoted mainly to news of members. It is not nor should it be a technical journal.
- There is no shortage of peer reviewed journals and I see them as different and separation is preferable
- Peer review is OK, depending on the kind of article.

Question 11: What else would you like us to consider as we seek to improve *Environmental Engineer & Scientist*?

- Include one major project in the quarterly magazine
- JUST KEEP DOING IT.
- Human interest story about someone distinguished in their career, but limited to 2-3 pages.
- I think "improve" is not quite the right word. Just fine tune or "tailor" it a bit.
- Get contributions from end users, industries and municipal operations.
- Provide news of differing international practises. For example, most North American municipalities disinfect water and treated wastewater with chlorine while in France, ozone is used more extensively. Why?
- Keep articles on AAEES member profiles.
- I would like to see more focus on those we serve -- the public. They must see value in the BCEE.
- I would not like to see peer reviewed articles -- there already are many peer reviewed journals that have their niche. AAEES serves too broad a field of expertise to have a credible peer reviewed journal that provides service to all members
- More science articles. Too many municipal articles
- There is a business side to environmental engineering that no publication covers. This could be something to do. Things like - how to start a business, how to grow a business, common financial metrics, how to sell a business, how to motivate employees in an entrepreneurial venture, etc.
- Keep up the good work. I had gotten into the practice of checking the TOC and chucking the mag. I find your efforts to date are producing a better document and I expect that this effort will again move it in a good direction. Remember, the goal is not perfection, it is continuous improvement!
- I like the articles on the AAEES members of their personal life and work experiences.
- Include management approaches as well as technical articles.
- Again, profiles of environmental leaders so younger members can learn from and emulate them.
- I like the idea of distributing to clients (municipal/federal) to make them more aware of the organization.
- Make it a tool for both students and professionals.
- More content aimed at environmental scientists.
- Provide a way for member to member discussion on topics of interest.
- More articles aimed at actual design and pitfalls to avoid for various processes.

Question 10 Results



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2014

Excellence in Environmental Engineering & Science

The Excellence in Environmental Engineering & Science (E3) Awards competition is the **Gold Standard** for identifying state-of-the-art projects in environmental engineering and science. Awards and presentations are held in late spring at the National Press Club, Washington, DC. Winning entries automatically qualify for the International Water Association's Project Innovation Awards.

Entries are accepted in the following categories:

- Design
- Industrial Waste Practice*
- Planning
- Small Firms
- University Research
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- Operations/Management
- Research
- Small Projects

**The top prize for Industrial Waste Practice will also be presented with the W. Wesley Eckenfelder Industrial Waste Management Medal*

In commemoration of the 100th anniversary of the Activated Sludge process, the E3 competition encourages the submission of Activated Sludge process (and its variants) projects in all the above categories. These projects will be judged within their submitted category and also in a new one time only category "100th Anniversary of Activated Sludge". Double your chances of winning!

Entries are due by February 1, 2014. Contact Sammi Olmo at JSOlmo@aaees.org for details.

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