The Periodical of the American Academy of Environmental Engineers®

Winter 2012 | Volume 48, Number 1

ENVIRONMENTAL *Engineer*

American Academy of Environmental Engineers
130 Holiday Court, Suite 100
Annapolis, Maryland 21401
ADDRESS SERVICE REQUESTED

REDUCING CARBON FOOTPRINT

We're dedicated to maximizing the energy efficiency of the products we sell to you. We perform life cycle assessments to critically evaluate such things as global warming potential, resource consumption and ecotoxicity. The end result: Sustainable ultraviolet water treatment solutions that reduce your carbon footprint and environmental impact.

Our environmental policy means the world to us. Read more about it at trojanuv.com.

TROJANUV™

The Quarterly Periodical of
The American Academy of Environmental Engineers®

www.aaee.net

EDITORIAL STAFF
C. Robert Baillod, Ph.D.
Editor-in-Chief, Applied Research & Practice

Otis J. Sproul, Ph.D.
Associate Editor, Applied Research & Practice

EDITOR
Yolanda Y. Moulden, News, Currents, and Careers

PRODUCTION
Yolanda Y. Moulden

ADVERTISING
Yolanda Y. Moulden
410-266-3311 Ext.18
ymoulden@aaee.net

OFFICES
Environmental Engineer is published by the American Academy of Environmental Engineers®. Address all communications on editorial, business and other matters to:

Editor-in-Chief,
Environmental Engineer®
American Academy of Environmental Engineers®
130 Holiday Court, Suite 100
Annapolis, Maryland 21401
410-266-3311

PUBLISHER
Craig Kelman & Associates

Managing Editor: Terry Ross
Design/layout: Vadim Brodsky
Advertising Coordinator: Lauren Campbell

ENVIRONMENTAL *Engineer*

Winter 2012 | Volume 48, Number 1

FEATURES

Board Certified Environmental Scientist (BCES) 12

2012 Kappe Lecturer 18

New Challenges for our Old Challenges 22

Class of 2011 23

ENVIRONMENTAL ENGINEER:
APPLIED RESEARCH AND PRACTICE

The Role of Landfills in US Sustainable Waste Management 31

DEPARTMENTS

President's Page 6

Academy News 8

Executive Director's Page 10

Side Tracks 15

Member News 16

Reach our Advertisers 38

By Michael W. Selna P.E., BCEE

Academy VIPs

The Academy's recent past presidents collectively are a very tough act to follow. Each had his or her distinctive style and areas of focus. While these differences make each of them unique, they all had one unifying characteristic: their unwavering dedication to the Academy. It will be my goal to advance the cause of the Academy over the next year in a style that emphasizes teamwork, communication, openness to feedback, and a strong expectation of results. I will be using this space in the *Environmental Engineer* to discuss areas of focus in strengthening the Academy. Four areas of growth are apparent:

- Recognition of Volunteers,
- Visibility,
- Value of Our Credential to the Profession, and
- Understanding of Our Core Values and Direction by Our Members.

Academy Volunteers

Much of the hard work in growing the Academy is done by our amazing volunteers. The Academy has 30 active committees and work groups with a total roster population of 272. Allowing for those serving on multiple committees, the number of committee volunteers is about 200, roughly 8% of our total membership. This rate of participation is virtually unheard of in a professional organization. Some amazing outcomes have resulted. Did you realize that our ABET Evaluators, who come from the Education Committee chaired by David Chin, spent countless person days on university campuses in 2011, and that there are now more than 70 universities with programs accredited in Environmental Engineering? Did you know that 16 separate events such as seminars, conference sessions, and Academy breakfasts were arranged in 2011, largely by the Seminars and Workshops Committee chaired by Sandy Tripp? Or that 34 complex award applications were reviewed and judged by the eight member Excellence in Environmental Engineering Awards Committee chaired by Steve Maguin?

> "Much of the hard work in growing the Academy is done by our amazing volunteers."

The Admissions Committee, also chaired by Sandy Tripp, processes about 125 applications per year, including determination of compliance with the Academy's detailed criteria, review of reference information and scoring of exams, and they accomplish this under a demanding schedule that allows the Board of Trustees to take its certification actions each fall.

I could cite many other worthy examples. While the contributions of our small but dedicated staff are amazing in their own right, this work simply could not get done without the focused efforts of our committee volunteers.

The Academy's State Representatives are our front line ambassadors. Their primary role is to organize and administer the certification exams. This involves making personal contact with the successful applicants and fitting their schedules to allow the exams to occur. Proctoring the written exams and the oral exam panels are also efforts carried out by the State Reps. Southern California's State Rep, Dick Corneille, organized exams for 24 applicants in 2011, more than double the next closest state (or partial state). Our State Reps are also beginning to expand their roles into areas such as new member recruiting and creating regional AAEE events to bring together existing and potential members for a meal and technical presentation.

While I am overwhelmed with the spirit and energy of our volunteers, I am certain of one thing: there are many more of you out there with untapped energy and great ideas on how to strengthen the Academy. Two thoughts emerge: (a) tell me about your ideas (*michaelselna@socal.rr.com*) and (b) volunteer to be on a committee (*jsolmo@aaee.net*).

I am certain that I have not cited all of the positive outcomes generated by our volunteers. In each issue of *Highpoints*, our electronic monthly newsletter, and on *aaee.net*, we will be honoring a volunteer nominated by one of our members. Please see the 'Volunteer of the Month' button on the AAEE website: *aaee.net*. We can all use this mechanism to bring some of the fine work of our volunteers to light My expectation is that we will see an avalanche of nominations because I know that our former presidents aren't the only ones with that characteristic unwavering dedication to the Academy. EE

Click HERE to return to Table of Contents

2011 Annual Meeting News

The 2011 Annual Meeting of the Academy's Board of Trustees (BOT) was held November 12 at the Stephen F. Austin Intercontinental Hotel in Austin, Texas. The well-attended event included five guest members: Christian Davies-Venn, Vice President-Elect; Stephen P. Graef, Deputy Treasurer; N. Bruce Hanes, AAEE 1989 Past President; C. Hunter Nolen, Trustee-at-Large-Elect; and Robert C. Williams, APHA Trustee-Elect. Guest speaker was Maynard Garfield whose topic was persuasive communication strategies. Here are additional outstanding highlights of the meeting:

- **New Board Certified Environmental Engineers** - Approved included 102 new BCEEs; 7 new BCEEMs; 1 Reinstatement, and 6 BCEEs who earned second specialties. We wish to thank all of those members who take the time to recruit new applicants. Word of mouth and personal encouragement are still our best tools for recruiting new members.
- **Sponsor Recognition** - THANK YOU to the BOT sponsors who made the Annual Meeting possible: CH2M Hill, Innovyze, and MWH Global. Sponsors were recognized at the BOT Meeting and at the Evening Installation Dinner and Ceremonies. You can also find them on the AAEE Website at *www.aaee.net*!

- **2012 Individual Award Recipients:**
  - Stanley E. Kappe Award - Stephen Lippy
  - Edward J. Cleary Award - Joseph Malina
  - Gordon Maskew Fair Award - C.P. Huang & Otis Sproul
  - Kappe Lecturer - Vladimir Novotny
  - Honorary Member Award - LTG Van Antwerp.

New Excellence in Environmental Engineering Education (E4) Award

The Academy established the E4 Award to be granted to an educator who has made a significant contribution to the profession on the area of educating practitioners. The award will be jointly administered with AEESP and will be bestowed annually at the AAEE Excellence in Environmental Engineering Awards Luncheon & Conference.

New Officers and Trustees

Congratulations to new Officers and Trustees for 2012 who were installed during the Annual Meeting on November 12 and will take office January 1, 2012. They are:

- Michael W. Selna, President;
- Pasquale S. Canzano, President-Elect;
- Christian Davies-Venn, Vice President;
- Howard B. LaFever, Treasurer; and
- Brian P. Flynn, Past President.

Trustees serving a first full three year-term are:

- Sharon A. Jones, representing ASEE;
- Kristin Morico, Trustee-at-Large;
- C. Hunter Nolen, Trustee-at-Large; and
- Robert C. Williams, representing APHA.

Trustees serving a second-three term are:

- Lamont "Bud" W. Curtis, representing APWA;
- Paul A. Bizier, representing ASCE; and
- Stephen J. Quail, representing AWWA.

Specialty Certification Renewals

Have you renewed your specialty certification for 2012? If you haven't renewed by the time you receive this issue, then do so now! The deadline has already passed (December 31); however, you still have time before your certification lapses. If you have lost or misplaced your renewal package, you can renew **right now** by logging into the AAEE Center at *https://netforum.avectra.com/eWeb/StartPage.aspx?Site=AAEE* or visit *AAEE.net* and click on the red **'Renew Online'** button under membership. The AAEE Center is a secure web site.

AAEE Volunteer of the Month

A new monthly feature has been added to the AAEE website – Volunteer of the Month. Congratulations to Wendy A. Wert, P.E., BCEE, AAEE's first Volunteer of the Month. Ms. Wert, Environmental Engineer, Sanitation Districts of Los Angeles County, is recognized for her dedication to AAEE. Go to *aaee.net* to view her full profile. EE

by Joseph S. Cavarretta, CAE

January is Janus's month

January is named after Janus – the Roman god of gates, doorways, and beginnings. In Roman mythology, Janus was the guardian of the gates of heaven, and the Romans invoked his name at the beginning of every major undertaking.

Besides the "Janus particle," what does Janus have to do with the Academy? January 2012 recognizes new gateways and new beginnings – specifically, it's time to recruit worthy qualified candidates to become Board Certified Environmental Engineers (P.E. licensed) and Board Certified Environmental Engineering Members (non-P.E. licensed).

I am personally asking each of you to recruit one new applicant for certification. Roll up your sleeves with the staff and me and commit to recruit just **one** new applicant. We're even offering a prize drawing as an expression of thanks: a $500 Canon T3 Digital Camera. It only takes two or three personal contacts with a candidate to make sure he or she stays on track. Can you carve out a few minutes each week over the next two months to help the Academy grow?

One of the Academy's recruiting heroes is 2006 AAEE President Alan Vicory, executive director and chief engineer of the Ohio River Valley Water Sanitation Commission. A member since 1985, Alan has successfully recruited a new applicant each year for at least the past 12 years. I asked Alan what motivates him to do this and he replied,

"Because I don't want you to keep bugging me all the time. Seriously, when I look at someone and I know that he or she should be recognized for his/her professional achievements and qualifications, I target that person. I was encouraged to apply by Leo Weaver (AAEE President, 1986). In my position, I feel the public has a right to expect that the chief engineer involved in the quality of their water has an adequate standard of professional achievement, and the BCEE demonstrates that."

As of 2012, Alan was voted in as chair of the AAEE Environmental Engineering Foundation (*www.environmentalengineeringfoundation.org*).

Membership Development and Outreach Committee volunteers and the entire staff devote substantial time and effort to facilitate and maintain membership growth. The committee of 21 includes Stephanie Carbone Boylard, Pasquale Canzano, Joseph Darby, John Ferguson, Charles Haas, Jeffrey Hahn, James Herberg, Stephen Lippy, Cecil Lue-Hing, Kristin Morico, Daniel Oerther, Webster Owen, James Patterson, Maya Rao, Rusty Shroedel, Michael Selna, Sandra Tripp, NC Vasuki, Wendy Wert, Thomas Wilson, and Megan Yoo. This prolific group of achievers is working hard, but they cannot do without you.

Historically, less than 2% of members reach out to recruit and follow through with one new applicant (not including consulting firms that actively promote certification to staff). This is why the Membership Committee is actively encouraging you to recruit new applicants by offering a substantial prize drawing.

One-to-one recruiting: you can make it happen

The goal this year is 350 new applicants. Realistically, it is unlikely we can achieve that unless each person reading this column not only commits to recruit a new applicant but also encourages other Academy certified members to recruit someone. Help AAEE attain its March 31 objective, please email *jcava@aaee.net* and make your intentions known. AAEE will assist your recruitment efforts. We will schedule conference calls to answer your prospects' questions and we'll supply you with materials. Do you need prospects in your geographic neck of the woods? They are available upon request.

Add muscle to the mission

By achieving the Strategic Plan's goal for 2011-2012, the Academy can take concrete steps to invest in membership ROI such as raising awareness of, and demand for, BCEEs and BCEEMs among federal and state agencies and utilities; providing greater career-enhancing benefits and the recognition that BCEEs and BCEEMs deserve; adding new market-driven benefits for consulting firms; offering more educational initiatives (e.g., K-12 contests, workshops/seminars for public and industry); creating webinars; partnering with Sponsoring Organizations, and updating the Academy's office infrastructure. More important, a stronger Academy will add muscle to the mission, ultimately honoring existing BCEEs and BCEEMs and those Diplomates who founded AAEE so many years ago.

Remember their vision: "[Members …] will be recognized for their expertise in environmental engineering specialties...as evidenced by their positions of leadership and service in public and private institutions" and the mission: "[AAEE] is dedicated to the practice of environmental engineering to ensure the public health, safety, and welfare to enable humankind to co-exist in harmony with nature." Achieving the vision is mission critical today more than ever.

Click HERE to return to Table of Contents

Top-down recruiting

CEOs and senior officers of consulting firms and public agencies can do the work of many individuals to help the Academy reach the 350 goal. It only takes a few minutes each week to encourage environmental engineers to reach out and achieve the personal satisfaction and recognition that comes with earning this exclusive certification. Your firm will also benefit. If you email prospective applicants' names, telephone numbers, and email addresses to jcava@aaee.net, the Academy will be pleased to follow up with candidates on your behalf. For groups of five or more, AAEE is willing to schedule a convenient conference call or arrange a personal visit to answer questions. Email *jcava@aaee.net*.

Applying is easier than ever. Prospects can now begin the application online and receive the form to complete their application. They simply go to *www.aaee.net*, click on 'Membership,' and follow the instructions. We also offer a comprehensive brochure that summarizes certification, describes who can apply and how to apply, and relates the value of becoming certified. To request a packet of printed brochures, email Joyce Dowen, *Jdowen@aaee.net*.

Share the commitment by staff and that of the Membership Development & Outreach Committee volunteers in 2012 to help AAEE achieve its goal. EE

MEMBER GET A MEMBER 2012

It's time to encourage your worthy colleagues to join the Academy. Do you remember who encouraged you to join? Most of us were encouraged by a colleague to become Board Certified, usually in a brief conversation. You can play the same role today with only a small investment of your time. **This year, for each applicant who lists you as referring them, your name will be entered in a drawing for a Canon EOS Rebel T3 digital single lens reflex camera ($500 value).** The more people you stimulate to apply, the more chances you have to win this fine camera. Remind them to list you in the space labeled "Referred By" on the application form. The streamlined certification process now begins with a short on-line application available at **AAEE.net**, and if support is needed, please contact Sammi Olmo at jsolmo@aaee.net or 410-266-3311. Subsequent submittal of the more detailed qualification information is required by **March 31, 2012**, so recommend that candidates apply early. All the information an applicant would need such as benefits of membership, information about the Academy, and how to apply can be found at AAEE.net. **More important than winning the camera, you will be making a difference in someone's career. They will appreciate that you think highly of them and will remember you, just as you remember who encouraged you to become Board Certified.**

American Academy of Environmental Engineers®

130 Holiday Court, Suite 100 | Annapolis, MD 21401 | http://www.aaee.net | Follow us @AAofEE

Board Certified Environmental Scientist

Brian P. Flynn, P.E., BCEE, Past President

Over the past year and a half, a dedicated team of Environmental Engineers and Scientists has developed a new class of specialty certifications for the Academy, the Board Certified Environmental Scientist (BCES). The BCES was accepted for implementation by the Academy's Board of Trustees on November 12, 2011. This article is one of a continuing series of communications with our members to make them aware of the nature and opportunities inherent in the new BCES program.

The idea of expanding the Academy's certification mission to Environmental Scientists arose from discussions within the Membership, Development and Outreach (MDO) committee in the early spring of 2010. The basic premise was that since most of the organizations that employ Academy members utilize Environmental Engineers and Scientists on multidisciplinary teams to solve environmental problems, why not certify both? In this way, the Academy will then be able to offer the users of environmental services and environmental employers a full range of professional certification services.

This is not a new idea. The Academy's Board had previously discussed it in the 1990s, but no action resulted. In this case, the committee quickly and enthusiastically formed a subcommittee to study the idea and develop a detailed actionable concept. The subcommittee consisted of six Board members (Cecil Lue-Hing, Brian Fynn, Mike Selna, Tim Haug, Jim Stahl, Jim Mihelcic), three of them being in the direct line of the Academy's presidential succession, and four other highly skilled and experienced individuals (Joe Reichenberger, Jim Patterson, Enos Stover, and B.C. Robison).

The subcommittee conducted an interview-type survey that indicated that an Environmental Scientist certification would be positively received by the environmental professional community and by the clients of such professionals. It then developed a fairly detailed concept for the BCES and presented it to the Board of Trustees in November of 2010 for comment, not a vote. Response was favorable and a number of useful suggestions were made. Encouraged by this, the subcommittee went to work and recruited a highly experienced and distinguished Science Advisory Panel (see sidebar) and gave it a dual charge: further refining the BCES concept and addressing the issue of a potential name change for the Academy. Both activities were implemented by the development of white papers. These were combined and presented to the Board of Trustees at their next meeting (May, 2011).

In May 2011, we informed our membership of the proposed BCES and name change to the Academy. This included an Internet poll that showed very strong support among our membership for the BCES program and majority support for a name change. The resolutions for the BCES implementation and the name change passed on November 12, 2011, in the Academy's Annual Board meeting.

What is the BCES?

The Academy will offer a new class of certifications, called the Board Certified Environmental Scientist (BCES). Science practitioners will come from the geology/hydrogeology, biological, chemistry, toxicology, etc. branches of environmental practice. The BCES will have the same fundamental requirements (time in service, responsible charge etc.) for certification as currently exists for the BCEE. The examination process will mimic the one we already have in place, and will have the same time in service/responsible charge requirements as the BCEE for the oral and written exam.

The BCES, like the BCEE or BCEEM, will confer a specialty certification. We are initially considering certifications in groundwater, soils, water/wastewater, sustainability, environmental biology/ecology, environmental microbiology, environmental chemistry, environmental toxicology, and air. Exams (written and oral) will be structured for each. For reference, we currently offer eight areas of specialization for BCEE/BCEEMs.

The Academy will also allow less experienced Environmental Scientists to join the Academy under the Member category, just as we do with less experienced Engineers.

What it is NOT

Discussions about the BCES have unearthed a number of misconceptions. We wish to lay them to rest here.

- The BCES is separate and distinct from the BCEE or BCEEM.
- It is not a license; like the BCEE and BCEEM, it is a certification of specialized knowledge in a specific area of environmental practice.
- A BCEE or BCEEM cannot become a BCES. In most cases it would be impossible because of the qualifications required; in a few rare cases, it would be possible but redundant and would unnecessarily blur the distinct bright line between our engineering and science certifications.
- Conversely, a BCES cannot become a BCEE or BCEEM for the same reasons stated in the prior point.
- The BCES confers absolutely no rights to practice engineering, just as the BCEE/BCEEM confers no rights to practice environmental science.

- The BCES is not a generalized or management certification, it is a technical specialty certification.

The BCES is an entirely separate certification system from the BCEE/BCEEM. It is **not** an engineering certification. The engineering certification that our members hold today will have the same value tomorrow, because it is based on the stringency of the Academy's experience and exam requirements. The Science Certification will have the same, but separate, experience and exam requirements. Our oral exam will have a mandatory ethics question which focuses on the distinction between a scientist and an engineer.

Implementation

The Science Advisory Panel has been instrumental in developing the BCES concept. These individuals were selected based on the same experience, title, and outside achievement requirements that the Academy currently attaches to its selection by eminence method of entry.

Like the BCEE, the BCES will include specific areas of specialization. Our Science Advisory Panel considered a number of alternatives based on environmental media and academic discipline, and settled on the so-called hybrid approach, a combination of media practice areas and specific scientific discipline.

The written exam will be done in a phased approach in the same multiple-choice format as the BCEE exams.

1. The first phase will include a written test that will contain 50 multiple-choice questions in a General Section that all Board Certified Environmental Scientists (BCES) applicants will take.
2. The specialty portion of the test will be an additional 50 multiple-choice questions in the area of specialization chosen by the applicant. Some of these areas of specialization will be focused on media and others on disciplines. The initial areas of specialization will include water/wastewater, groundwater, air, environmental biology/ecology, environmental microbiology, and environmental chemistry.
3. In the second phase, depending on feedback from the environmental scientist community, more specialties could be added, including: environmental toxicology, soil science, and environmental sustainability.

Some items in the second phase may be added to the first phase list, depending on the resources for exam writing available to the Science Advisory Panel.

Each area of specialization will also include a set of oral exam questions, using the same type of scope and format used by AAEE for the BCEE exam. The new oral and written exams will be piggybacked onto the Academy's existing exam system.

The Science Advisory Panel has already developed a preliminary draft list of competencies to be covered by the new exams. This will serve as the foundation for question development, which has already occurred in draft form for the general section of the written exam.

During the first quarter of 2012, Science Advisory Panel members will be invited to apply for membership by Eminence. AAEE's Eminence Committee will go through its normal screening and evaluation procedures to vet the candidates, and recommend those it deems worthy to the BOT for membership by eminence at the April 2012 Board meeting. This will provide the necessary core group of BCES members.

The written and oral exams should be drafted no later than mid-year 2012. We will be calling for volunteers to field test exam questions in the second half of 2012. In fact, if you have any Environmental Science colleagues that might be interested in helping with either task, please contact the Academy's Executive Director at *jcava@aaee.net*.

The new certification will be announced to the public and applications taken, starting in the second quarter of 2012. The field testing of exam questions will be completed by the end of 2012. This allows the exams to be finalized for the normal 2013 examination cycle, which begins March 31, 2013.

Academy volunteers will provide technical assistance to committees charged with implementing the new certification. The bulk of the work of the committees will be done by the new BCES certificate holders. The BCES examination process will be integrated with the Academy's existing process, sharing common sites and facilities.

We will be sending an announcement about the BCES to some of the biggest employers of BCEEs. A number of these firms

Click HERE to return to Table of Contents

were interested enough in the concept to write letters of support to our Board. We anticipate that this and other actions will generate BCES applications in 2012.

The initial monetary investment by AAEE is very modest (about 1% of budget) and will result in a positive cash flow by the second year. Academy finances are very sound. In fact, we will have our first significant surplus in 10 years in 2011 and expect another modest surplus in 2012. We have abundant volunteer resources to make the new certification system a reality. If we have any future increase in Academy fees, it would not be related to the BCES. Historically, fees have risen slowly in response to inflation.

Academy Name Change

The Subcommittee and the Science Advisory panel considered whether the Academy should change its name when if offers the BCES. It concluded that it would be advisable for the following reasons:

1. A name change will better reflect the engineering and scientific membership and focus of the organizations that employ current Academy members.
2. Publicizing the interdisciplinary nature of environmental engineering through a formal name change will demonstrate that the Academy has adjusted to pertinent developments in the multidisciplinary environmental field.
3. A name change will signify the Academy as an organization that provides specialty certification to all environmental technical professionals.
4. A name change will avoid any perception of a 'two-tiered' system or lack of uniformity in certification processes or structure for the two disciplines.
5. A name change should encourage scientists practicing in the environmental field who might not show interest in participating if the parent name does not make any reference to science.

The name change will be simple. We will add "and Scientists" to the current name, making it the American Academy of Environmental Engineers and Scientists (AAEES). We have already secured the web domain name.

We do not know precisely when the name change will become official. It has to fit in with a detailed project plan for implementing the BCES. The plan should be ready by the time this article is published.

Summary

The AAEE has added a new and exciting certification system to its lineup: the Board Certified Environmental Scientist (BCES). This aligns the Academy with the modern implementation of environmental projects by including both engineers and scientists in our organization. For consistency, the Academy will change its name to the American Academy of Environmental Engineers and Scientists in the near future.

If you want to provide the names and contact information of potential BCES applicants, please send the information to our Executive Director at *jcava@aaee.net*.

About the Author

Brian P. Flynn, P.E., BCEE served as President of the Academy in 2011 and lives and works in Austin, TX. He can be reached at bflynn4290@aol.com. EE

ENVIRONMENTAL SCIENTIST ADVISORY PANEL

NAME	TITLE
Dr. Jay Banner	Director, Environmental Science Institute, University of Texas
Layne Baroldi	Regional Vice President of Business Development, Synagro Technologies
Dr. Patrick L. Brezonik	Professor Emeritus, Department of Civil Engineering, University of Minnesota
Dr. Mary Buzby	Director, Environmental Technology, Merck & Co
Dr. Bill Cooper	Professor, Department of Civil and Environmental Engineering, University of California-Irvine
Dr. Mary De Flaun	Managing Principal, Geosyntec Consultants
Dr. Mas Dojiri	Division Manager, Environmental Monitoring Division, City of Los Angeles
Dr. John Dorsey	Associate Professor and Chair, Natural Sciences Department, Loyola Marymount University
Dwayne Fischer	Manager of Laboratories, Sanitation Districts of Los Angeles County
Dr. Charles P. Gerba	Professor Colleges of Agriculture and Public Health, University of Arizona
Dr. Robert Ghirelli	Assistant General Manager, Orange County Sanitation District
Dr. Mark Gold	President, Heal the Bay Foundation
Dr. James Lavelle	Associate, Senior Toxicologist, CDM
Bruce Macler	National Microbial Risk Assessment Expert, USEPA Region 9 (SF)
Charlie McGee	Microbiology Laboratory Supervisor, Orange County San. District
Jeff Mosher	Executive Director, National Water Research Institute
Dr. Raj Naran	CEO, ALS Labs
Alan Nye	Partner, Director of Risk Assessment and Toxicology, Center for Toxicology and Environmental Health, LLC
Dr. Roger Olsen	Senior VP, Senior Geochemist, CDM
Dr. Betty Olson	Professor, Department of Civil and Environmental Engineering, University of California-Irvine
Dr. Joan Oppenheimer	Principal Scientist, Vice President, MWH
Dr. Joan Rose	Homer Nowlin Chair in Water Research, Michigan State University
Dr. Keith Tolson	Director of Toxicology, Geosyntec Consultants
Dr. Dan Woltering	Director of Research, Water Environment Research Foundation

SIDE TRACKS

HOWARD LAFEVER, P.E., BCEE - CAR ENTHUSIAST

AAEE Treasurer Howard LaFever, a Principal with GHD, has an interest that takes him on some literal *'side tracks.'* Howard has been involved in car racing for over 18 years. These are not short, a few laps around the track races; they are endurance events with charitable outcomes, making Howard's participation even more meaningful.

In each of the last 18 years, Howard has completed the "One Lap of America" race that covers 6,000 miles over nine days. He also competes annually in the 5,000-mile Fireball Run and the 24-hour Lemons Race, in which the race-car cannot be worth more than $500. Howard owns 17 cars that range from a 1948 MG-TD to a 556 HP 2009 Cadillac CTS-V and include a 1982 Rolls Royce Silver Spur and a 1986 Corvette, all parked in a 3,200 sq. ft. car barn.

Howard has served as Treasurer since 2009 and was the representative of APWA on the Board of Trustees from 2003-2008. EE

Awards & Honors

Peter B. Lederman, Ph.D., P.E., DEE, was presented with the American Institute of Chemical Engineers (AIChE) Award for Service to Society. This award, sponsored by the Fluor Foundation, recognizes outstanding contributions by a chemical engineer to community service and to the solution of socially oriented problems. Dr. Lederman, of Peter Lederman & Associates, LLC. (New Providence, NJ), is a Life member and has been board certified in Hazardous Waste Management since 1982.

Cecil Lue-Hing, D.Sc., P.E., DEE, NAE, has been selected as an Honorary Diplomate, Water Resources Engineer (Hon.D.WRE) of the American Academy of Water Resources Engineers. This honor is only granted to outstanding individuals who have demonstrated advanced expertise in water resources engineering. Dr. Lue-Hing, President of Cecil Lue-Hing & Associates, Inc. (Burr Ridge, IL), is a Past President of AAEE (2010) and has been board certified in General Environmental Engineering since 1982.

Tim Madhanagopal, P.E., BCEE, F.FES, F.NSPE, F.WEF, was presented with the 2011 FES Engineer of the Year award by the Florida Engineering Society (FES). This award is presented to a FES member who best exemplifies the ideal image of the Professional Engineer and in recognition of the Professional Engineer's record of consistent achievement over a long period of time in education, employment, professional and public service activities.

Mr. Madhanagopal was also inducted as one of seventeen Fellows selected to the inaugural group of WEF Fellows by the Board of Trustees of the Water Environment Federation (WEF). The WEF Fellow Recognition Program recognizes professional achievement, stature and contributions of the WEF members to the preservation and enhancement of the global water environment.

Additionally, the Central Florida Engineer's Week Celebration Committee recognized Mr. Madhanagopal with the Lifetime Achievement in Engineering Award. He is Plant Manager of Orange County Utilities (Orlando, FL) and has been board certified in Water Supply and Wastewater Engineering since 1995.

In Memoriam

John F. Andrews, Ph.D., of Fayetteville, Arizona, passed away on April 10, 2011. Dr. Andrews, Professor Emeritus of Rice University, was an Emeritus Member and was originally board certified in Sanitary Engineering in 1967.

Joe King, II, P.E., BCEE, passed away on September 23, 2011. Mr. King, who had been Regional Market Segment Leader at AECOM (Fort Worth, TX), had been board certified in Water Supply and Wastewater Engineering since 1997.

Specialty Certification

Scott B. Bell, P.E., BCEE, has been transferred to Active status. Mr. Bell, Vice President with Limno-Tech (Dexter, MI), has been board certified in Hazardous Waste Management since 2001.

James L. Condon, P.E., BCEE, has been board certified in a second specialty, Environmental Sustainability. Mr. Condon, Project Engineer with Olsson Associates (Lincoln, NE), has been board certified in Water Supply and Wastewater Engineering since 1990.

David R. Hokanson, Ph.D., P.E., BCEE, has been board certified in a second specialty, Environmental Sustainability. Dr. Hokanson, Supervising Engineer III with Trussell Technologies, Inc. (Pasadena, CA), has been board certified in Water Supply and Wastewater Engineering since 2009.

Jafir A. Jaferi, P.E., DEE, has been board certified in a second specialty, Radiation Protection. Mr. Jaferi, of the Canadian Nuclear Safety Commission in Ottawa, Ontario, has been board certified in Air Pollution Control since 1990.

Raymond R. Longoria, Jr., P.E., BCEE, has been board certified in a second specialty, Environmental Sustainability. Mr. Longoria, Principal of Freese and Nichols, Inc. (Forth Worth, TX), has been board certified in Water Supply and Wastewater Engineering since 1990.

Dominic Meo, III, P.E., BCEE, has been board certified in a second specialty, Environmental Sustainability. Mr. Meo, Principal Associate of Meo & Associates (Huntington Beach, CA), has been board certified in Air Pollution Control since 1995.

Carl S. Niizawa, P.E., BCEE, has been board certified in a second specialty, Water Supply and Wastewater Engineering. Mr. Niizawa, Deputy General Manager & District Engineer with Marina Coast Water District (Marina, CA), has been board certified in Solid Waste Management since 1999.

Thomas L. Smith, P.E., BCEE, has been board certified in a second specialty, Environmental Sustainability. Mr. Smith, Chief Technical Officer of Green Sustainable Services (Ponder, TX), has been board certified in Water Supply and Wastewater Engineering since 2007. EE

THE 2012 KAPPE LECTURER: **Vladimir Novotny, Ph.D, P.E., DEE**

Professor Emeritus, Marquette University (Milwaukee, WI) and Northeastern University (Boston, MA) Director Emeritus, Center for Urban Environmental Studies, Northeastern University Managing Partner, AquaNova, LLC

Education

Brno University of Technology (Czech Rep.)
1963 Diploma Engineer, Sanitary Engineering
Brno University of Technology
1968 Candidate of Science, Sanitary and Water Resources Engineering
Vanderbilt University
1971 Ph.D, Environmental and Water Resources

Engineering

Professional Associations
International Water Association
Water Environment Federation
American Academy of Environmental Engineers
Fulbright Association
Czech and Slovak Society of Arts and Science

Professional Awards & Honorary Appointments

Fulbright Senior Scholar, 2008 - 2013
Endowed 2011 Freeman Lecturer - Boston Society of Civil Engineers
2011 BSCES Technical Group Award, Boston Society of Civil Engineer Section
Visiting Professor, Beijing University of Civil Engineering and Architecture, 2009
Visiting Chair Professor, Capital Normal University Beijing 2006 - 2008
Diplomate of the American Academy of Environmental Engineers, Certified by Eminence, 2005
Member of The International Water Academy, Oslo, Norway, 2002
Sam Jenkins Medal recipient for Outstanding Service, International Water Association, 2002
Outstanding Researcher Award, Marquette University College of Engineering, 1997
Fulbright Fellowship for lecturing and research at the Universities of Venice and Padova, Italy and lecturing at the Mohamadia Technical University of Rabat, Morocco, 1987

Dr. Vladimir Novotny is an internationally recognized scholar and educator. In 2011, he became Professor Emeritus at Northeastern University where he was a CDM Endowed Chair Professor of Environmental and Water Resources Engineering and Director of the Center for Urban Environmental Studies. He continues to be active in AquaNova, LLC (formerly AquaNova International, Ltd). From 1973 through 2002, he taught and conducted research at Marquette University in Milwaukee, WI, and became Emeritus Professor in 2002. He received his undergraduate and part of his graduate education from the Brno University of Technology and his doctoral degree from Vanderbilt University (Nashville, TN) in 1971.

In 1991, Dr. Novotny founded the Specialist Group on Diffuse Pollution and Eutrophication of International Water Association (IWA) for which he received IWA's Sam Jenkins Medal award in 2002. Diffuse (nonpoint) pollution and water quality have been cornerstones of his research and publishing for forty years, and he published in this field ten books and more than 150 peer-reviewed journal and conference proceedings articles and book chapters. His book *WATER QUALITY: Diffuse Pollution and Watershed Management* (2nd edition, Wiley 2003) is a leading text on the topic.

In 2006, he prepared a successful proposal and subsequently organized the NSF, IWA, CDM, and Johnson Foundation sponsored workshop on *Cities of the Future*, attended by leading experts from several countries and held at the F.L. Wright built Wingspread Conference Center. *Cities of the Future* is now an acronym for a worldwide movement of water specialists, landscape architects, urban planners, and NGOs towards a paradigm change, resulting in planning, building and retrofitting urban areas that would reduce water use, restore and protect water resources, and use energy without adversely contributing to the global climatic changes.

This was a natural change of the paradigm of environmental engineering from fixing the pollution problems caused by humans to developing urban societies living in harmony with nature where waste becomes a resource and water, energy, and nutrients are recovered and reused. This also necessitates a better management of water resources, eliminating pollution and preventing harmful algal blooms. He published three books and made numerous keynote presentations on this 21st century defining topic in China, Japan, Democratic Korea, Europe, Canada, Brazil, and the US. In 2009, he was appointed to the IWA's Steering Committee for The Cities of the Future.

Abstracts of lectures offered

Closing the Water Cycle, Recovering Energy and Resources in the Cities of the Future

Since the end of the last millennium, it has become evident that the current paradigm of water management in urban areas, in both developed and developing countries, is becoming exceedingly unsustainable, exerting large demands on water, energy and other resources that in the near future, cannot be met by the resources the earth possesses. Increasing population, movement from rural areas into cities, and adding to the global climatic change have exasperated this imbalance. In the context of a city system, the flow, use and transformations of input water, energy, and materials result in polluted effluents and overflows, air pollution, excessive amounts of solid waste and GHG emissions. The entire flow, use and transformation of resources and energy through the city constitutes urban metabolism. Current urban metabolism is linear, characterized by long distance underground transfers of water to the communities, underground conveyance of used water and stormwater, high energy use for transport, treatment and disposal of used water and solids. The metabolism concept and its footprints will be introduced, which will document the unsustainability problems with the current linear paradigm of urban water infrastructure design and management.

Introducing the Cities of the Future initiative, the presentation will highlight current developments and concepts of the new (fifth) paradigm leading towards water centric sustainable communities whereby stormwater conveyance is mostly on surface and rehabilitated and restored urban surface and ground water bodies are the integral parts of the entire water cycle system. Water use cannot be separated from energy. The backbone of the new paradigm approach to building new cities and retrofitting the old to become sustainable is distributed water and energy reclamation from used water and stormwater and reusing them in a partially or fully closed urban metabolic cycle based on the concept of the four Rs: reduce (conserve), reclaim, reuse and restore. Implicit in these designs is a significant reduction of energy use from nonrenewable sources, and water conservation is the most efficient measure to reduce GHGs. In addition, nutrients (struvite), biofuel, hydrogen, heat, electricity, and organic solids can be reclaimed for reuse. A switch from traditional activated sludge energy demanding wastewater treatment to anaerobic co-digestion of concentrated used water with organic solids (sludge, solid food and yard waste and algae produced from waste nutrients) to produce energy is being investigated. This change will bring the GHG emissions from water systems to net zero or positive (energy producing) and significantly reduce water and energy use by the entire urban conglomeration. Current and near future developments of sustainable water centric 'ecocities' in Canada, China, Singapore, Sweden, Australia and other countries will be presented, analyzed, while research needs and barriers to implementation will be outlined.

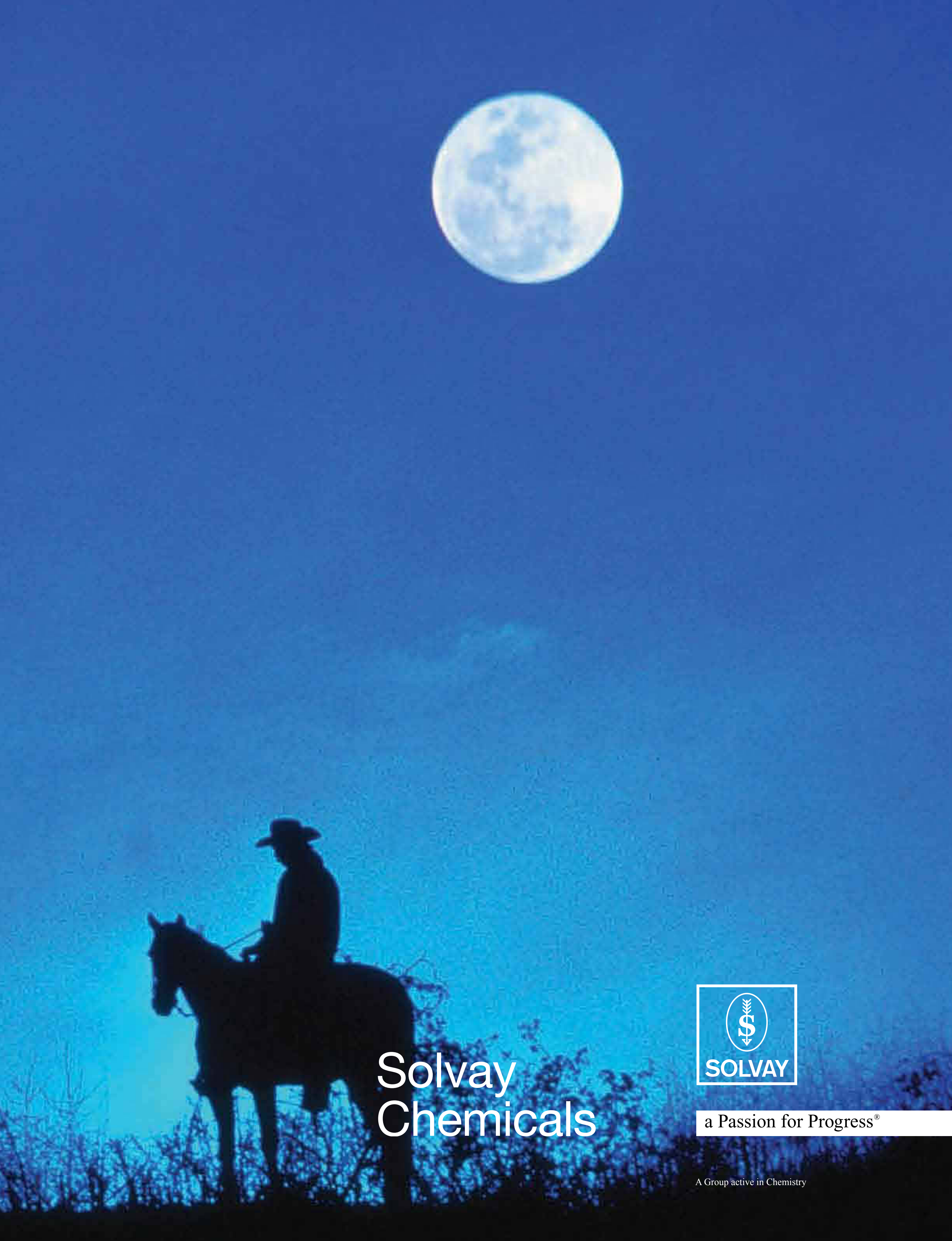
Prevention and Remediation of Advanced (Hyper) Eutrophication of Multipurpose Impoundments – A Case For Integrated Watershed Management

As a result of the intensification of agriculture in the last 50 years and building massive underground sewerage systems in growing communities in the last century, nutrient loads to surface and ground waters have dramatically increased throughout the world, creating eutrophic and hypertrophic water quality in lakes and reservoirs exemplified by harmful algal blooms (HABs) and hypoxic dead zones. Global warming magnifies the problem because the specific bloom causing genera, the cyanobacteria (blue-green algae), prefer warmer water where they can outcompete the other phytoplankton species. Cyano-HABs are exhibited by scrums and pea-soup appearance of the water body.

This problem is especially troublesome in impoundments providing water supply to large communities. The problem of the hyper-eutrophic status exhibited by harmful algal blooms of cyanobacteria (Cyano-HAB) is becoming endemic to many impoundments in Europe and Asia including The Netherlands, Germany, China, and in the US (Florida and Texas). In Czech Republic, 70% of reservoirs are classified as hypertrophic, which during algal blooms impairs their beneficial uses for water supply, recreation, and aquatic life propagation (fishing). Remedies are costly, drastic and sometimes unsuccessful or transient. Eutrophication has been studied for decades but recently new findings contradict the previous theories such as the role of a limiting nutrient, linearity of the eutrophication progression being related to the input of the limiting nutrient, effect and causes of internal loads, two-sided effects of high nitrate loads and even carbon sequestering or greenhouse gases release. Cyanobacteria growth, occurrence and behavior in impoundments defy the traditional mass balance lake models by Vollenweider and others and new modeling methodologies are being developed.

Several cases will illustrate the dilemma, including the stratified Švihov, Orlik and Brno Reservoirs in the Czech Republic, and shallow Lakes Taihu and Donghu in China and Okeechobee in Florida. These impoundments are receiving excessive nutrient loads from nonpoint agricultural and point municipal and industrial sources. However, not all water bodies overloaded by nutrients have developed a full hypertrophic status. The barriers attenuating excessive nutrient loads include agricultural and urban best management practices, buffer zones, restoration and creation of wetlands in conjunction with better agronomy of crops and fertilizer application in agriculture and integrated water, stormwater and used water management in urban areas. Simultaneous anaerobic decomposition of organic matter and nitrate denitrification in restored alluvial riparian buffer wetlands reduce also greenhouse gas emissions of methane and nitrous oxide. Surprisingly, high nitrate content in some impoundments appears to retard or even prevent hyper-eutrophication, which may be the case of the Švihov Reservoir providing water to Prague.

The needs for coordinated interdisciplinary research and implementation of remedial plans will be outlined, discussed and developed into a concept of an ecoregion for multiple purpose water bodies and watersheds providing water supply to communities. EE


Solvay
Chemicals
SOLVAY
a Passion for Progress®
A Group active in Chemistry

NEW CHALLENGES FOR OUR OLD CHALLENGES

By Joel G. Burken, Associate Chair and Professor, Missouri University of Science and Technology President, AEESP

As environmental engineers and scientists, we are accustomed to facing challenges in terms of new pollutants or mitigating public health impacts by addressing a variety of exposure pathways. Our 'old' challenges keep reappearing in new forms and new places, like pharmaceuticals and trace pollutants in water reuse or mitigating combined sewer overflows (insert never-ending list of problems…). We've become somewhat proficient and comfortable in facing these 'old' challenges as they develop and appear in many new forms — mostly from our increasing anthropogenic footprint.

As an engineering field, we have engaged in the process of advancing knowledge and developing new technologies to address the most urgent environmental needs. As a practicing profession, we have developed engineering expertise to apply these technologies successfully in a wide range of settings to improve human health and mitigate environmental impacts.

We now face 'new' challenges in the way we go about our business to reduce exposure and emissions. The 'new' challenges include the declining research programs and funding, as well as decreasing infrastructure expenditures from the federal and state governments. We also face the demand for reducing energy and materials use in our operations. So as we aim to reduce exposure of pharmaceuticals in drinking water – an 'old' challenge in a new form – or in combined sewer overflows (CSOs) as a profession, we are tasked to do so with fewer resources.

In the recent issue of Science, the article "Fewer Dollars, Forced Choices" (*www.sciencemag.org/content/334/6057/750.full*) outlines the proposed cuts to federal R&D programs. At a time when "environment" is at the top of many lists of most important topics, the EPA is experiencing yet another cut and USDA programs are seeing the largest cut of all (in percentage). As USDA has a clear priority to increase food production and safety, their efforts in environmental issues, which are not in their primary mission and focus, will most likely see a distinct downward turn. USGS and NIH are looking at flat funding at best.

Essentially, we are being asked to do more for human health and the environment with less to develop new technological approaches with fewer resources to deploy infrastructure.

But certainly all hope is not lost. We just have a type of 'new' challenge. In the Science article noted above, I have less of an issue with the "fewer dollars" than I do with the "forced choices." I doubt many of us really support the continued spending beyond our means as a country. I would wager that most of us could provide insight to where the greatest needs are, even if we had to give up a sacred cow or two in our own pet areas. Who is informing decision makers what choices should be "forced choices?"

We face an important time to present a voice as a profession to help efficiently deploy our valuable research support and infrastructure investments. Our voice is critical and important at this time. As federal budgets for research are constrained, we need to speak out regarding what areas are important for fundamental research and for technological advancement and application.

Our message is also diluted and somewhat hijacked. We have lost some of the 'environmental' tag and perhaps political relevancy in today's society where sustainability and greenwashing can many times be associated with 'environmental engineering and science,' rather than our core mission of providing technological solutions to protect human health and the environment. Sierra Club probably has a bigger stick in Washington, D.C. than we do as a profession.

Hopefully the collaboration between AEESP and AAEE (AAEES) can provide that needed voice. AEESP is currently looking to develop policy statements on important issues and make these statements available to all members. Our members are also active in many professional societies such as WEF, ASCE, IWA, etc. AEESP is also evaluating a potential adoption of an international journal, allowing for increased reach, of not only important research developments, but also our general message and methods of advancing environmental engineering and science education. We will continue to face our challenges both 'old' and 'new' for generations to come. We are a leading group of scientific and technological experts, at a time when such insight is needed to help improve the efficiency of the research and infrastructure dollars spent and the direction of our field overall. I recently have adopted a new quote as a favorite, which is applicable to this issue: *"We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology."* *- Carl Sagan*

In closing this might seem like a dire message, but facing 'new' challenges is certainly part of our history as a profession. We need not look any farther than the coming 40th anniversary of the *Clean Water Act*. Water quality specifically and environmental quality have come a long way since efforts were set forth in 1972. EE

Click HERE to return to Table of Contents

The Class of 2011

These individuals were Board Certified in 2011.

From the first applicants in 1956 to the 124 Board Certified Environmental Engineers and Board Certified Environmental Engineering Members listed on the following pages, the Academy has undergone growth and changes, but has never wavered from it's core objective to "identify and credential persons with special capabilities in environmental engineering."

Today, there are nearly 2,500 Board Certified Environmental Engineers and Board Certified Environmental Engineering Members in the Academy and interest continues to grow on an annual basis.

A brief description of the specialty certification process follows: To be included in an annual class, the application for specialty certification must be submitted to the Academy by March 31. Any application received after that date is held over to the next class. The applications received by March 31 are then reviewed by the Admissions Committee for adequacy of education and qualifying experience in April and May. Examinations are administered to the qualified applicants during July and August at convenient locations throughout the country. The examination results are reviewed by the Admissions Committee in September and recommendations for each candidate are presented to the Board of Trustees. Each person's history is reviewed by the Board members at the Academy's Annual Meeting and decisions made to certify or not.

The Academy announces the issuance of specialty certificates and Board Certified Environmental Engineers and Board Certified Environmental Engineering Members status to those individuals portrayed in this special section of the Environmental Engineer®. These persons have demonstrated to their peers that they possess the requisite formal education and environmental engineering practical experience and have successfully completed the Academy's examinations to be Board-Certified environmental engineering specialists. The special capability of each person is shown after their name using the following codes:

- AP Air Pollution Control,
- ES Environmental Sustainability,
- GE General Environmental Engineering,
- HW Hazardous Waste Management,
- IH Industrial Hygiene,
- RP Radiation Protection,
- SW Solid Waste Management,
- WW Water Supply and Wastewater Engineering.

2011

Thomas A. Allbaugh, P.E., BCEE
WW
Tetra Tech, Inc.
710 Avis Drive
Ann Arbor, MI 48108

Mr. Allbaugh received his B.S. degree in Civil Engineering from the University of Kansas. He is a licensed P.E. in Michigan with more than 31 years experience.

Brent A. Alspach, P.E., BCEE
WW
Senior Project Engineer
Malcolm Pirnie/ARCADIS
1525 Faraday Avenue #290
Carlsbad, CA 92008

Mr. Alspach received his B.S. degree in Civil Engineering, and M.S. degree in Civil/Environmental from Cornell University. He is a licensed P.E. in California with more than 12 years experience.

Alan Ronald Appleton, Jr., P.E., BCEE
WW
Senior Process Technologist
Carollo Engineers, Inc.
2700 Ygnacio Valley Road #300
Walnut Creek, CA 94598

Mr. Appleton received his B.S. and M.S. degrees in Civil Engineering from Stanford University. He is a licensed P.E. in Virginia and has more than 27 years experience.

Raymond L. Armstrong, P.E., BCEE
WW
Director of Municipal Group
DOWL HKM
222 North 32nd Street #700
Billings, MT 59101

Mr. Armstrong received his B.S. degree in Microbiology and M.S. degree in Civil Engineering from Montana State University. He is a licensed P.E. in Montana, Washington and Arkansas and has more than 36 years experience.

Kamil S. Azoury, P.E., BCEE
WW
General Manager/District Engineer
Goleta Sanitary District
One William Moffett Place
Goleta, GA 93117

Mr. Azoury received his B.S. degree in Civil Engineering from the American University of Beirut, Lebanon and M.S. degree in Sanitary Engineering from Syracuse University. He is a licensed P.E. in California and has more than 40 years experience.

Wallace R. Bachelder, P.E., BCEE
WW
Team Manager
Metropolitan Water District
700 North Alameda Street
Los Angeles, CA 90012

Mr. Bachelder received his B.S. degree in Mechanical Engineering from U.C. Berkeley and M.S. in Environmental Engineering from Long Beach State University. He is a licensed P.E. in California and has more than 17 years experience.

Jean-Pierre Bardet, Ph.D., BCEEM
ES
Chair, Sonny Astani Department Of Civil & Environmental Engineering
University of Southern California
Kaprelian Hall, KAP 210
Los Angeles, CA 90089-2531

Dr. Bardet received his B.S. degree in Engineering from Ecole Centrale, Lyon, France, M.S. and Ph.D. degrees in Civil Engineering from the California Institute of Technology. He has more than 33 years experience.

William A. Barrack, II, P.E., BCEE
WW
Project Engineer
Malcolm Pirnie, Inc.
3101 Wilson Boulevard #550
Arlington, VA 22201

Mr. Barrack received his B.S. in Environmental Engineering from the University of Delaware and M.S. degree in Environmental Engineering from the University of Michigan. He is a licensed P.E. in Virginia and has more than 8 years experience.

Click HERE to return to Table of Contents

Allen E. Blodgett,
P.E., BCEE
HW
Principal Engineer
URS Corporation
2020 East First Street #400
Santa Ana, CA 92705

Mr. Blodgett received his B.S. and M.S. degrees in Civil Engineering from Wayne State University. He is a licensed P.E. in California with more than 25 years experience.

Lucas Botero,
P.E., BCEE
WW
Project Engineer
CDM
1601 Belvedere Road #400E
West Palm Beach, FL 33406

Mr. Botero received his B.S. degree in Civil Engineering from Pontificia Universidad and M.S. degree in Civil Engineering from California State University. He is a licensed P.E. in Kansas and Florida with more than 14 years experience.

Paul F. Boulos,
Ph.D., BCEEM
WW
President and COO
Innovyze
370 Interlocken Boulevard #300
Broomfield, CO 80021

Dr. Boulos received his B.S., M.S. and Ph.D. degrees in Civil Engineering from the University of Kentucky and MBA in Advanced Management from Harvard Business School. He has more than 30 years experience.

Harvey A. Brodsky,
P.E., BCEE
WW
Principal
Greeley and Hansen
1818 Market Street
Philadelphia, PA 19103

Mr. Brodsky received his B.S. degree in Civil Engineering from the City College of New York. He is a licensed P.E. in New Jersey with more than 39 years experience.

Joel G. Burken,
Ph.D., P.E., BCEE
HW
Professor
Missouri University of Science and Technology
224 Butler Carlton CE Hall
1401 North Pine
Rolla, MO 65409

Dr. Burken received his B.S., M.S. and Ph.D. degrees in Civil/Environmental from the University of Iowa. He is a licensed P.E. in Missouri with more than 18 years experience.

James L. Burror, Jr.,
P.E., BCEE
WW
Engineering Supervisor
Orange County Sanitation District
10844 Ellis Avenue
San Clemente, CA 92673-5674

Mr. Burror received his B.S. in Civil Engineering from California Polytechnic University and M.S. degree in Civil Engineering from Loyola Marymount University. He is a licensed P.E. in California with more than 19 years experience.

Anne M. Carayon,
P.E., BCEE
WW
Senior Engineer
Sanitation Districts of LA County
920 South Alameda Street
Compton, CA 90221

Ms. Carayon received her B.S. degree and M.S. degrees in Structural/Civil Engineering from the Institut Superieur de Gestion and M.S. degree in Sanitary Engineering from the University of California, Berkeley. She has a P.E. license in California with more than 25 years experience.

Alfred J. Carrier,
P.E., BCEE
WW
CH2M Hill
18 Tremont Street #700
Boston, MA 02108

Mr. Carrier received his B.S. degree in Civil Engineering from Wentworth Institute of Technology. He is a licensed P.E. in Massachusetts and has more than 22 years experience.

James F. Chamberlain,
Ph.D., P.E., BCEE
ES
Research Engineer
University of Oklahoma
PO Box 2086
Norman, OK 73070

Dr. Chamberlain received his B.S. in Agricultural Engineering from Texas A&M University and M.S. and Ph.D. degrees in Environmental Engineering from Clemson University. He is a licensed P.E. in Tennessee with more than 13 years experience.

Henry J. Chlupsa,
P.E., BCEE
GE
President
Dvirka and Bartilucci Consulting Engineers
330 Crossways Park Drive
Woodbury, NY 11797

Mr. Chlupsa received his B.S. in Civil Engineering from Manhattan College and M.S. degree in Environmental Engineering from the SUNY at Stony Brook, NY. He is a licensed P.E. in New York, Connecticut, Massachusetts, New Jersey and Delaware with more than 46 years experience.

James E. Christopher,
P.E., BCEE
WW
Vice President
Tetra Tech, Inc.
201 East Pine Street #1000
Orlando, FL 32801

Mr. Christopher received his B.S. degree in Chemistry from Duke University and M.S. degree in Environmental Science from the University of Central Florida. He is a licensed P.E. in Florida and has more than 31 years experience.

John G. Ciccotelli,
P.E., BCEE
WW
Principal Engineer
MWH Americas
618 Michillinda Avenue #200
Arcadia, CA 91107

Mr. Ciccotelli received his B.S. and M.S. degrees in Civil Engineering from Queensland University of Technology. He is a licensed P.E. in California and has more than 20 years experience.

David K. Clark,
P.E., BCEE
WW
Unit Manager
Metropolitan Water District
700 North Alameda
Los Angeles, CA 90012

Mr. Clark received his B.S. degree in Mechanical Engineering from Cal Poly San Luis Obispo and M.S. degree in Environmental Engineering from the University of Southern California. He is a licensed P.E. in California and has more than 26 years experience.

Richard L. Clegg,
P.E., BCEE
GE
Senior Environmental Project Manager
Stevenson & Palmer Engineering, Inc.
723 Industrial Park Drive #2
Evans, GA 30809

Mr. Clegg received his B.S. degree in Chemical Engineering and M.S. degree in Environmental Management from the University of Missouri-Rolla. He is a licensed P.E. in Missouri and Georgia and has more than 20 years experience.

Michael K. Cook,
P.E., BCEE, LEED
WW
Environmental Engineer
Air National Guard
136 CES/CEV
100 Hensley Avenue, Building 1671
Fort Worth, TX 76127-1671

Mr. Cook received his B.S. in Mechanical Engineering from Baylor University. He is a licensed P.E. in Texas with more than 22 years experience.

Patrick Aaron Costello,
P.E., BCEE
AP
Team Leader
Caterpillar, Inc.
901 Washington Street
ACSO Building KK, KK-1500
East Peoria, IL 61630

Mr. Costello received his B.S. in Mechanical Engineering from the University of Missouri-Rolla and M.S. degree in Business Administration from Webster University. He is a licensed P.E. in Illinois with more than 31 years experience.

Cheryle F. Culler,
P.E., BCEE
WW
Senior Project Engineer
GAI Consultants, Inc.
1502 Magnavox Way
Fort Wayne, IN 46804

Ms. Culler received her B.S. degree in Civil Engineering from the University of Dayton. She is a licensed P.E. in Indiana and Ohio with more than 22 years experience.

Peter R. Daukss,
P.E., BCEE
WW
Discipline Lead WW Engineer
Tetra Tech
1921 East Miller Road, Suite A
Lansing, MI 48911

Mr. Daukss received his B.S. degree in Chemical Engineering and M.S. degree in Civil/Water from the University of Michigan and MS CHE in Chemical Engineering from the University of Toledo. He is a licensed P.E. in Michigan and Florida with more than 31 years experience.

Stacey A. DePasquale,
P.E., BCEE
WW
Owner and President
Stacy DePasquale Engineering, Inc.
354 Merrimack Street #200
Lawrence, MA 01843-1755

Ms. DePasquale received her B.S. and M.S. degrees in Civil/Environmental from the Worcester Polytechnic Institute. She is a licensed P.E. in Massachusetts with more than 18 years experience.

Stephen M. Diamond,
P.E., BCEE
WW
Senior Project Engineer
Malcolm Pirnie/ARCADIS
8001 Irvine Center Drive #1100
Irvine, CA 92618

Mr. Diamond received his B.S. in Civil Engineering from Lehigh University. He is a licensed P.E. in Florida with more than 17 years experience.

Click HERE to return to Table of Contents

Darrin D. Dillah,
Ph.D., P.E., BCEE
SW
Vice President/Group Leader
SCS Engineers
11260 Roger Bacon Drive #300
Reston, VA 20190

Dr. Dillah received his B.S. in Electrical Engineering from the University of Florida and M.S. in Environmental Engineering and Ph.D. in Civil Engineering from Polytechnic University NY. He is a licensed P.E. in New York and Maryland with more than 23 years experience.

Mark S. Drummond,
P.E., BCEE
WW
President
C Solutions Inc.
610 SE 14th Court #2
Fort Lauderdale, FL 33316

Mr. Drummond received his B.A. in Civil Engineering from Florida International University. He is a licensed P.E. in Florida with more than 15 years experience.

James C. Elliott,
P.E., BCEE
WW
Gannett Fleming, Inc.
PO Box 67100
Harrisburg, PA 17106-7100

Mr. Elliott received his B.S. degree in Physics from Grinnell College and M.S. degree in Sanitary Engineering from the Pennsylvania State University. He is a licensed P.E. in Pennsylvania with more than 38 years experience.

Elena P. Ellis,
P.E., BCEE
WW
Project Manager
CDM
50 Hampshire Street
Cambridge, MA 02139

Ms. Ellis received her B.S. in Earth & Environmental from Wesleyan University and M.S. degree in Environmental Engineering from the University of California. She is a licensed engineer in Massachusetts and has more than 13 years experience.

Steven H. Ellis,
P.E., BCEE
WW
Senior Project Manager
Tetra Tech
17885 Von Karman #500
Irvine, CA 92614

Mr. Ellis received his B.S. in Civil Engineering from the City University of New York and M.S. in Civil Engineering from the University of Arizona. He is a licensed P.E. in California with more than 31 years experience.

Nathan W. Epling,
P.E., BCEE
WW
Civil Engineer
National Park Service
199 Hemphill Knob Road
Asheville, NC 28803

Mr. Epling received his B.S. in Environmental Engineering from Mercer University and M.S. degree in Water Resources from Norwich University. He is a licensed P.E. in North Carolina with more than 11 years experience.

John A. Fitch, Jr.,
P.E., BCEE
WW
Senior Engineer
Brown and Caldwell
6055 Rockside Woods Boulevard #350
Independence, OH 44131

Mr. Fitch received his B.S. in Civil Engineering from Cleveland State University. He is a licensed P.E. in Ohio with more than 8 years experience.

Jeffrey M. Forde,
P.E., BCEE
AP
Manager
ENVIRON International Corporation
18100 Von Kaman Avenue #600
Irvine, CA 92612

Mr. Forde received his B.S. degree in Environmental Engineering from California Polytechnic State University. He is a licensed P.E. in California with more than 12 years experience.

Grant A. Gartrell,
P.E., BCEE
WW
CDM
1 Woodward Avenue #1500
Detroit, MI 48226

Mr. Gartrell received his B.S. in Environmental Engineering from Michigan Technological University. He is a licensed P.E. in Michigan with more than 17 years experience.

Angelia M. Gebeau,
P.E., BCEE
WW
Project Engineer
AECOM
200 Indiana Avenue
Stevens Point, WI 54481

Ms. Gebeau received her B.S. in Environmental Engineering from Michigan Technological University. She is a licensed P.E. in Wisconsin and has more than 9 years experience.

Valerie P. Going,
P.E., BCEE
WW
Project Manager
CDM
1715 North Westshore Boulevard #875
Tampa, FL 33607

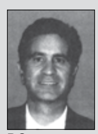
Ms. Going received her B.S. and M.S. degrees in Civil Engineering and MBA in Business Administration from the University of South Florida. She is a licensed P.E. in Florida and has more than 12 years experience.

Helen T. Gordon,
P.E., BCEE
WW
Senior Project Engineer
Woodard & Curran
980 Washington Street #325
Dedham, MA 02026

Ms. Gordon received her B.S. in Civil Engineering from Northeastern University. She is a licensed P.E. in Rhode Island and Massachusetts with more than 31 years experience.

Gopal K. Guthikonda,
P.E., BCEE
WW
Assistant Director
City of Austin Water Utility
PO Box 1088
Austin, TX 78701

Mr. Guthikonda received his B.S. in Civil Engineering from Andhra University and M.S. degree in Civil Engineering from Texas Tech University. He is a licensed P.E. in Texas with more than 29 years experience.



Stephen Hadjiyane,
P.E., BCEE
WW
Project Director
Gannett Fleming Engineers, PC
100 Crossways Park West #300
Woodbury, NY 11797

Mr. Hadjiyane received his B.S. in Chemical Engineering from SUNY Buffalo and M.S. degree in Environmental Engineering from Manhattan College. He is a licensed P.E. in New York with more than 26 years experience.

Dennis K. Henning,
P.E., BCEE
GE
Parsons Brinckerhoff
2777 North Stemmons Freeway #1333
Dallas, TX 75207

Mr. Henning received his B.S. in Civil/Environmental from the University of Wisconsin-Madison. He is a licensed P.E. in Wisconsin and Texas with more than 32 years experience.

Manuel J. Hernandez,
P.E., BCEE
SW
Senior Project Manager
CDM
1601 Belvedere Road #400E
West Palm Beach, FL 33406

Mr. Hernandez received his B.S. degree in Environmental Engineering from the University of Central Florida. He is licensed P.E. in Puerto Rico and Florida and has more than 12 years experience.

Colin Hobbs,
Ph.D., P.E., BCEE
WW
Environmental Engineer
CDM
2301 Maitland Center Parkway #300
Maitland, FL 32751

Dr. Hobbs received a B.S. in Civil Engineering, a B.S., M.S. and Ph.D. degree in Environmental Engineering from the University of Central Florida. He is a licensed P.E. in Florida with more than 8 years experience.

Kerry S. Hogan,
P.E., BCEE
WW
Vice President
URS Corporation
277 West Nationwide Boulevard
Columbus, OH 43215

Mr. Hogan received his B.S. degree in Civil Engineering from the Ohio State University. He is a licensed P.E. in Ohio and has more than 24 years experience.

P.K. Andrew Hong,
Ph.D., P.E., BCEE
ES
Professor, Department of Civil & Environmental
University of Utah
110 Central Campus Drive, 2068 MCE
Salt Lake City, UT 84124

Dr. Hong received his B.S. in Chemistry, M.S. and Ph.D. degrees in Environmental Engineering Science from the California Institute of Technology. He is a licensed P.E. in Utah with more than 30 years experience.

Richard C. Hope,
P.E., BCEE
WW
AECOM
200 Indiana Avenue
Stevens Point, WI 54481

Mr. Hope received his BCE degree in Civil Engineering from Teesside Polytechnic, United Kingdom. He is a licensed P.E. in Wisconsin with more than 33 years experience.

Mark A. Hubal, P.E., BCEE
WW
Senior Associate
Hatch Mott MacDonald
3 Paragon Way
Freehold, NJ 07728

Mr. Hubal received his B.S. in Chemical Engineering and M.S. in Environmental Engineering from the New Jersey Institute of Technology. He is a licensed P.E. in Delaware and New Jersey with more than 23 years experience.

Michael P. Hyland, P.E., BCEE
WW
Senior Project Manager
CDM
1218 3rd Avenue #1100
Seattle, WA 98101

Mr. Hyland received his B.S. in Engineering from Harvey Mudd College and M.S. degree in Earth & Environmental from Columbia University. He is a licensed P.E. in Washington and has more than 9 years experience.

Uche "Ike" Ikemba, P.E., BCEE
HW
Project Manager
Texas Commission on Environmental Quality (TCEQ)
12100 Park 35 Circle, MC-137
Austin, TX 78753

Mr. Ikemba received his B.S. and M.S. degrees in Civil Engineering from Wayne State University. He is a licensed P.E. in Texas and has more than 20 years experience.

Christopher L. Jacquemin, P.E., BCEE
HW
Vice President
Hydro Geo Chem, Inc.
6370 East Thomas Road #200
Scottsdale, AZ 85251

Mr. Jacquemin received his B.S. degree in Civil Engineering from Arizona State University. He is a licensed P.E. in Arizona with more than 18 years experience.

Jason A. Kirby, P.E., BCEE
WW
Wastewater Department Manager
Jones & Carter, Inc.
6335 Gulfton #100
Houston, TX 77081-1169

Mr. Kirby received his B.S. in Civil Engineering from Texas A&M University. He is a licensed P.E. in Texas and has more than 8 years experience.

David L. Klemm, P.E., BCEE
WW
Senior Associate
Hatch Mott MacDonald
27 Bleeker Street
Millburn, NJ 07041-1008

Mr. Klemm received his B.S. degree in Civil Engineering from Worcester Polytechnic Institute and M.S. in Environmental Engineering from the New Jersey Institute of Technology. He is a licensed P.E. in New Jersey and Pennsylvania and has more than 20 years experience.

Joseph Klewicki, Ph.D., P.E., BCEE
WW
Associate
The Cadmus Group, Inc.
1555 Wilson Boulevard #710
Alexandria, VA 22310

Dr. Klewicki received his B.S. degree in Chemical Engineering from Clarkson University and Ph.D. in Environmental Engineering from the California Institute of Technology. He is a licensed P.E. in Virginia with more than 13 years experience.

John D. Kobrick, P.E., BCEE
WW
Principal
Doug Kobrick, PE LLC
7528 East Windrose Drive
Scottsdale, AZ 85267

Mr. Kobrick received his B.S. in Civil Engineering from Brown University and M.S. degree in Civil Engineering from Arizona State University. He is a licensed P.E. in Missouri and Arizona with more than 30 years experience.

Andrew Kricun, P.E., BCEE
WW
Deputy Executive Director
Camden County Municipal Utilities Authority
1645 Ferry Avenue
Camden, NJ 08104

Mr. Kricun received his B.S. degree in Chemical Engineering from the Princeton University. He is a licensed P.E. in New Jersey with more than 26 years experience.

Arthur H. Kuljian, Jr., P.E., BCEE
GE
Manager Remediation Engineering
Tetra Tech
710 Avis Drive
Ann Arbor, MI 48105

Mr. Kuljian received his B.S. degree in Environmental Systems from Southern Methodist University and M.S. degree in Sanitary Engineering from the University of Michigan. He is a licensed P.E. in Michigan with more than 24 years experience.

James Langenbach, P.E., BCEE
HW
Geosyntec Consultants
6770 South Washington Avenue #3
Titusville, FL 32780

Mr. Langenbach received his B.S. in Environmental Engineering from the Florida Institute of Technology. He is a licensed P.E. in Florida with more than 19 years experience.

Bryan T. Langpap, P.E., BCEE
SW
Supervising Engineer
Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90601

Mr. Langpap received his B.S. in Civil Engineering and M.S. degree in Civil/Environmental from the University of California-Davis. He is a licensed P.E. in California with more than 16 years experience.

Luis R. Leon, P.E., BCEE
WW
Associate/Senior Project Manager
CDM
9220 Cleveland Avenue #100
Rancho Cucamonga, CA 91739

Mr. Leon received his B.S. degree in Civil Engineering from the Northrop University. He is a licensed P.E. in California with more than 24 years experience.

Dingfang Liu, Ph.D., P.E., BCEE
WW
Project Manager
CH2M Hill
18 Tremont Street #700
Boston, MA 02114

Dr. Liu received his B.S. in Environmental Engineering from Nanchang Institute of Aeronautical Industry, his M.S. degree in Environmental Science from the Chinese Academy of Science and Ph.D. in Civil Engineering from Louisiana State University. He is a licensed P.E. in Ohio with more than 16 years experience.

Nancy G. Love, Ph.D., P.E., BCEE
WW
Professor & Department Chair
University of Michigan
2340 GG Brown Laboratory
2350 Hayward Road
Ann Arbor, MI 48109

Dr. Love received her B.S. and M.S. degrees in Civil Engineering from the University of Illinois-Urbana-Champaign and Ph.D. in Environmental Systems Engineering from Clemson University. She is a licensed P.E. in Michigan with more than 31 years experience.

Jay Lovelass, P.E., BCEE
GE
Greeley and Hansen
1818 Market Street
Philadelphia, PA 19103

Mr. Lovelass received a B.S. degree in Civil Engineering from the University of Michigan and a B.S. in Physics from Kalamazoo College. He is a licensed P.E. in Pennsylvania with more than 42 years experience.

Arthur Hall Lundquist, P.E., BCEE
WW
Environmental Engineer
U.S. Army Public Health Command
5158 Blackhawk Road
MCHB-IP-EWS, BLDG E-1675
APGEA, MD 21010

Mr. Lundquist received his B.S. in Environmental Science from the University of Delaware and M.S. degree in Environmental Engineering from Montana State University. He is a licensed P.E. in Maryland with more than 11 years experience.

Joshua D. MacCulloch, P.E., BCEE
WW
Senior Project Engineer
CDM
670 North Commercial Street
Manchester, NH 03101

Mr. MacCulloch received his B.S. in Environmental Engineering from the University of New Hampshire. He is a licensed P.E. in New Hampshire and has more than 10 years experience.

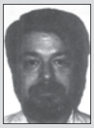
John A. Markus, P.E., BCEE
WW
Senior Project Manager
Tetra Tech
1420 5th Avenue #600
Seattle, WA 98101

Mr. Markus received his B.S. in Biological Science from the California State University and M.S. degree in Environmental Engineering from the University of Southern California. He is a licensed P.E. in Washington and California with more than 35 years experience.

Silvia Marpicati, P.E., BCEE
WW
Malcolm Pirnie/ARCADIS
855 Route 146 #210
Clifton Park, NY 12065

Ms. Marpicati received her B.S. in Civil Engineering from the Politecnico de Milano, Italy and M.S. in Environmental Engineering from Rensselaer Polytechnic Institute. She is a licensed P.E. in New York and has more than 9 years experience.

Click HERE to return to Table of Contents



Marty D. Matlock,
Ph.D., P.E., BCEE
ES
Project Director
University of Arkansas
Department of Biological and Agricultural Engineering
203 Engineering Hall
Fayetteville, AR 72701

Dr. Matlock received his B.S. in Soil Chemistry, M.S. in Plant Physiology and Ph.D. degree in Biosystems Engineering from Oklahoma State University. He is a licensed P.E. in Texas with more than 25 years experience.

Jeffrey T. McBride,
P.E., BCEE
WW
General Manager
EW2 Environmental, Inc.
613 South cherry Street
Richmond, VA 23220

Mr. McBride received his B.S. in Civil Engineering from Virginia Polytech, M.S. degree in Environmental Engineering from Utah State University and MBA in Business Administration from Virginia Commonwealth University. He is a licensed P.E. in Utah with more than 17 years experience.

Suzanne E. Mechler,
P.E., BCEE
WW
Project Manager
CDM
1601 Belvedere Road #400 East
West Palm Beach, FL 33406

Ms. Mechler received her B.S. and M.S. degrees in Environmental Engineering from the University of Florida. She is a licensed P.E. in Florida with more than 10 years experience.

Anil K. Mehrotra,
P.E., BCEE
AP
Plant Engineer
Hampton/NASA Steam Plant
50 Wythe Creek Road
Hampton, VA 23666-1333

Mr. Mehrotra received his B.S. in Mechanical Engineering from the Indian Institute of Technology, India. He is a licensed P.E. in Virginia with more than 29 years experience.

Barbara A. Melcher,
P.E., BCEE
WW
Project Manager
CDM
1925 Palomar Oaks Way #300
Carlsbad, CA 92008

Ms. Melcher received her B.S. in Civil Engineering from the University of Iowa and M.S. degree in Civil/Environmental from the University of Wisconsin-Madison. She is a licensed P.E. in Illinois and California with more than 12 years experience.

William J. Meyer, Jr.,
P.E., BCEE
WW
Assistant Director
City of Chesapeake, Public Utilities
306 Cedar Road
Chesapeake, VA 23320

Mr. Meyer received his B.S. in Civil Engineering from Virginia Polytechnic & State University. He is a licensed P.E. in Virginia and has more than 29 years experience.

Drew Mihocko,
P.E., BCEE
WW
Senior Project Manager
D&B/Guarino Engineers, LLC
8 Neshaminy Interplex #219
Trevose, PA 19053

Mr. Mihocko received his B.S. degree in Engineering from Widener University. He is a licensed P.E. in Pennsylvania with more than 40 years experience.

Keith A. Miller,
P.E., BCEE
WW
Principal
CDM
429 North Pennsylvania Street #409
Indianapolis, IN 46204

Mr. Miller received his B.S. in Ocean Engineering, MSE in Environmental Engineering and M.S. degree in Science from Purdue University. He is a licensed P.E. in Indiana with more than 25 years experience.

Traci J. Minamide,
P.E., BCEE
WW
Chief Operating Officer
City of Los Angeles
1149 South Broadway 9th Floor
Los Angeles, CA 90015

Ms. Minamide received her B.S. in Civil Engineering from the California State Polytechnic and M.S. degree in Civil Engineering from Loyola Marymount University. She is a licensed P.E. in California with more than 25 years experience.

Prasad Madhav Modak,
Dr. Eng., BCEEM
GE
Naigaon x Road
Mumbai 400031
India

Dr. Modak received his B.Tech. in Civil Engineering and M.Tech. in Environmental Science and Engineering from the Indian Institute of Technology, Bombay, India and Dr. Eng. from the Asian Institute of Technology, Bangkok, Thailand. He has more than 37 years experience.

H. Keith Moo-Young,
Ph.D., P.E., BCEE
SW
Dean of Engineering
California State University
5151 State University Drive
Los Angeles, CA 90032

Dr. Moo-Young received his B.S. in Civil Engineering from Morgan State University, a M.S. degree and Ph.D. in Civil Engineering from the Rensselear Polytechnic Institute and a M.S. in Environmental Management from the University of Pennsylvania. He is a licensed P.E. in Pennsylvania with more than 19 years experience.

Kamyar Motamedi,
P.E., BCEE
WW
Project Manager
Metropolitan Water District Of Southern California
700 North Alameda Street
Los Angeles, CA 90012

Mr. Motamedi received his B.S. in Environmental/Civil from Loyola Marymount University and M.S. in Civil Engineering from the University of Texas at Austin. He is a licensed P.E. in California with more than 27 years experience.

James W. Moyer,
P.E., BCEE
WW
Senior Project Engineer
Environmental Engineering & Management Associates, Inc.
PO Box 232
Kulpsville, PA 19443

Mr. Moyer received his B.S. in Environmental Engineering and M.S. degree in Civil Engineering from Temple University. He is a licensed P.E. in Pennsylvania with more than 8 years experience.

P.P. Mujumdar,
Ph.D., BCEEM
WW
Professor & Chair
Department of Civil Engineering
Indian Institute of Science
Bangalore, India

Dr. Mujumdar received his B.Tech. in Civil Engineering from Mysore University, India and M.Tech. degree in Water Resources Engineering and Ph.D. in Water Resources Systems from the Indian Institute of Science, India. He has more than 34 years experience.

Daria Navon,
P.E., BCEE
HW
Senior Environmental Engineer
ARCADIS
14025 Riveredge Drive #600
Tampa, FL 33637

Ms. Navon received her B.S. in Environmental Engineering from the University of Florida and her M.S. degree in Civil/Environmental from the University of Texas at Austin. She is a licensed P.E. in New York and Florida with more than 13 years experience.

Howard M. Neukrug,
P.E., BCEE
WW
City of Philadelphia Water Department
1101 Market Street
Philadelphia, PA 19107

Mr. Neukrug received his B.S. degree in Civil & Urban Engineering from the University of Pennsylvania. He is a licensed P.E. in Pennsylvania with more than 39 years experience.

Chandra Shekhar Prasad Ojha,
Ph.D., BCEEM
WW
Professor of Civil Engineering
Indian Institute of Technology, Roorkee
Uttranchal, 247 667, India

Dr. Ojha received his B.E. in Civil Engineering from Gorakhpur University, M.E. in Hydraulics & Water Resources from the Indian Institute of Science, Bangalore and Ph.D. degree in Environmental Hydraulics from the Imperial College of Science, Technology and Medicine, London. He has more than 33 years experience.

Chad T. Olsen,
P.E., BCEE
WW
Project Engineer
McMahon Associates
1445 McMahon Drive, POB 1025
Neenah, WI 54957-1025

Mr. Olsen received his B.S. in Environmental Engineering from Michigan Technological University. He is a licensed P.E. in Wisconsin with more than 16 years experience.

Say Leong Ong,
Ph.D., BCEEM
HW
Professor and Acting Head
National University of Singapore
Blk E1A, #02-14, 1 Engineering Drive 2
Department of Civil & Environmental Engineering
Singapore, 117576

Dr. Ong received his B.Eng. in Civil Engineering from the University of Singapore, MESc in Biochemical Engineering from the University of Western Ontario, Canada and Ph.D. degree in Civil Engineering from the University of Toronto, Canada. He has more than 36 years experience.

Fred P. Osman,
P.E., BCEE
AP
President
Osman Environmental Solutions, LLC
4708 Rock Ledge Drive
Harrisburg, PA 17110

Mr. Osman received his B.S. degree in Electrical Engineering from Lehigh University. He is a licensed P.E. in Pennsylvania with more than 25 years experience.

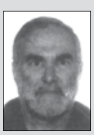
Ana J. Pena-Tijerina,
Ph.D., P.E., BCEE
WW
Environmental Engineer
Carollo Engineers, Inc.

8918 Tesoro Drive #400
San Antonio, TX 78217

Dr. Pena-Tijerina received her B.S. in Chemical Engineering and M.S. in Environmental Engineering from the Tech Institute of Monterrey and Ph.D. degree in Environmental Engineering from the University of Texas at Arlington. She is a licensed P.E. in Texas with more than 8 years experience.

Robert L. Raab,
P.E., BCEE
GE
Vice President
Dvirka and Bartilucci, Consulting Engineers
330 Crossways Park Drive
Woodbury, NY 11797-2015

Mr. Raab received his B.S. in Civil Engineering and M.S. degree in Environmental Engineering from Manhattan College. He is a licensed P.E. in New York with more than 41 years experience.



Barry Rabinowitz,
Ph.D., P.E., BCEE
WW
Principal Wastewater Treatment Technologist
CH2M Hill
4720 Kingsway #2100
Burnaby, BC V5H 4N2
Canada

Dr. Rabinowitz received his B.Sc. in Civil Engineering and M.Sc. in Civil/Sanitary Engineering from the University of Cape Town and Ph.D. degree in Environmental Engineering from the University of British Columbia. He is a licensed P.E. in Canada with more than 34 years experience.

Thomas B. Ramsey,
P.E., BCEE
SW
Associate
Geosyntec Consultants, Inc.
10220 Old Columbia Road, Suite A
Columbia, MD 21046

Mr. Ramsey received his B.S. in Civil Engineering from the Thayer School of Engineering and M.S. degree in Civil/Environmental from Duke University. He is a licensed P.E. in Georgia and Maryland with more than 9 years experience.

Joseph S. Robertaccio,
P.E., BCEE
GE
Environmental Engineer
New York Power Authority
6520 Glass Factory Road
PO Box 191
Marcy, NY 13403

Mr. Robertaccio received his B.S. in Mechanical Engineering from Clarkson University. He is a licensed P.E. in New York with more than 21 years experience.

James A. Santroch,
P.E., BCEE
WW
Sanitary Engineer
Tetra Tech
1420 5th Avenue #600
Seattle, WA 98101

Mr. Santroch received his B.S. in Civil Engineering from Cornell University and M.S. degree in Environmental Engineering from Stanford University. He is a licensed P.E. in Washington with more than 39 years experience.

Fernando Sarmiento,
P.E., BCEE
WW
Greeley and Hansen LLC
2800 North 44th Street #650
Phoenix, AZ 85008

Mr. Sarmiento received his B.S. in Mechanical Engineering from the National Polytech School, Ecuador and M.S. degree in Environmental Engineering from Arizona State University. He is a licensed P.E. in Arizona with more than 16 years experience.

Steven K. Sauer,
P.E., BCEE
WW
USPHS, Environmental Engineer
Great Smoky Mountains National Park
107 Park Headquarters Road
Gatlinburg, TN 37738-4102

Mr. Sauer received his B.S. in Civil Engineering from the University of Missouri-Rolla and M.S. degree in Environmental Engineering from Missouri University of Science and Technology. He is a licensed P.E. in Louisiana with more than 10 years experience.

Sean E. Scuras,
Ph.D., P.E., BCEE
WW
Senior Wastewater Process Engineer
Tetra Tech
36 Pinckney Street
Greenville, SC 29601

Dr. Scuras received his B.S. degree in Engineering from the Southern Illinois University, his M.S. in Civil Engineering from the University of Colorado and Ph.D. degree in Environmental Engineering from Clemson University. He is a licensed P.E. in Colorado with more than 22 years experience.

Robert F. Serpente,
P.E., BCEE
WW
President & Chief Engineer
D&B/Guarino Engineers, LLC
330 Crosskeys Park Drive
Woodbury, NY 11797

Mr. Serpente received his B.S. in Mechanical Engineering from the University of Dayton and M.S. degree in Water Resources Engineering from the Villanova University. He is a licensed P.E. in Pennsylvania, Delaware and Maryland with more than 40 years experience.

Sham A. Sihabdeen,
P.E., BCEE
WW
CH2M Hill
1103 Schrock Road #400
Columbus, OH 43229

Mr. Sihabdeen received his B.S. in Civil Engineering from University of Peradeniya, Sri Lanka and M.S. degree in Structural Engineering from the University of Florida. He is a licensed P.E. in Ohio, New York and the District of Columbia with more than 33 years experience.

Peter Silva,
P.E., BCEE
WW
Retired Assistant Administrator for Water
US Environmental Protection Agency

Mr. Silva received his B.S. degree in Civil Engineering from California Polytechnic Institute, Pomona. He is a licensed P.E. in California with more than 34 years experience.

Lianfa Song,
Ph.D., BCEEM
WW
Associate Professor
Texas Tech University
10th and Akron
Lubbock, TX 79409

Dr. Song received his B.S. in Physical Engineering and M.S. in Environmental Science from the Peking University, Beijing, China and Ph.D. degree in Environmental Engineering from the University of California. He has more than 24 years experience.

Charles H. Starling, III,
P.E., BCEE
WW
Senior Engineer
Malcolm Pirnie, Inc.
5 Conception Street 2nd Floor
Mobile, AL 33602

Mr. Starling received his B.S. in Microbiology from Auburn University and M.S. in Civil Engineering from the University of South Alabama. He is a licensed P.E. in Alabama with more than 10 years experience.

Randy A. Stoll,
P.E., BCEE
WW
Project Manager
M-E Companies, Inc.
635 Brooksedge Boulevard
Westerville, OH 43081

Mr. Stoll received his B.S. in Civil Engineering from Ohio State University and M.S. degree in Business Administration from Otterbein College. He is a licensed P.E. in Ohio with more than 16 years experience.

John Story,
P.E., BCEE
WW
Project Engineer
GHD, Inc.
415 North French #100
Amherst, NY 14228

Mr. Story received his B.S. in Civil Engineering from the University of Buffalo. He is a licensed P.E. in New York with more than 8 years experience.

Yue Sun,
P.E., BCEE
WW
Project Manager
CDM
3050 Post Oak Boulevard #300
Houston, TX 77056

Ms. Sun received her B.S. and M.S. in Environmental Engineering from Tongji University, China and M.S. degree in Environmental Engineering from Virginia Tech. She is a licensed P.E. in Texas with more than 11 years experience.

Ronald Tatariw,
P.E., BCEE
WW
Project Engineer
Prince William County Service Authority
4 County Complex Court
Woodbridge, VA 22195

Mr. Tatariw received his B.S. in Environmental Science from Fairleigh Dickinson University and M.S. degree in Civil Environmental from Colorado State University. He is a licensed P.E. in South Carolina and Virginia with more than 32 years experience.

Steven D. Tedesco,
P.E., BCEE
WW
Senior Vice President
Tetra Tech
17885 Von Karman Avenue #500
Irvine, CA 92614

Mr. Tedesco received his B.S. degree in Civil Engineering from the Polytechnic Institute of New York. He is a licensed P.E. in Oklahoma and California with more than 32 years experience.

Click HERE to return to Table of Contents

Kevin Y. Teichman,
Ph.D., BCEEM
GE
Deputy Assistant Administrator for Science
1200 Pennsylvania Avenue NW 8101R
Washington, DC 20460

Dr. Teichman received his B.S. and M.S. degrees in Mechanical Engineering from the Massachusetts Institute of Technology and Ph.D. degree in Mechanical Engineering from the University of California at Berkeley. He has more than 40 years experience.

Raymond L. Tremblay,
P.E., BCEE
WW
Operations Engineer
LA County Sanitation Districts
1955 Workman Mill Road
Whittier, CA 90601

Mr. Tremblay received his B.S. in Civil Engineering and M.S. in Environmental Engineering from the University of Michigan. He is a licensed P.E. in California with more than 17 years experience.

Celine C. Trussell,
P.E., BCEE
WW
Supervising Engineer III
Trussell Technologies, Inc.
6540 Lusk Boulevard #C274
San Diego, CA 92121

Ms. Trussell received her B.S. in Civil Engineering from the Speciale des Travaux Publics, Paris and M.S. in Civil Engineering from the University of California. She is a licensed P.E. in California with more than 12 years experience.

Robert S. Trussell,
Ph.D., P.E., BCEE
WW
Principal Engineer
Trussell Technologies, Inc.
6540 Lusk Boulevard #C274
San Diego, CA 92121

Dr. Trussell received his B.S. in Chemical Engineering, M.S. in Civil Engineering and Ph.D. degree in Environmental Engineering from the University of California. He is a licensed P.E. in California with more than 14 years experience.

Rosanna Tse,
P.E., BCEE
WW
Engineer
San Francisco Public Utilities Commission
1155 Market Street 3rd Floor
San Francisco, CA 94103

Ms. Tse received her B.S. in Civil Engineering from the University of California, Berkeley and M.S. degree in Civil/Environmental from the Massachusetts Institute of Tech. She is a licensed P.E. in California with more than 15 years experience.

Steven A. Van Dyke,
P.E., BCEE
WW
Project Engineer/Manager
Fox Engineering Associates, Inc.
414 South 17th Street #107
Ames, IA 50010

Mr. Van Dyke received his B.S. and M.S. degrees in Civil Engineering from Iowa State University. He is a licensed P.E. in Iowa and has more than 14 years experience.

Kevin N. Vann,
P.E., BCEE
SW
Project Manager
CDM
1701 Highway A-1-A #301
Vero Beach, FL 32963

Mr. Vann received his B.S. and M.S. degrees in Environmental Engineering from the University of Florida. He is a licensed P.E. in Florida with more than 9 years experience.

Donald J. Voogt,
P.E., BCEE
WW
Project Engineer
McMahon Associates
1445 McMahon Drive, POB 1025
Neenah, WI 54957-1025

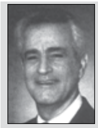
Mr. Voogt received his B.S. in Civil Engineering from Michigan Technological University and M.S. degree in Civil Engineering from the South Dakota State University. He is a licensed P.E. in South Dakota and Wisconsin and has more than 30 years experience.

Glenn D. Walters,
P.E., BCEE
WW
Senior Environmental Engineer
City of Los Angeles Bureau of Sanitation
2714 Media Center Drive
Los Angeles, CA 90065

Mr. Walters received his B.S. in Civil Engineering from the University of California. He is a licensed P.E. in California and has more than 22 years experience.

Guihua Wang,
Ph.D., P.E., BCEE
WW
Associate/Project Manager
KCI Technologies, Inc.
936 Ridgebrook Road
Sparks, MD 21152

Dr. Wang received her B.S. and M.S. degrees in Environmental Engineering from the Tsinghua University and Ph.D. in Civil Engineering from Virginia Tech. She is a licensed P.E. in Maryland with more than 14 years experience.



William Wankoff,
P.E., BCEE
WW
Water Engineering Manager
D&B/Guarino Engineers, LLC
8 Neshaminy Interplex #219
Trevose, PA 19053

Mr. Wankoff received his BSCE in Civil Engineering and MSEE degree in Environmental Engineering from Drexel University. He is a licensed P.E. in Pennsylvania with more than 43 years experience.

Dick R. Weigel,
P.E., BCEE
WW
Senior Project Manager
Hannum, Wagle & Cline Engineering
151 North Delaware #800
Indianapolis, IN 46204

Mr. Weigel received his B.S. in Civil Engineering from the Rose Hulman Institute of Technology. He is a licensed P.E. in Indiana with more than 24 years experience.

Mark R. Wiesner,
Ph.D., P.E., BCEE
WW
James L. Meriam Professor of Civil and Environmental Engineering
Pratt School of Engineering
Duke University
120 Hudson Hall
Durham, NC 27708-0287

Dr. Wiesner received his B.A. in Mathematics/Biology from Coe College, M.S. in Civil and Environmental Engineering from the University of Iowa and Ph.D. in Environmental Engineering from The Johns Hopkins University. He is a licensed P.E. in Texas and has more than 33 years experience.

Ronald E. Williams,
P.E., BCEE
WW
Senior Project Manager
CH2M Hill
2625 South Plaza Drive #300
Tempe, AZ 85282

Mr. Williams received his B.S. in Civil Engineering from New Mexico State University. He is a licensed P.E. in Arizona with more than 22 years experience.

Kevin P. Wynn,
P.E., BCEE
WW
Senior Project Manager
Hatch Mott MacDonald
27 Bleeker Street
Millburn, NJ 07041

Mr. Wynn received his B.S. in Civil Engineering and M.S. in Environmental Engineering from the New Jersey Institute of Technology. He is a licensed P.E. in New Jersey with more than 22 years experience.

Shuang (Sharon) Yin,
P.E., BCEE
WW
Engineer
Orange County Sanitation District
10844 Ellis Avenue
Fountain Valley, CA 92708

Ms. Yin received her B.S. degree in Pharmaceutical Engineering and a M.S. in Medicinal Chemistry from the Shenyang College of Pharmacy, China and M.S. in Civil/Environmental from the University of California. She is a licensed P.E. in Iowa and California with more than 10 years experience.

Daniel H. Zitomer,
Ph.D., P.E., BCEE
WW
Professor
Marquette University
PO Box 1881
Milwaukee, WI 53201

Dr. Zitomer received his B.S. in Civil Engineering from Drexel University and M.S. and Ph.D. degrees in Environmental Engineering from Vanderbilt University. He is a licensed P.E. in Wisconsin with more than 21 years experience.

How Much Energy Can You Conserve?

CONTEST

Win a Trip To...

Washington, DC and the Festival Expo!

Contest is open to Middle and High School Students

USA Science and Engineering Festival
www.usasciencefestival.org

Washington, DC
April 28-29, 2012

Go to AAEE.net for details & entry packet

Sponsored by

AMERICAN ACADEMY OF ENVIRONMENTAL ENGINEERS®

"You've gotta be in it to win it!"

www.aaee.net

Volume 15, Winter 2012

Environmental Engineer: Applied Research and Practice

The Role of Landfills in
U.S. Sustainable Waste Management
Debra R. Reinhart, Ph.D., PE, BCEE,
Hamid Amini, Stephanie C. Bolyard 33

Instructions to Contributors

PURPOSE AND SCOPE

Environmental Engineer: Applied Research and Practice, is a peer-reviewed journal focused on practical research and useful case studies related to the multi-disciplinary field of environmental engineering. The journal strives to publish useful papers emphasizing technical, real-world detail. Practical reports, interesting designs and evaluations of engineering processes and systems are examples of appropriate topics. Papers relating to all environmental engineering specialties will be considered.

MANUSCRIPT REQUIREMENTS:

Manuscripts should follow the general requirements of the ASCE authors' guide (*http://www.pubs.asce.org/authors/index.html#1*) and should be submitted electronically in WORD format to the Editor and Assistant Editor.

C. Robert Baillod, Ph.D., P.E., BCEE
Editor e-mail: *baillod@mtu.edu*

Otis J. Sproul, Ph.D., P.E.
Associate Editor email: *otis.sproul@unh.edu*

Yolanda Moulden
Assistant Editor email: *YMoulden@aaee.net*

For questions or hard copy submission, please contact:
Yolanda Moulden, AAEE
Assistant Editor
130 Holiday Court, Suite 100
Annapolis, MD 21401
ATTN: Yolanda Moulden
(410) 266-3311
(410) 266-7653 (Fax)

REVIEW PROCESS

All papers submitted to the journal are subject to critical peer review by three referees, who have special expertise in a particular subject. The Editor will have final authority over a paper's suitability for publication.

CATEGORIES

Papers may be submitted in the following areas:

Applied Research

Original work presented with careful attention to objectives, experimental design, objective data analysis, and reference to the literature. Practical implications should be discussed.

Review

Broad coverage of an environmental engineering application or a related practice with critical summary of other investigators' or practitioners' work.

Practical Notes

Novel methods that the author(s) have found to be sufficiently successful and worth recommending.

Case Studies

Recently completed projects or studies in progress that emphasize novel approaches or significant results.

Design/Operation

Conceptual or physical design or operation of engineering systems based on new models or techniques.

Management

Papers describing novel approaches to problems in environmental management, or to the global, sustainability or business asects of environmental engineering.

ABSTRACT

An abstract of up to 200 words should be provided, including a statement of the problem, method of study, results, and conclusions. References, tables, and figures should not be cited in the abstract. Up to six key words or terms should be included for use by referencing sources.

PHOTOGRAPHIC CONSENTS

A letter of consent must accompany all photographs of persons in which the possibility of identification exists. It is not sufficient to cover the eyes to mask identity.

COPYRIGHT AND LICENSE TO PUBLISH

Authors retain copyright but are required to grant AAEE the license and right to be the first publisher of the paper and to have an ongoing continuing world-wide license to reproduce the paper in print form and on-line.

The Role of Landfills in U.S. Sustainable Waste Management

Debra R. Reinhart[1], Ph.D., PE, BCEE, Hamid Amini[2], Stephanie C. Bolyard[3]

ABSTRACT

Sustainable solid waste management involves socially-acceptable solutions that minimize environmental impacts and cost, and incorporate waste minimization, recycling, treatment, and landfill disposal practices. This paper discusses the role of the landfill in sustainable waste management, including sustainable operation and design to control emissions, greenhouse gas issues, waste diversion, gas to energy opportunities, and a new concept, pump and treat aerobic flushing, for sustainable landfill operation to completion. Through these practices, landfills can promote safe waste disposal. Greenhouse gas emission offsets can be achieved through the collection and beneficial use of methane and carbon dioxide, in addition to the storage of recalcitrant carbon. Landfill-gas-to-energy projects provide an opportunity for compensation for reduced gas emissions. However, it appears that reduction of emissions beyond current practice may not be cost effective because of the high cost of fugitive emissions avoidance.

INTRODUCTION

Sustainable solid waste management involves socially-acceptable solutions that minimize environmental impacts and cost. There is a generally accepted hierarchy to sustainable waste management that involves waste minimization, recycling, treatment, and landfill disposal. Landfill disposal of non-recoverable and non-recyclable waste is inevitable and, in countries with large land resources, relatively well accepted. In developing countries, landfills offer a low cost option for waste management and a potential revenue source through sale of energy and carbon credits associated with landfill gas (LFG) collection and destruction.

Landfills should be designed and operated to reach a sustainability goal. Ideally, the end result of operating a sustainable landfill will be a stable, reusable land area, which is in equilibrium with the environment within one generation. An example of sustainable landfilling is the current European Union Directive, which achieves this concept by permitting landfill disposal of predominately inorganic waste only, through extensive mechanical, biological pretreatment.

Also, in the State of Wisconsin, a landfill organic stability plan rule was enacted in 2006 with the objectives that landfills reach (1) an organically stable state with minimal LFG production, (2) low-organic-component landfill leachate, and (3) stable landfill elevations (complete landfill settlement). Landfill operation to accelerate the stabilization of waste approaches sustainable landfilling (bioreactor landfilling) at considerably lower cost than mechanical or biological waste pretreatment followed by landfilling. In some parts of the world, however, sustainable landfilling may not yet be possible due to economic constraints. This paper discusses the role of the landfill in sustainable waste management, including operation and design to control emissions, greenhouse gas issues, gas to energy opportunities, and a new concept (pump and treat aerobic flushing) for landfill operation to completion.

WASTE DIVERSION

The overall interest in waste diversion has been increasing due to societal movement towards sustainability. Waste diversion would increase material and energy recovery; decreasing the amount of unnecessary waste and conserving natural resources. Diversion goals in the US currently range from 25% up to 100%, or 'zero waste.' Zero waste is defined as diverting 100% of the waste from a landfill, and primarily relies on combustion of waste with energy recovery.

Several US communities have implemented a zero waste program, for example in 2007 San Jose, California established a goal of 100% diversion from landfills by 2022. It should be noted that zero waste is an aspirational goal; there will always be a need to dispose of waste that cannot be incinerated or that remains after incineration. While some residuals generated from solid waste combustion processes can be beneficially used (e.g., daily landfill cover or in road construction), there are limitations on alternatives to landfilling.

Diversion of solid waste will increase the life of landfills, but can reduce production of gas that can otherwise be used as a renewable energy source. For example, the diversion of 33% of the MSW generated in the US in 2006, reduced GHG emissions by 50 million metric tons of carbon equivalent (MTCE). This reduction equates to the GHG emissions from 39 million cars (USEPA, March 2008). However, studies show that diverting rapidly decomposing MSW components, mainly food waste, would significantly reduce LFG production but would have minimal effect on the energy production due to the fact that LFG from such components would be generated prior to initiation of LFG collection in most cases (Amini, 2011).

THE BIOREACTOR LANDFILL

The bioreactor landfill is an important component of current sustainable waste management practices. Much research has been conducted to create an efficient bioreactor landfill system that can significantly reduce pollution potential of municipal solid waste (MSW) within a decade (Reinhart and Townsend, 1998; Reinhart et al., 2002). The benefits of bioreactor landfills have been well documented by a variety of researchers and include enhanced and accelerated waste stabilization, greater and more reliable gas production, improved leachate quality, and more rapid landfill settlement. The most effective (but not the only) element of bioreactor operation is moisture control through liquid injection. Liquid is commonly injected using permeable blankets, tankers at the working face, surface ponds, spray or drip irrigation, horizontal trenches, and/or vertical wells.

LANDFILL EMISSIONS

Emissions from landfills (i.e., methane and carbon dioxide) can be controlled to minimize environmental impact while waste degradation and bio-stabilization of the waste occurs. These processes and system components include construction and maintenance of an effective bottom liner and leachate collection system, optimization of environmental conditions to promote waste stabilization through controlled liquid addition, in-situ treatment of leachate constituents, efficient collection of LFG, placement of an active biocover to control fugitive LFG emissions through methane oxidation, and beneficial utilization of methane generated during waste degradation.

Leachate. A liner system is generally required to prevent migration of leachate from the landfill and to facilitate leachate removal. To minimize risk of contamination, a liner consists of multiple layers composed of natural material (usually clay) and/or geomembranes. Landfills may be designed with single, composite, or double liners depending on the applicable regulations. A single liner provides only a clay or geomembrane layer while a composite liner consists of two layers – a clay material overlain by a geomembrane. The two layers of a composite liner are in intimate contact to maximize moisture restriction. A double liner may be either two single liners or two composite liners (or even one of each) separated by a leak detection system - a series of pipes placed between the liners to collect and monitor any leachate leaking through the upper liner. Clearly, the more layers that are included, the more protective the liner system will be; however, costs will increase dramatically. Leachate is rapidly directed to low points at the bottom of the landfill through the use of an efficient drainage layer composed of sand, gravel, or a geosynthetic net. Perforated pipes are placed at the low points to collect leachate. These pipes are sloped to allow the moisture to move out of the landfill. A study of 187 double-lined landfill US cells concluded that these liners are capable of 90 to 99% hydraulic efficiencies with leakages often less than 2 liters/ha/day (Bonaparte et al., 2002).

Gas. Waste is covered at the end of each working day with soil or an alternative daily cover material such as textiles, geomembrane, carpet, foam, or other proprietary materials. The landfill sides are sloped to facilitate maintenance and to maximize slope stability. Once the landfill reaches design height, a final cap is constructed to minimize the infiltration of rainwater, minimize waste dispersal, accommodate settling, and facilitate long-term maintenance. The cap may consist (from top to bottom) of vegetation and supporting soil, a filter and drainage layer, a hydraulic barrier, foundation for the hydraulic barrier, and a gas control layer. Because of the prevailing anaerobic conditions within a biologically active landfill, these sites produce large quantities of gas composed of methane, carbon dioxide, water, and various trace components such as ammonia, sulfide, and non-methane volatile organic carbon compounds (VOCs). Reported LFG production rates vary from 0.12 to 0.41 m^3/kg dry waste (Pohland and Harper, 1985). LFG is generally controlled by installing vertical or horizontal wells within the landfill. These wells are either vented to the atmosphere (if gas migration control is the primary intent of the system) or connected to a central blower system that pulls gas to a flare or treatment process.

Globally, landfills are the third-largest anthropogenic source of methane emissions, while in the US, landfills are the second largest anthropogenic source, accounting for 22% of total US methane emissions for a CO_2 equivalent of 126.3 Tg in 2008 (USEPA, 2010). The US has made capture and destruction of LFG a priority resulting in 15% decline from 1990 to 2008 despite a significant increase in the amount of waste landfilled. The actual ability to control LFG with a cover is not well known. EPA states that none of the gas can be captured without a cover, and 75% of the gas can be recovered with application of daily, intermediate, and final covers.

However, field studies suggest that capture with a geomembrane cap significantly exceeds 90% (Ogor and Guerbois, 2005). In addition, covers can be designed and operated to encourage methanotrophic bacteria to consume methane and reduce the fugitive emission rate considerably.

However, it appears that reduction of gas emissions beyond current common practices is not cost-effective because of the high cost of high level gas collection (Amini, 2011).

CARBON STORAGE

Anaerobic conditions normally prevail in landfills, which are not conducive to the decomposition of lignins or to cellulosic material protected by lignins. Consequently, much of the wood and paper products, which are primarily lignin and cellulose, will remain in the landfill for very long periods of time. Thus, while landfills tend to contribute large amounts of greenhouse gases, to some extent they offset these emissions through carbon storage. Landfilled paper, yard trimmings, and food wastes accounted for 1.2% of the total US carbon sequestration in 2009 (USEPA, 2011).

LANDFILL-GAS-TO-ENERGY PROJECTS

LFG can pose an environmental threat due to the presence of greenhouse gases, odorous or potentially toxic VOCs, and the explosive nature of methane. However, the gas has high energy content and can be captured for power, steam, or heat generation. Treatment of the gas prior to beneficial use may include condensation of water and some of the organic acids and/or the removal of sulfide, particulates, heavy metals, VOCs, and carbon dioxide. Collection and destruction of the methane in LFG allows Annex I countries to meet emission targets by using credits purchased through a Clean Development Mechanism under the Kyoto Protocol. The cost of reducing greenhouse gas emissions in developing countries is a fraction of that in developed countries. Obviously, when a project is coupled with energy production, the benefits are even greater. Carbon emission trading has created a strong worldwide market. The value of the European carbon trading market was about USD 95 billion in 2008, while the US voluntary carbon trading market value was over USD 0.7 billion in 2008 (Hamilton et al., 2009).

However, following the economic recession, the estimated global carbon market value dropped from USD 118 billion in 2008 to USD 84 billion in 2009 (Carbon Positive, 2009).

In the US, there are over 540 (as of December 2010) LFG recovery projects capturing and beneficially using some 9.4 billion m^3 of LFG annually. The energy produced by these projects is equivalent to heating over 2.1 million homes. The reduced emissions from these projects are over 75 million metric tonnes of carbon equivalents per year (US EPA LMOP, 2011). The US Environmental Protection Agency created the Landfill Methane Outreach Program (LMOP) and, internationally, the Methane to Markets Partnership (M2M) to encourage LFG recovery and beneficial use. Some of the uses of LFG are described below.

Boilers and Other Direct Combustion Applications. Direct combustion of LFG is by far the cheapest and easiest option Direct use of LFG to replace or supplement coal, oil, propane, and natural gas has been successfully demonstrated. Applications include boiler firing, space heating, cement and brick kilns, sludge drying, and leachate drying and incineration In most cases, gas cleanup consists of little more than condensate removal.

Vehicle Fuel. A market for LFG as a vehicle fuel exists if the gas is upgraded to natural gas quality. Vehicles can be modified for operating on some form of natural gas. Refueling stations are available and are equipped for dispensing natural gas. The technology is established for liquid natural gas (LNG) and compressed natural gas (CNG).

Conversion to Synthetic Fuels/Chemicals. It is technically possible, even if not economically feasible, to produce synthetic fuels and chemicals from LFG. The technologies include hydrocarbon production by the Fischer-Tropsch process and methanol synthesis by high-pressure chemical catalysis and partial biological oxidation. Synthesis gas-based chemical processes for acetic acid and other compounds are also available. These technologies were developed for large-scale production of synfuels using coal gas feed stocks. Production ventures were costly and their products were expensive.

Electrical Power Generation. Generation of electricity, using reciprocating internal combustion and gas turbine engines, is by far the most common LFG-to-energy application. A number of proven technologies with a range of economies of scale easily adapted to LFG, a highly developed and distributed transmission infrastructure, and a virtually limitless market make LFG-to-electricity one of the easiest and most profitable alternatives.

Electrical Power Generation (Fuel Cells). Until recently, the well-established technology of fuel cells was subject to unfavorable economics when using LFG. Fuel cells are electrochemical batteries utilizing molten carbonate or phosphoric acid fueled by coal, petroleum, natural gas, or other such hydrocarbon feedstocks. Hydrogen from the converted fuel combines with oxygen to produce electricity.

Purification to Pipeline Quality Natural Gas. There are major differences between LFG and natural gas in composition and energy content. LFG has a lower BTU content, combusts at a lower temperature, is more corrosive, and contains much greater concentrations of undesirable gases (CO_2, O_2, N_2) and harmful halocarbons than pipeline-quality natural gas. Diligent extraction and stringent cleanup is therefore necessary to render LFG devoid of all components except methane. The required gas cleanup, an expensive and complex process for other alternatives, includes nearly complete CO_2 removal.

Conversion to Hydrogen Gas. Hydrogen can be produced by catalytic processing of LFG with minimal environmental impact. Hydrogen gas could be used locally by a variety of end-users (e.g., in transportation or for on-site generation of heat and/or electricity using energy efficient fuel cells). The Florida Solar Energy Center at the University of Central Florida (Orlando, FL, US) has proposed this concept based on direct (i.e., without preliminary recovery of methane) reforming of LFG to synthesis gas (or syngas) via CO_2-reforming of methane (often called, 'dry' reforming) according to the equation (Muradov et al., 2008):

$CH_4 + CO_2 ‡ 2H_2 + 2CO$

$H°_{298}= 247$ kJ/mol   (1)

This is an endothermic reaction that operates at 850-950°C (i.e., the same temperature range as commercial steam methane reforming, SMR, process) and produces syngas with the H_2:CO ratio of approximately 1:1. Most of the H_2S and other harmful contaminants have to be removed from LFG before the reforming stage in order to prolong the life of the catalysts used in the process. The purified CH_4-CO_2 mixture enters a catalytic reformer, where it is processed into syngas. The syngas is further processed in the CO-shift reactor to H_2-CO_2 mixture according to the reaction (2):

$CO + (H_2O)_g ‡ H_2 + CO_2$

$H°= - 41.5$ kJ/mol   (2)

At the final gas separation stage of the process, hydrogen gas with 99.999 vol. % purity is recovered from H_2-CO_2 mixture using a pressure swing adsorption (PSA) unit. A pilot-scale unit with the capacity of 5 kW of hydrogen gas was designed, fabricated and tested (Muradov et al., 2008).

Pump and Treat Aerobic Flushing Bioreactor Landfill: A New Concept

After the landfill has been operated as a bioreactor for a period of time and the anaerobically biologically degradable organic compounds are removed, the leachate may contain organic contaminants and refractory organic by-products that threaten the environment and human health. Once gas production declines to a point where it is no longer economical or feasible to generate electricity, the objectives of landfill operation change to final stabilization of waste. At this point, consideration should be given to shifting to an aerobic mode of treatment. In addition, bioreactor landfill operation tends to yield high ammonia-nitrogen concentrations. Ammonia-nitrogen concentrations tend to increase beyond concentrations found in leachate from conventional landfills because recirculating leachate under anaerobic conditions increases the rate of ammonification and provides no major biological pathway for ammonia removal (Berge et al., 2006).

In order to reduce landfilling long-term liability and environmental impact, in the US, post-closure care (PCC) of landfills is now required for 30 years; however, this time period may be inadequate and PCC may actually be needed indefinitely. In some cases, removal of both remaining organic contaminants and ammonia-nitrogen must be accomplished before landfill post-closure periods can end. Removal of these constituents may require a series of costly biological, chemical and physical processes either at a local treatment plant or on-site facilities. To minimize PCC following biological anaerobic digestion of waste in a bioreactor landfill, a completion phase is proposed during which remaining contaminants such as leachable ammonia and organic and inorganic contaminants are treated and/or removed from the landfill through a combination of in-situ biological and ex-situ oxidation processes (Batarseh et al., 2010).

This method uses leachate indigenous to the landfill cell as the flushing media as opposed to using clean water. As leachate is flushed, it is chemically treated outside the cell, and subsequently pumped back into the cell to transport more of the releasable carbon, as seen in Figure 1. Additional carbon that resisted anaerobic degradation could be removed from the landfill cell by aerobic biodegradation if air is injected into landfill. With such a process, the ultimate end products within a landfill are essentially humic matter and inert inorganics. Recent batch and modeling studies (Reinhart et al., 2006) have preliminarily demonstrated the economic and technical feasibility of a concept called a **Pump and Treat Aerobic Flushing Bioreactor Landfill** (PTAFBL), estimated to add approximately $23 per ton landfilled (Batarseh et al., 2010). This process is proposed to provide sustainable landfilling by removing releasable carbon, dissolved solids, and ammonia nitrogen at the end of a MSW landfill life as shown in Figure 1.

This concept has application to both operating landfills and to closed sites, which number in the US in the many thousands. Ideally, the end result of operating a landfill in this fashion will be a stable, reusable land area. This suggested method is recommended to be applied as a post-bioreactor landfill treatment step with the objective of producing stable solid waste cells, with the potential to rapidly recover the landfill site for redevelopment (i.e., recreational park, nature reserve, golf course, or industrial sites).

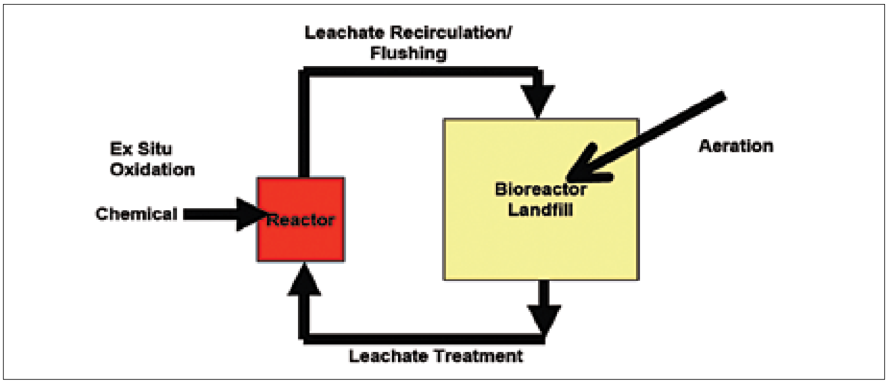


Figure 1 - The Pump and Treat Aerobic Flushing Bioreactor Landfill

FUKUOKA SEMI-AEROBIC LANDFILL METHOD

As an alternative means to fully stabilizing landfilled waste, particularly in developing countries, a semi-aerobic landfill can be considered. The Fukuoka Semi-Aerobic Landfill Method (Chong et al., 2005) is a proven technology in Japan that has been proposed or constructed around the world because of potential economic benefits. Aerobic treatment of waste could have multiple advantages, including biological treatment of waste and leachate constituents that are recalcitrant under anaerobic conditions (such as ammonia) while controlling methane production. Low-pressure aeration has been used in Germany to accelerate aerobic stabilization (Heyer et al., 2005). Addition of air can be accomplished passively according to the Fukuoka Method by removing gas extraction wells/blankets from the extraction system and promoting gas convection within the waste Aerobic treatment of the waste results in a temperature elevation which promotes convection of air upward from the leachate collection system, through the waste, and out the gas vents. The leachate collection system must be constructed of highly permeable material to promote passive aeration, such as river rock.

CONCLUSIONS

While many landfills have historically created pollution through improper siting, design, and/or operation, the potential for sustainable landfilling does exist. Landfilling of waste is currently inevitable and modern landfill practices can promote safe land disposal. Leachate can be safely collected and treated, reducing the potential for ground and surface water contamination. Methane can be either collected and beneficially used or oxidized in soil covers; carbon dioxide can be sequestered cryogenically or sold for commercial use, and recalcitrant carbon can be stored in the landfill, all resulting in greenhouse gas emission offsets. However, significant reduction of gas emissions beyond common practice today does not appear to be cost-effective because of the cost of high level of gas collection. EE

REFERENCES

Amini, H.R. (2011); “Landfill gas to energy: incentives and impediments,” PhD Dissertation, University of Central Florida, Orlando, Florida.

Batarseh, E.S., D.R. Reinhart, N.D. Berge (2010); “Sustainable disposal of municipal solid waste: Post bioreactor landfill polishing,” Waste Management, Volume 30, Issue 11, 2170-2176.

Berge, N.D., D.R. Reinhart, J. Dietz, T. Townsend (2006); “In situ ammonia removal in bioreactor landfill leachate,” Waste Management, Volume 26, Issue 4, 334-343.

Bonaparte, R., D. E. Daniel, and R. M. Koerner (2002); “Assessment and recommendations for improvement in the performance of waste containment systems,” EPA/600/R-02/099, US EPA ORD, NRMRL, December 2002.

Carbon Positive (2009); “Carbon trade to reach $670bn in 2013,” Retrieved from www.carbonpositive.net/viewarticle.aspx?articleID=1500 in April 2011.

Chong, T.L., Matsufuji, Y., Hassan, M.N. (2005); Implementation of the semi-aerobic landfill system (Fukuoka method) in developing countries: A Malaysia cost analysis, Waste Management, Volume 25, Issue 7, 2005, Pages 702-711.

Hamilton, K., M. Sjardin, A. Shapiro, T. Marcello (2009); “Fortifying the foundation: State of the voluntary carbon markets 2009,” A report

Click HERE to return to Table of Contents

by Ecosystem Marketplace and New Carbon Finance.

Heyer, K.-U., Hupe, K., Koop, A., Stegman, R. (2005), Aerobic In Situ Stabilisation of Landfills in the Closure and Aftercare Period, Eleventh International Waste Management Landfill Symposium.

Muradov, N., Smith, F., T-Raissi, A. (2008), Hydrogen production by catalytic processing of renewable methane-rich gases, International Journal of Hydrogen Energy, Volume 33, Issue 8, April 2008, Pages 2023-2035.

Ogor Y., M. Guerbois (2005); "Comparison of landfill methane emission models: A case study," Sardinia 2005, 10th International Waste Management and Landfill Symposium, October 6-10.

Pohland F. G., S.R. Harper (1985); "Critical review and summary of leachate and gas production from landfills," EPA/600/2-86/073, US Environmental Protection Agency, Cincinnati, 1985.

Reinhart, D. R., T. G. Townsend (1998); "Landfill bioreactor design and operation," CRC Press, New York, NY.

Reinhart, D. R., T. Townsend, and P. McCreanor, (2002) "The status of bioreactor landfills" Waste Management and Research, 20: 67-81.

Reinhart, D. R., N. Berge, E. Batarseh (2006); "Long-term treatment and disposal of landfill leachate – Final Report," Hinkley Center of Solid and Hazardous Waste Management, Gainesville, Florida, www.hinkleycenter.com.

US Environmental Protection Agency (2011); "Inventory of US greenhouse gas emissions and sinks: 1990-2009," 430-R-11-005, Office of Atmospheric Programs, Washington DC, April 2011.

US Environmental Protection Agency (2008); Resource Conservation Challenge Update, March 2008, US EPA 530-R-08-005.

US EPA LMOP (2011); "Energy projects and candidate landfills," Retrieved from www.epa.gov/lmop/projects-candidates/index.html#map-area on April 2011.

FOOTNOTES

1. Professor, University of Central Florida, 4000 Central Florida Blvd., MH 243, Orlando Florida 32816, Debra.Reinhart@ucf.edu
2. Post-Doctoral Fellow, University of Central Florida, Civil, Environmental, and Construction Engineering Department, PO Box 162450, Orlando, FL 32816, hamini@knights.ucf.edu
3. Graduate Student, University of Central Florida, Civil, Environmental, and Construction Engineering Department, PO Box 162450, Orlando, FL 32816, Stephanie.Bolyard@ucf.edu

REACH OUR ADVERTISERS

COMPANY / ORGANIZATION	PAGE	TELEPHONE	WEBSITE
Advanced Valve Technologies	7	877-489-4909	www.avtfittings.com
Alaimo Group Consulting Engineers	37	609-267-8310	www.alaimogroup.com
Carollo Engineers	37	800-523-5822	www.carollo.com
Carylon Corporation	2	800-621-4342	www.caryloncorp.com
CDM Smith	37	617-452-6000	www.cdm.com
Degremont Technologies	39	800-446-1150	www.degremont-technologies.com
Dvirka and Bartilucci Consulting Engineers	37	516-364-9890	www.dvirkaandbartilucci.com
Freese and Nichols	37	214-217-2200	www.freese.com
GLOBE 2012	9	800-274-6097	globe2012.com
Greeley and Hansen	37	800-837-9779	www.greeley-hansen.com
H2M	37	631-756-8000	www.h2m.com
Hatch Mott MacDonald	37	800-832-3272	www.hatchmott.com
HNTB	37	317-636-4682	www.hntb.com
Master Meter Inc.	4	800-765-6518	www.mastermeter.com
Oldcastle Precast	13	888-965-3227	www.oldcastleprecast.com/wastewater
Peer Consultants, P.C.	37	301-816-0700	www.peercpc.com
Pollardwater.com	40	800-437-1146	www.pollardwater.com
Remington & Vernick	37	856-795-9595	www.rve.com
Solvay Chemicals	11, 20, 21	800-765-8292	www.solvair.us
Trojan Technologies	3	888 220 6118	www.trojanuv.com
Walker Process Equipment	11	800-9WALKER	www.walker-process.com
Willis Engineers	37	704-377-9844	www.willisengineers.com

Please Support Our Advertisers. It's Good Business!!

Pollardwater.com

QUALITY TOOLS FOR WINTER

Winter Clothing

Plastic and Copper Shut-Off

Valve & Basin Cleaners

Food Grade Lubricant

Leak Detectors

Locator for Buried Hydrants

Hydrant Steam Thawer

Hydrant Flags

Phone 800-437-1146

Find it all at www.pollardwater.com