

# EREF's Regional Summit on Sustainable Solid Waste Practices & Research

September 7 - 8, 2011  
Hilton North Raleigh/Midtown  
Raleigh, North Carolina



## PROGRAM

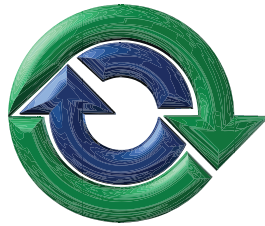


**Environmental Research  
& Education Foundation**

*Lighting a path to sustainable waste management practices*

# Thank You to our Sponsors

## Major Sponsors



**WASTE INDUSTRIES**

**JOYCE**  
*ENGINEERING*

## General Sponsors



**Geosyntec**   
consultants

engineers | scientists | innovators



# LIGHTING A PATH TO SUSTAINABLE waste management practices

EREF has funded over \$9 million in extensive research grants, scholarships and education initiatives, resulting in enhanced industry operations and providing valuable information.



**Environmental Research  
& Education Foundation**

*Lighting a path to sustainable waste management practices*

[www.erefdn.org](http://www.erefdn.org)

## RESEARCH focus

LANDFILLS

TRANSPORT &  
COLLECTION

POLICY/ECONOMICS

WASTE MINIMIZATION

COMBUSTION/  
WASTE-TO-ENERGY

EQUIPMENT/SAFETY

CONVERSION  
TECHNOLOGIES

LIFE CYCLE  
INVENTORY/ANALYSIS

RECYCLING

# AGENDA

## EREF's Regional Summit on Solid Waste Practice & Research

*All presentations will take place in Salon EFG  
Lunch will be served in Salon CD*

### **DAY ONE (9:00 am - 5:00 pm)**

Welcome/Introduction to EREF  
*Bryan Staley, EREF*

Solid Waste Management and Engineering:  
the Role of Research in Improving Performance  
*Mort Barlaz, NCSU*

### **BREAK/NETWORKING (10:00 am - 10:30 am)**

Methane Emissions from Landfills and Cover Oxidation:  
Developments Towards Better Measurement and Quantification  
*Jeff Chanton, FSU*

Biodegradability: Is this a Desirable Attribute?  
*Jim Levis, NCSU (EREF Scholar Highlight)*

Using Culturally Relevant Technology in Solid Waste Management and Recycling  
*Jenna Jambeck, UGA*

### **LUNCH/NETWORKING (12:00 pm - 1:30 pm)**

Solid Waste Collection Ergonomics  
*Debbie Reinhart, UCF*

Assessing Landfill Gas Collection Efficiency  
*Paul Imhoff, UD*

Determining Critical Data for Implementing and Improving the Post Closure Methodology  
*Jeremy Morris, Geosyntec*

### **BREAK/NETWORKING (3:00 pm - 3:30 pm)**

The Fate of Nanoparticles in Landfills  
*Debbie Reinhart, UCF*

Using C&D Fines as Daily Cover  
*Jenna Jambeck, UGA*

MSW Conversion to Biofuels  
*Tarek Aziz & Bryan Staley*

**ENDS AT 5:00 pm**

**DAY TWO SPECIAL LFGTE SESSION (8:30 am - 12:00 pm)**

Gas to Energy: EPA Perspectives  
*Susan Thorneloe, US EPA*

Innovative Applications for Landfill Gas Energy Recovery at Home and Abroad  
*Chris Godlove, US EPA*

Estimation of Landfill Gas Generation Using Waste Components  
Specific Landfill Decay Rates  
*Mort Barlaz, NCSU*

**BREAK/NETWORKING (10:00 - 10:30 am)**

Small-Scale LFGTE System Design: A Case Study  
*Tim Kelly, Joyce Engineering*  
*Steve Cox, GkW Energy*

Implementing LFGTE on an Existing Landfill  
*Jerry Johnson, Waste Industries*

Current Landfill Gas to Energy Opportunities for Electricity Generation and Direct Use  
*Steve Hamilton, SCS Engineers*

**BUS TOUR OF  
BLACK CREEK RENEWABLE ENERGY FACILITY (ROSEBORO, NC)**  
*(12:15 pm - 5:00 pm, Lunch to be provided on the bus)*

# presentation abstracts

## **Solid Waste Management and Engineering: the Role of Research in Improving Performance**

*Mort Barlaz, NC State University*

The objective of this presentation is to discuss the role of research in improving the performance of solid waste systems. Research needs in each area of an integrated solid waste management system will be discussed. The relationship between research, graduate education and the university system will be described and some examples of the translation of research into practice presented.

## **Methane Emissions from Landfills and Cover Oxidation: Developments Towards Better Measurement and Quantification**

*Jeff Chanton, Florida State University*

We have conducted three approaches towards the determination of landfill methane budgets, focusing on methane emission and oxidation. Two techniques we have utilized to determine rates of fugitive landfill methane emission are EPA's OTM-10, which is based upon a tunable diode laser technique with reflectors placed on the landfill surface, and the approach of tracer gas correlation, which is based on downwind cavity ring-down laser measurements. The first technique has the properties of allowing the quantification of specific area landfill emission. The second approach is less somewhat expensive and yields emission determinations for an entire property. The two techniques yield similar results when extrapolated to the same areas. For example, landfills yield emissions of 6-17 g CH<sub>4</sub> m<sup>-2</sup>d<sup>-1</sup> with the OTM-10 technique and 5 to 9 g CH<sub>4</sub> m<sup>-2</sup>d<sup>-1</sup> with tracer plume correlation. For methane oxidation we have used both chamber and surface air samples. The percentage of methane oxidized during passage across a cover soil is 38%, which is more than the 10% currently credited under regulations. The 38% value is similar to the 35% value reported in a recent literature survey that did not include this new data. Methane oxidation is an inverse function of methane loading to the landfill cover, and it increases as methane loading goes down. At closed old landfill facilities where gas generation is low or at sites with very efficient gas collection systems that are NSPS compliant, the 10% oxidation value is too low. Methane oxidation is also a function of climate type, likely due to variation in rainfall amounts and the associated wetness of the waste. More methane is produced in wetter climates. Higher rates of methane production and subsequent higher rates of loading to the landfill cover then decrease the amount of methane oxidation from 50-70% in dry climates to 20% in subtropical humid climates. Moderate northern California and continental sites vary from 35 to 46% oxidation.

## **Biodegradability: Is this a Desirable Attribute?**

*Jim Levis, NC State University (EREF Scholar Highlight)*

There is increasing interest in the use of biodegradable materials because they are believed to be "greener." In a landfill, these materials degrade anaerobically to form methane and carbon dioxide. The fraction of the methane that is collected can be utilized as an energy source and the fraction of the biogenic carbon that does not decompose is stored in the landfill. A landfill life-cycle model was developed to represent the behavior of MSW components and new materials disposed in a landfill representative of the U.S. average with respect to gas collection and utilization over a range of environmental conditions (i.e., arid, moderate wet, and bioreactor).

The behavior of materials that biodegrade at relatively fast (food waste), medium (biodegradable polymer) and slow (newsprint and office paper) rates was studied. Poly(3-hydroxybutyrate-co-3-

hydroxyoctanoate) (PHBO) was selected as illustrative for an emerging biodegradable polymer. Global warming potentials (GWP) of 26, 720, -1000, 990, and 1300 kg CO<sub>2</sub>e wet Mg<sup>-1</sup> were estimated for MSW, food waste, newsprint, office paper, and PHBO, respectively in a national average landfill. In a state-of-the-art landfill with gas collection and electricity generation, GWP's of -250, 330, -1400, -96, and -420 kg CO<sub>2</sub>e wet Mg<sup>-1</sup> were estimated for MSW, food waste, newsprint, office paper and PHBO, respectively. Additional simulations showed that for a hypothetical material, a slower biodegradation rate and a lower extent of biodegradation improve the environmental performance of a material in a landfill representative of national average conditions.

## **Using Culturally Relevant Technology in Solid Waste Management and Recycling**

*Jenna Jambeck, University of Georgia*

Technology has a finite point relevant to attaining sustainability. Human behavior must also be considered, and is especially relevant in the case of solid waste management where reducing, reusing and recycling of waste all encompass influencing human behavior. The Industrial Revolution brought us technology, advancement and comfort, all steps in the right direction. However, advanced technology can also create a disconnection with nature and the natural world, exacerbate the NIMBY mentality if people don't understand the connection of, for example, waste collection and management with what actually occurs at a recycling facility or landfill. Our current consumption rates, often enabled by technological advancement, have become unsustainable. However, the answer is not to go backwards, but to smartly use technology to reconnect people with their environment and behavioral impacts. We need to change people's behavior to reduce our impact on the environment by engaging, interacting, and educating with culturally relevant technology. This talk will present innovative research using citizen science, and technology such as Smartphone Apps and Ecofeedback. Future research to evaluate impacts to recycling bin use based upon various technological and psychological stimuli will also be discussed.

## **Solid Waste Collection Ergonomics**

*Debbie Reinhart, University of Central Florida*

This research is an in-depth ergonomic and environmental analysis of waste collection vehicles. This research includes comprehensive ergonomic and biomechanical analysis of waste collection tasks at varying levels of automation including manual, semi-automatic and automatic. Observational analysis and site visits were conducted through the study and it was noticed that manual waste collectors are exposed to severe occupational injuries more than the waste collectors of automated and semi-automated vehicles; due to lifting, heavy load handling and awkward postures. Laboratory analyses were also conducted and it was found that dumping the waste container was the riskiest task among the others not only due to the excessive load but the way the workers are lifting the garbage container. Moreover, detailed analysis of the injuries data collected by the Bureau of Labor Statistics was performed to evaluate the nature and frequency of injury incidents and it was noticed that the waste collection field has the highest rate of non-fatal injuries among the other fields of waste management industry from 2003 till 2009. Surveys were conducted for solid waste collectors and safety personnel of different waste companies to understand the factors affecting waste collectors safety. This study will establish a foundation for additional research and recommendations for mitigating risks at all levels of task performance.

## **Assessing Landfill Gas Collection Efficiency**

*Paul Imhoff, University of Delaware*

There is a critical need for methods to quantify methane capture efficiency from landfill gas (LFG) collection systems. In addition to providing information that will improve calculations of landfill methane budgets, such measurements are essential for evaluating the utility of alternative gas collection systems and management practices. While measurements of surface methane emissions from landfills aid in determining methane capture efficiency, a fundamentally new approach is evaluated here - quantifying

the capture efficiency using controlled releases of inert tracer gas within refuse. An instrumented site at Yolo County Central Landfill is used to develop this technology. A slug of an inert gas tracer is injected at multiple depths and distances away from a conventional vertical gas collection well, and the concentrations of this tracer are measured through time at the gas collection well. Using the measured concentrations and gas extraction rate, the efficiency of gas collection is calculated for different locations within the zone of influence of the well. We are using these data to assess gas collection efficiency in the region surrounding the well, gas flow patterns within refuse, and the residence time of LFG in waste. Numerical modeling is used to help interpret data and provide guidelines for improved gas collection systems.

## **Determining Critical Data for Implementing & Improving the Post Closure Methodology**

*Jeremy Morris, Geosyntec Consultants*

Between 2002 and 2006, Geosyntec worked with a multi-disciplinary team on an EREF funded project to develop the Evaluation of Post-Closure Care (EPCC) Methodology. The EPCC Methodology provides a technically defensible, performance-based approach for evaluating the site-specific elements of post-closure care (PCC) at municipal solid waste (MSW) landfills regulated under Subtitle D. The methodology establishes a modular approach for evaluating the functional stability of a landfill facility. By sequentially addressing the four primary PCC elements of Subtitle D (i.e., leachate management, LFG management, groundwater monitoring, and final cover system maintenance) the methodology can be used to demonstrate how and when operation, care, and/or monitoring within each module can be optimized or terminated.

Since its publication in September 2006, only limited independent use of the EPCC Methodology has been attempted. Clearly, far more experience is needed to be able to confidently conclude that the methodology is universally useful as a means to define optimization and termination of regulated PCC obligations. To gain this experience, EREF funded Geosyntec to perform a multi-site case study to critically examine the methodology and attempt to expose potential weaknesses. The primary goals of the study were to evaluate ten case study sites to:

- Determine if the data prerequisites outlined in the EPCC Methodology's Technical Manual are presently available at a "typical" MSW landfill site;
- Identify data gaps and data collection needs that impede starting or completing an EPCC Methodology evaluation, and assess whether such data gaps constitute "fatal flaws" in the methodology or may be omitted, modified, or replaced by other data;
- Critically appraise the methodology's usability in key areas of application in the Leachate, Landfill Gas, and Groundwater Modules, particularly with regard to its sensitivity to certain data requirements; and
- Recommend how the methodology could be improved to address identified limitations.

The study, which was completed in March 2011, serves to "ground-truth" the state of the industry relative to data availability for landfill evaluation using the EPCC Methodology. As such, this study goes some way toward answering the question "does the EPCC Methodology work in real situations?" It should be noted that the limited scope of this study cannot be expected to provide a definitive answer as to whether any case study site can actually end regulated PCC within one or more modules. Similarly, this study cannot provide the basis for using the current EPCC Methodology in a predictive capacity. Nonetheless, this study is an important continuation in the development of tools and metrics to evaluate environmental performance and PCC requirements that result from specific landfill operational practices.

## **The Fate of Nanoparticles in Landfills**

*Debbie Reinhart, University of Central Florida*

Over the past decade nanomaterials (NMs) have been key to advancements in drug delivery, nanotechnology, biomaterials, and energy production. An inventory completed by the Project on Emerging Nanotechnologies showed that 1,317 nanotechnology consumer products were available in 2010. Given the unique properties of NMs, the fate and transport in the environment is unknown, and published data suggests the potential for bioavailability and ecotoxicity. The prevalence of these materials increases the probability of NMs being disposed of in a landfill at the end of their useful life. Therefore understanding the fate of NMs in municipal solid waste landfills (MSW) is vital to ensure the proper handling of these novel materials from cradle to grave. This research provides information regarding the mechanisms for the transport of NMs within landfills and effects on anaerobic and aerobic processes. This presentation will specifically address the fate of Zinc Oxide (ZnO) coated with triethoxycaprylylsilane through anaerobic and aerobic test methods and NM characterization. Results to date have not found inhibitory effects from ZnO, which can be attributed to relatively low concentrations of dissolved zinc, although the concentration of dissolved zinc increased with time. To simplify the leachate studies, using a solvent extraction method, leachate components were extracted, based on their increasing polarity, and exposed to ZnO NMs. Fluorescence characteristics of ZnO in these leachate components were systematically studied. It was found that water-soluble leachate components (i.e. humic substances) greatly impact the dispersibility of ZnO in leachate leading to dissolution of zinc and potentially to transport in leachate.

## **Using C&D Fines as Daily Cover**

*Jenna Jambeck, University of Georgia*

A First order decay rate model was developed based upon sulfur content and reduced sulfur gas concentration data from nine landfills in the Northeast. Based on the results of the data analysis and the preliminary model, H<sub>2</sub>S generation in an MSW landfill resulting from C&D fines is expected to peak and decline much more rapidly than for methane. Additionally, the model results indicate that C&D fines used as ADC in MSW landfill environments are expected to decay more rapidly (higher k value) and produce more H<sub>2</sub>S per ton of sulfate deposited in the Landfill (higher S<sub>0</sub> value) than C&D fines that are monofilled. Further, based on the model results at a landfill, which in addition to monofilling the C&D fines also mixed C&D fines with soils to reduce H<sub>2</sub>S generating potential, there is some preliminary evidence that by mixing or layering C&D fines with the right kind of soil in a monofill environment, the H<sub>2</sub>S generating potential of the fines can be reduced. Modeling of four MSW sites that used C&D Fines as ADC resulted in a range of decay rates 1/yr (k) of between 0.54 and 0.88, with an average k for these four sites of 0.702 and a range of H<sub>2</sub>S generating potential in ft<sup>3</sup> of H<sub>2</sub>S per ton sulfur as sulfate (S<sub>0</sub>) of between 3186 Ft<sup>3</sup>/ton and 7184 Ft<sup>3</sup>/ton with an average S<sub>0</sub> value of 5360 Ft<sup>3</sup>/ton.

## **MSW Conversion to Biofuels**

*Tarek N. Aziz, NC State University & Bryan Staley, EREF*

With rising prices for petroleum-derived fuels, improving the economic and technological feasibility of alternative fuel sources has become a key research priority. Unlike dedicated energy crops, fuels derived from waste products incur minimal land use burdens and may add economic value to existing waste disposal processes. One possibility involves the thermo-chemical conversion of a feedstock derived from municipal solid waste (MSW) via gasification or other conversion processes. Typically such processes produce a synthesis gas, which can then be converted into a number of useful products, including biofuels. In order for such a technology to be deployed as an alternative to gasoline, the MSW-derived biofuels must be cost-competitive and reduce environmental impacts compared with direct incineration and landfill options. NC State, EREF and Maverick Biofuels are partners on a project funded by the North Carolina Biofuels Center project to perform a feasibility assessment of MSW-derived biofuel. An overview of key literature regarding MSW conversion processes is provided and some of the challenges expected in making this process feasible are noted.

## Gas to Energy: EPA Perspectives

*Susan Thorneloe, US EPA*

Landfill gas to energy helps to convert energy from buried waste into electricity or fuel. Landfill gas to energy helps conserve fossil fuel and can be a benefit to the environment. The EPA supports energy recovery from landfill gas and has a program (the Landfill Methane Outreach Program) to help developers and landfill owners to identify new sites or better technologies to increase energy recovery from landfills. In the last three decades, it is unusual to not see a large landfill utilizing landfill methane. Through research at EPA in collaboration with RTI and NCSU, we have developed a decision support tool that allows decision makers to determine how best to maximize energy from waste through recycling, combustion, or landfilling. A major priority with recovery energy from landfills is maximizing gas collection to minimize leaks that emit landfill gas to the atmosphere which negates the benefits of energy recovery. Landfill developers and operators have a difficult task to ensure continual and effective gas collection and control while meeting the daily challenges of landfill operations. Operators can even have challenges in dealing with what Mother Nature throws their way from draughts, floods, and even earthquakes. Trying to estimate emissions is also challenging due to continual changes over time in landfill design and operation. This paper will provide perspectives on gas to energy as well as recent research to improve methods for quantifying total emissions from landfills while helping to better quantify the potential benefits of landfill gas to energy projects.

### Innovative Applications for Landfill Gas Energy Recovery at Home and Abroad

*Chris Godlove, US EPA*

In the United States, stakeholders promoting landfill gas (LFG) energy projects are continually identifying new opportunities to utilize this valuable resource. Today, more than 550 beneficial LFG energy projects are in operation across the country. Recently, LFG has been used to meet several regulatory driven mandates for a localized renewable energy source. LFG vehicle fuels have been used to meet clean transportation standards, while LFG direct thermal and electricity projects promote green jobs in LFG-fueled green industrial parks and help meet state-driven renewable portfolio standards. These project successes and biomass-friendly renewable energy incentive programs in the United States are now being replicated throughout the world, where LFG utilization is in an early adoption stage. The United States Environmental Protection Agency Landfill Methane Outreach Program (LMOP) is working with countries under a Global Methane Initiative to build the regulatory and technical capacity for installing LFG energy project abroad. LMOP works with grantees and private sector partners to construct demonstration projects, provide landfill and LFG collection system operational trainings, and assess sites for private investment in LFG energy. This presentation will feature recent innovative LFG energy projects in the United States and beyond. In addition, this presentation will illustrate how projects and companies in the U.S can play an important role in encouraging international projects.

### Estimation of Landfill Gas Generation Using Waste Components Specific Landfill Decay Rates

*Mort Barlaz, NC State University*

The current methane generation model used by the U.S. EPA (LANDGEM) treats municipal solid waste (MSW) as a homogeneous waste with one decay rate. However, component-specific decay rates are required to evaluate the effects of changes in waste composition on methane generation. Laboratory-scale rate constants,  $k_{lab}$ , for the major biodegradable MSW components were used to derive field-scale decay rates ( $k_{field}$ ) for each waste component using the assumption that the average of the field-scale decay rates for each waste component, weighted by its composition, is equal to the bulk MSW decay rate. For an assumed bulk MSW decay rate of  $0.04 \text{ yr}^{-1}$ ,  $k_{field}$  was estimated to be 0.298, 0.171, 0.015, 0.144, 0.033, 0.02, 0.122, and  $0.029 \text{ yr}^{-1}$ , for grass, leaves, branches, food waste, newsprint, corrugated containers, coated paper and office paper, respectively. The effect of landfill waste diversion programs on methane production was explored to illustrate the use of component-specific decay rates. 100% diversion of yard waste and food waste reduced the year 20 methane production rate by 45%. When a

landfill gas collection schedule was introduced, collectable methane was most influenced by food waste diversion at years 10 and 20, and paper diversion at year 40.

### **Small-Scale LFGTE System Design: A Case Study**

*Tim Kelly, Joyce Engineering & Steve Cox, GkW Energy*

This presentation focuses on developing financially viable landfill gas projects at small or closed landfills (<2 million tons). Traditionally, landfill gas projects at these facilities have not been considered financial viable due to the relatively small amount of landfill gas (<500scfm) available. A successful case study from central Virginia (Montgomery Regional Solid Waste Authority) will be discussed. This landfill recently won EPA's LMOP Small Project of the Year for 2010. Additionally, the presentation will outline a two-tier strategy utilized by Joyce Engineering to develop a successful project. Joyce Engineering currently has 6 projects following this strategy, all of which have landfill gas flow rates under 400 scfm. This discussion will present various options for creating a successful project including equipment selection and methods of revenue generation.

These options include the following

- Sale of carbon credits;
- On-site and off-site direct use;
- Electricity generation.

### **Implementing LFGTE on an Existing Landfill**

*Jerry Johnson, Waste Industries*

This will be a discussion involving the Owner's perspective on developing a Landfill Gas to Energy facility. We will look at the steps taken beginning with the economics of the project - meeting the bankers requirements on ROI, the design-choosing the right engineering firm or firms to assist in the project, permitting- working with the regulators to make sure that the project is an environmentally safe alternative to flaring the gas, construction contracts-look for experience, power purchase agreement from the utility and last but not least a long term maintenance contract with the engine manufacturer. Developing partnerships in this type of project is key to success. This is a 30 to 40 year endeavor. Proper planning and making the right decisions early in the game is crucial to meeting long term goals.

### **Current Landfill Gas to Energy Opportunities for Electricity Generation & Direct Use**

*Steve Hamilton, SCS Engineers*

Current landfill gas to energy opportunities associated with electrical generation and direct use projects, unique design issues that facilities face today, technologies being deployed to address gas pretreatment and air pollution controls, and LFGE economics. He will also discuss the design of the Waste Industries LFGE project.

# speaker bios

**TAREK AZIZ** is Teaching Assistant Professor in the Department of Civil, Construction, and Environmental Engineering at North Carolina State University. He received a B.S. and M.S. in Civil Engineering from Clemson University and his Ph.D. in Civil Engineering from North Carolina State University. Dr. Aziz joined the Dept. of Civil, Construction, and Environmental Engineering faculty in January of 2010 and currently teaches in Environmental Engineering and Water Resources. Dr. Aziz is interested the interface of environmental process engineering and energy. His current research efforts focus on: (1) The computational and experimental assessment of grease abatement devices, (2) Enhancing biogas production through anaerobic co-digestion of oily waste, and (3) The use of life-cycle assessment tools to quantify environmental differences in waste disposal options.

**MORTON BARLAZ** is Professor and Head of the Department of Civil, Construction, and Environmental Engineering at North Carolina State University. He received a B.S. in Chemical Engineering from the University of Michigan and an M.S. and Ph.D. in Civil and Environmental Engineering from the University of Wisconsin. He has been involved in research on various aspects of solid waste since 1983. Over this time, he has conducted research on biological refuse decomposition, methane production, and the biodegradation of hazardous wastes in landfills. He has participated in two state-of-the-practice reviews of bioreactor landfills. His research forms the basis for much of the work done to assess the impact of landfills on methane emissions inventories. Dr. Barlaz is also recognized for his research on the use of life-cycle analysis to evaluate environmental emissions associated with alternate solid waste management strategies. Dr. Barlaz is the author of over 90 peer-reviewed publications and has made over 200 presentations at conferences throughout the world. In 1992 he was awarded a Presidential Faculty Fellowship from the National Science Foundation. Dr. Barlaz has been active in service throughout his career. He is an Associate Editor for two journals (Waste Management and Journal of Environmental Engineering) and serves as co-chair of the bi-annual Intercontinental Landfill Research Symposium. He has served as chair of the Government Affairs Committee and the Lectures Committee for the Association of Environmental Engineering and Science Professors. Finally, he

serves on the Science Advisory Committee for the International Waste Working Group.

**JEFF CHANTON** is a Gulf Coast Native, born in New Orleans, Louisiana. He received his PhD from the University of North Carolina at Chapel Hill. Awards include the title of Distinguished Research Professor and the John Winchester Professorship. He is an Aldo Leopold Fellow and was named the Florida Wildlife Federation's Conservation Communicator of the year in 2005. He has authored or co-authored over 160 papers in the peer reviewed literature and received over 50 grants and contracts to support his research. Chanton works on a variety of research problems that involve fluxes of greenhouse gases methane and carbon dioxide, sulfur chemistry, isotopic chemistry and groundwater issues. He has worked on methane emission issues since 1985 and on landfill gas issues since 1995. He developed the stable isotope approach for in situ determinations of methane oxidation.

**STEVE COX** is currently President of GkW Energy, Inc. and a Research Associate in the Virginia Tech Department of Civil and Environmental Engineering. He previously worked as a manufacturing engineer in the automotive industry for six years and then for four years as an air quality compliance project manager with an environmental consulting firm.

**CHRIS GODLOVE** manages domestic and international programs in support of the U.S. EPA LMOP, covering the mid-Atlantic and northeastern regions of the United States and programs in Brazil and Southeast Asia. Prior to joining LMOP, Chris worked with the Clinton Climate Initiative where he forged partnerships with cities around the world to develop GHG mitigation projects in the waste, water, and wastewater sectors. Chris has worked for both private and non-profit organizations for over 10 years, implementing projects and programs centered on energy and environment. This included managing program implementation for the Alliance to Save Energy, Environmental Export Council, and the U.S. Environmental Training Institute. Chris has a B.A. from Washington University, St. Louis and an M.A. in International Relations from American University, Washington DC. He is also a Certified Energy Manager with AEE.

**STEVE HAMILTON** has over 30 years of environmental project experience, with particular emphasis in solid waste management. Mr.

Hamilton's project experience ranges from hands-on participation in field and design work to direction of solid waste management projects. This work has involved over 500 projects on more than 300 sites throughout the United States and in Brazil, Chile, China, Colombia, Egypt, India, Jamaica, México, Panama, Poland, and Puerto Rico. His project responsibilities have included solid waste planning; solid waste privatization; landfill siting, design, and operations and closure permits and plans; landfill contamination assessments and remedial actions; landfill leachate monitoring and treatment system design; landfill groundwater and landfill gas (LFG) monitoring programs; landfill Clean Air Act (CAA) permitting and compliance; LFG Clean Development Mechanism (CDM) projects, LFG-to-energy (LFGE) recovery feasibility due diligence, studies, and investigations; and the testing, design, installation, and operation of LFGE facilities and LFG migration and emission control systems. Mr. Hamilton currently serves as Director of SWANA's Landfill Gas Training Program. He has extensive experience in providing solid waste training and education at numerous venues in the United States, and in Egypt, India, Jamaica, México, and Poland.

**PAUL IMHOFF** is an Associate Professor in the Department of Civil and Environmental Engineering at the University of Delaware, Newark, DE, USA. Dr. Imhoff received his degrees in Civil and Environmental Engineering at the University of Cincinnati (BS), University of Wisconsin (MS), and Princeton University (MA, PhD). Dr. Imhoff is a recipient of the National Science Foundation Career Award, the Editors Award from the *Journal of Environmental Engineering*, and outstanding reviewer awards from *Waste Management*. Dr. Imhoff's teaching and research interests are in several areas of environmental engineering, but in general focus on the movement of fluids and mass transfer processes in porous media. He has worked for over 15 years on the impact of nonaqueous phase liquids (NAPLs) (e.g., gasoline) on groundwater. In the last 7 years he has employed field, laboratory, and computer modeling techniques to understand and describe the movement of gas and liquid in landfills and to advance technologies for improved capture of landfill gas. Methane oxidation in biologically active cover soils and measurements of airborne methane emissions are the focus of ongoing research projects. Dr. Imhoff's research is supported by the National Science Foundation (NSF), Department of Energy (DOE), California Department of Resources Recycling and Recovery, Environmental Research and Education Foundation (EREF), and the Delaware Department of Transportation.

**JENNA JAMBECK** is an Assistant Professor in Environmental Engineering at the University of Georgia. She received her PhD from the University of Florida in 2004, was an ORISE post-doc at the US EPA ORD in Research Triangle Park, North Carolina and was a Research Assistant Professor at the University of New Hampshire before moving to Georgia. She has conducted research on solid waste related issues over ten years, including marine debris, construction and demolition debris, wallboard, chromated copper arsenate (CCA)-treated wood, abrasive blasting media, mining waste, bioreactor landfills, hydrogen sulfide generation and treatment in landfill gas and leachate treatment with microbial fuel cells. She also has direct experience conducting life cycle assessments (LCA) for analyzing solid waste management options. She is currently leading a new NOAA partnership called the Southeast Atlantic Marine Debris Initiative with Georgia, North Carolina and South Carolina which includes using culturally relevant technology with an exciting new mobile smartphone app (*Marine Debris Tracker*) that serves as a worldwide tool for marine debris data collection.

**JERRY JOHNSON** is currently Vice President of Capital Projects for Waste Industries. He studied Civil Engineering at Wake Technical Community College - Civil Engineering in Raleigh, NC. He has 37 years of varied experience in Transportation, Construction, Recycling and Waste Management. Eighteen of the thirty seven years have been in waste management roles.

2008-Current: Vice President of Capital Projects - Waste Industries, USA

2000-2008: Vice President of Landfill Division for Waste Industries, USA

1995-2000: General Manager of Virginia and New York operations for Atlantic Waste Disposal - Brambles of Australia.

1991-1995: Manager Recycling Division and Field Support Services - Waste Industries, USA

1977-1991: Area Manager -- Reynolds Aluminum Recycling Company covering a four state area (NC, SC, VA and West Virginia)

**TIM KELLY** brings over 19-years of civil and environmental engineering experience to Joyce Engineering, Inc. He has spent the last 7 years at Joyce Engineering designing landfill gas to energy projects, storm water conveyance and detentions systems, Subtitle D landfill design, evaluation of solid waste generating facilities, preparation of corrective action plans (CAPs), and Clean Air Act (CAA) Title V air quality permitting. Dr. Kelly currently serves on the Research Council of the Environmental Research and Education Foundation (EREF) as well as participating on other technical committees.

**JAMES LEVIS** is a PhD candidate in the Department of Civil, Construction, and Environmental Engineering at North Carolina State University. He received a B.S. in Mechanical Engineering from Carnegie Mellon University and an M.S. in Civil Engineering from North Carolina State University. He is currently a Fiessinger Scholar through the Environmental Research and Education Foundation. His research focuses on systemic analyses of solid waste management processes and systems, with a concentration on how climate change policies and energy system alterations will affect the costs and environmental impacts of solid waste management operations. His dissertation work is aimed at developing a multi-stage integrated life-cycle optimization model to estimate the costs, energy use, emissions, and environmental impacts associated with SWM systems under various greenhouse gas pricing schemes. Mr. Levis intends to graduate with his PhD in 2012.

**JEREMY MORRIS** has over 16 years of professional and academic experience in the field of solid waste management, with particular expertise in issues relating to waste disposal by landfill. His Ph.D. research work involved investigating methods for enhancing waste degradation and landfill gas generation at water deficit landfills in South Africa, and field measurement and modeling of fugitive greenhouse gas emissions through landfill covers. Since joining Geosyntec in 2001, he has provided technical design and project management services during permitting and construction of new landfills and lateral or vertical landfill expansions at numerous sites around the country and internationally. His technical specialties include landfill closure and post-closure care, waste characterization, and leachate characterization and treatment. He also has experience with landfill gas management and utilization, feasibility analyses for landfill-based renewable energy technologies, and sustainable approaches to landfill development and long-term management and remediation of closed sites. From 2002 - 2006, Jeremy led Geosyntec's work on development of the EPCC Methodology for EREF. Since 2007, he has conducted ongoing assignments for EREF and EREF's industry members to critically assess and improve the methodology for application in the U.S. and Europe.

**DEBBIE REINHART** is Pegasus Professor at the University of Central Florida which she joined 1989. She is currently the UCF Assistant VP for Research and Commercialization. Dr. Reinhart received her B.S. in Environmental Engineering from UCF and M.S. and Ph.D. degrees in Environmental Engineering from the Georgia Institute of Technology. During the past twenty-two years, she has been teaching and conducting research in solid

and hazardous waste management. Dr. Reinhart has served on the boards of the American Academy of Environmental Engineers and a national research foundation (the Environmental Research and Education Foundation). In 2009 she was president of the American Academy of Environmental Engineers. She has served as a reviewer for more than 30 journals and organizations. She is a registered professional engineer in Florida and Georgia, a Board Certified Environmental Engineer, a Fellow of the American Society of Civil Engineers, and a Fellow of the American Association for the Advancement of Science. She has been on the editorial board for four archival journals and is currently Associate Editor for *Waste Management*.

**BRYAN STALEY** currently serves as President and CEO of the Environmental Research and Education Foundation. He joined the EREF 3 years ago, where he started as vice-president of environmental programs, and has 17 years experience in the environmental engineering field. He obtained a Ph.D. in solid waste research at North Carolina State University and is also a licensed professional engineer. Dr. Staley has held key positions in consulting firms as a project manager and vice-president of engineering where he managed projects related to wastewater treatment system design, retail/commercial land development, stormwater design/permitting and large-scale livestock operations.

**SUSAN THORNELOE** is a chemical engineer in the Emissions Characterization & Prevention Branch that helps to develop and apply new technology for characterizing emissions. Susan's current research focus is to evaluate the fate of metals in air pollution control residues from coal-fired power plants. Susan has led the development and application of the Leaching Environmental Assessment Framework (LEAF) which is improving and standardizing leach testing. Susan has been with EPA since 1984 and has been awarded over 25 EPA awards including 7 Bronze medals for her leadership and innovation in finding more efficient and effective solutions to environmental management. She has led the application of life-cycle assessment in providing a more holistic approach to environmental management of waste and materials. One of Susan's first jobs with EPA was to characterize, model, and measure emissions from municipal solid waste landfills. Today, Susan will talk about the EPA's Perspective on Landfill Gas to Energy and the importance of effective gas management and control.





**Environmental Research  
& Education Foundation**

*Lighting a path to sustainable waste management practices*

[www.erefdn.org](http://www.erefdn.org)