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

April 27 – 28, 2011
Omni Severin Hotel
Indianapolis, Indiana

PROGRAM

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- LANDFILLS
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- 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 activities are located in or adjacent to the Fisher Ballroom

DAY ONE (9 am – 5:15 pm)

Welcome/Introduction to the EREF
Bryan Staley, EREF

Trends Affecting the Solid Waste Industry
Bryan Staley, EREF

EREF's Research Program
Todd Watermolen, Veolia

Solid Waste Management and Engineering: The Role of Research in Improving Performance
Mort Barlaz, NCSU and Tim Townsend, UF

BREAK/NETWORKING (10:20 - 10:40 am)

Sustainability and Solid Waste Management Decision Making
Jim Levis, NCSU (EREF Scholar Highlight)

Lysimeters vs. Actual Covers: Implications for Permitting Evapotranspirative Final Covers
Miles Khire, MSU

Geophysical Monitoring of Leachate Recirculation & Its Effects on Waste at Orchard Hills Landfill
Krishna Reddy, UIC

LUNCH/NETWORKING (12:10 - 1:25 pm)

Determining critical data for implementing and improving the EPCC Methodology
Jeremy Morris, Geosyntec

Yolo County's Research Program: Summary of Recent Research Projects
Ramin Yazdani, Yolo County (EREF Scholar Highlight)

BREAK/NETWORKING (2:55 - 3:15 pm)

Landfill Gas Modeling and Carbon Balance Analysis
Mort Barlaz, NCSU

Assessing Landfill Gas Collection Efficiency & Landfill Processes with Gas Tracers and Numerical Modeling
Paul Imhoff, UD

Advances in Landfill Fugitive Emission Measurements: the Benefits of Collaborative Research
Eben Thoma, US EPA

A New Field-Validated Model for Site-Specific Landfill Methane Emissions
Jean Bogner, UIC

DAY TWO WORKSHOPS (8:30 am – 5 pm)

Safe & Effective Disposal of Secondary Aluminum Wastes (8:30 am – 12 pm)

Aluminum Waste Disposal Field Issues & Introduction
Panel Discussion

Ongoing Research & Studies
Thabet Tolaymat, US EPA ORD

Developing Model Practices and Research Direction
Panel Discussion

LUNCH/NETWORKING (*ON YOUR OWN,* 12 – 1:30 pm)

Bioreactor Landfills – State of Practice & Research (1:30 pm – 5 pm)

Session Introduction & Bioreactors 101
Mort Barlaz, NCSU and Tim Townsend, UF

The State-of-the-Practice
Chris Bareither, UW and Mort Barlaz, NCSU

Industry Experience
Roger Green, WM and Thabet Tolaymat, US EPA ORD

Regulatory Perspective
Craig Dufficy, US EPA and Rebecca Geyer, US EPA Region 5

Research Directions
Tim Townsend

Question & Answer Session

speaker abstracts

Monitoring of Leachate Recirculation and its Effects on Municipal Solid Waste at Orchard Hills Landfill

Krishna R. Reddy, Ph.D., P.E.
Department of Civil and Materials Engineering
University of Illinois-Chicago

Bioreactor landfills or leachate recirculation landfills are increasingly being considered at several municipal solid waste (MSW) landfills to increase moisture content of the waste, resulting in benefits such as faster waste degradation, rapid increase in landfill volumetric capacity, and enhanced landfill gas recovery. However, methods to monitor the leachate distribution and its effect on MSW are not well established, hence the effectiveness of current design and operational practices of leachate recirculation systems cannot be properly evaluated. This presentation will describe a comprehensive investigation undertaken to investigate different geophysical techniques to monitor leachate recirculation at Orchard Hills landfill located in Davis Junction, Illinois. The techniques included electrical resistivity tomography, electromagnetic surveys, ground penetrating radar, seismic surveys, and well logging. Complementing the geophysical investigations, boreholes were drilled through MSW in the vicinity of leachate injection locations, and MSW samples were collected at different depths and tested for composition and particle size distribution, moisture content, volatile solids, biochemical methane potential, and hydraulic and mechanical properties. Based on all of these results, suitability and challenges of using different methods to monitor leachate recirculation are identified.

Advances in Landfill Fugitive Emission Measurements: The Benefits of Collaborative Research

Eben D. Thoma , *Office of Research and Development, National Risk Management Research Laboratory, U.S. EPA*

The U.S. EPA Office of Research and Development has several research efforts underway to develop and apply cost-effective methods for quantification of greenhouse gas emissions from difficult to measure sources such as landfills. These collaborative efforts are conducted with an array of partners including the landfill industry, EREF, and academia. Over the last five years, much progress has occurred in use of optical remote sensing (ORS) and remote mobile measurement approaches providing new insight into the complex nature of landfill emissions. This presentation will briefly outline two measurement methods, EPA OTM 10 which is an ORS method for measurement of a potion of landfill surface and the complimentary tracer correlation approach that may provide rapid assessment of whole-facility emissions. In addition to describing these measurement approaches and plans for future work, the benefits of collaborative methods development research will be discussed.

Yolo County's Research Program: Summary of Recent Research Projects

Ramin Yazdani
Yolo County Planning and Public Works Department

Two research studies were performed at the Yolo County Central Landfill. The objective of the first study was to quantify the degree of anaerobic degradation and methane generation during full-scale aerobic bioreactor landfilling and the mechanisms limiting aerobic activity. The objective of the second study was to construct, operate, monitor and evaluate the performance of a low cost landfill-based two-stage (anaerobic/aerobic) batch digester cell for treatment of source separated green waste and aged horse manure, while recovering energy and compost.

Landfill Gas Modelling: Estimation of Landfill Gas Decay Rate Constants and Yields for Individual Waste Components Using Laboratory-Scale Data

Morton A. Barlaz* and Florentino B. dela Cruz
Department of Civil, Construction, and Environmental Engineering
North Carolina State University

The manner in which landfill gas is managed plays a dominant role in a landfill carbon balance. The objective of this presentation is to provide an overview of a landfill carbon balance to illustrate the importance of landfill gas production and collection modeling. This will serve as the basis for the presentation of new concepts in landfill gas modeling in which a gas production model is linked to waste composition and component-specific decay rates and methane yields. The use of an updated gas production model is then illustrated to assess the impact of various organics diversion scenarios on methane production and collection at a hypothetical landfill.

Assessing Landfill Gas Collection Efficiency and Landfill Processes with Gas Tracers and Numerical Modeling

Paul T. Imhoff[1], Ramin Yazdani[2], Don Augenstein[3], and Pei Chiu[1]
[1]Department of Civil and Environmental Engineering, University of Delaware
[2] County of Yolo, Public Works Department, Division of Integrated Waste Management
[3]Institute for Environmental Management (I E M), Inc

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.

Lysimeters vs. Actual Covers: Implications for Permitting Evapotranspirative Final Covers

Milind V. Khire, Ph.D., P.E.,
Department of Civil & Environmental Engineering
Michigan State University

Evapotranspirative (ET) or earthen covers have been tested since late 1980s and have been permitted for municipal solid waste landfills (MSW) since mid 1990s. Often approval of ET covers requires field-scale demonstration of relatively low deep infiltration (percolation) from the cover into the underlying waste. Lysimeters are used to measure the percolation. However, lysimeters contain a drainage boundary to collect percolation which does not exist at that location in an actual cover, which if built, is underlain by MSW. Hence, the hydrology and hydraulics of lysimeters and actual covers is not the same. In order to evaluate the critical differences, field-scale test section of an ET cover was constructed and instrumented at a landfill located in Detroit, Michigan. The design of the test section allowed hydrologic and hydraulic comparison of lysimeter versus the corresponding actual cover. This presentation will focus on the design of the test sections, field-scale testing and monitoring, numerical modeling, and practical implications of the results.

Sustainability and Solid Waste Management Decision Making

Jim Levis
Department of Civil, Construction, and Environmental Engineering
North Carolina State University

In 2009, U.S. solid waste management (SWM) systems processed roughly 240 million tons of waste, resulting in 134 Tg of CO_2e emissions, which represents 2% of total greenhouse gas emissions. Landfills, which received 54% of municipal solid waste in 2008, represented the third largest source of anthropogenic methane in the U.S. An impending national GHG mitigation policy will place a price on GHG emissions and drive significant changes in energy supply and prices, which will in turn have a strong influence on the SWM system. Systematic analysis of SWM—from unit processes to integrated programs—will identify opportunities for cost-effective GHG mitigation. The resulting changes in SWM programs could have latent consequences, so it is imperative to evaluate the environmental sustainability of SWM by performing a multi-pollutant analysis.

Given the complexity of climate change mitigation, there is significant potential for unintended consequences. This is particularly true in regard to SWM, which consists of complex relationships among a multitude of individual processes as well as competing management objectives. As the cost of energy and GHG emissions increase in response to GHG policy, the relative cost-effectiveness of SWM options will change, consequently altering the optimal waste material flows as well as technology and process selections in future SWM programs. This research aims to answer the following: Given that future SWM is likely to be driven by the price effects of a GHG policy, how will GHG emissions and other pollutant discharges be affected and what are the key tradeoffs among them? Rigorous analysis of SWM system response under a GHG mitigation policy requires a modeling framework that links detailed process-level operations to an aggregate SWM strategy and to the larger energy system. The proposed framework will include an integrated life-cycle optimization model to estimate the costs, energy use, emissions, and environmental impacts associated with SWM processes.

A New Field-Validated Model for Site-Specific Landfill Methane Emissions

J. Bogner[1], K. Spokas[2], M. Corcoran[3], J. Chanton[4], G. Franco[5]
[1]University of Illinois at Chicago, Chicago IL
[2]U.S. Dept. of Agriculture/Agricultural Research Service (ARS), St. Paul MN
[3]University of Illinois at Chicago, Chicago IL
[4]Florida State University, Tallahassee FL
[5]California Energy Commission, Sacramento CA

Atmospheric methane (CH_4) has multiple anthropogenic sources with high uncertainties, including rice production, ruminant animals, natural gas leakages, biomass burning, and landfills. We have developed a new field-validated inventory model which decouples landfill methane emissions from a theoretical first order kinetic model for CH_4 generation potential. The model (CALMIM, CAlifornia Landfill Methane Inventory Model) is a freely-available, user-friendly JAVA tool which estimates net CH_4 emissions to the atmosphere for any landfill cover soil over a typical annual cycle, including (1) the effect of engineered gas extraction; (2) the physical effects of daily, intermediate, and final cover materials to retard emissions; and (3) seasonal soil moisture and temperature effects on both gaseous transport and methanotrophic CH_4 oxidation. Linking site-specific data with existing globally-validated USDA models for annual climate and soil microclimate (Global TempSim; Global RainSim; Solarcalc; STM^2), this model relies on 1-D diffusion as the major driver for emissions. Importantly, unlike current inventory methods based on modeled generation, the driving force for emissions (e.g., the CH_4 concentration gradient) can be directly compared to field data. Methane oxidation is scaled to maximum rates over the full range of moisture and temperature conditions based on extensive supporting laboratory studies using California landfill cover soils. Field validation included meteorological data, soil moisture/temperature measurements, and seasonal (wet/dry) CH_4 emissions & oxidation measurements for daily, intermediate, and final cover soils over two annual cycles at a northern (Monterey County) and southern California (Los Angeles County) landfill, as well as more limited data from three additional California landfills. In addition to regional defaults for inventory purposes, CALMIM permits user-selectable parameters and boundary conditions for more rigorous site-specific applications where detailed

CH_4 emissions, meteorological, and soil microclimate data exist. The current model also accommodates many types of alternative cover materials.

CALMIM was developed and field-validated during a 3-year project (2007-2010) supported by the California Energy Commission PIER (Public Interest Energy Research) Program. Because the embedded meteorological and soil microclimate models have been globally validated at the 0.5^{o} X 0.5^{o} latitude-longitude scale, this model is also applicable to sites outside of California. During 2011-2012, EREF is supporting expanded field validation of CALMIM in cooperation with several U.S. and international research groups. CALMIM is compliant with IPCC Tier III "validated higher quality" methods. The current version (CALMIM 4.3) and manual are available at www.ars.usda.gov [follow links to "Products and Services", then to "Software"].

Determining Critical Data for Implementing and Improving the EPCC 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.

DAY 2 WORKSHOPS

Workshop #1: Safe & Effective Disposal of Secondary Aluminum Wastes (8:30 am – 12 pm)

Aluminum Waste Disposal Field Issues & Opening Discussion (60 min)

A team approach was utilized to resolve environmental, operational and regulatory issues involving a complex subsurface aluminum dross reactions at a landfill. An overview of these issues will be presented along with a firsthand account of the approach taken to resolve them by principal actors who were involved in the process.

Panelists:

Clarke Lundell, Republic Services (moderator)
Kurt Princic/Joshua Adams, Ohio EPA
Peter Augustin, AEG
Paul Ruesch, US EPA Region 5
Michael Darnell, Republic Services
Mike Beaudoin, CEC

Ongoing Research & Studies (45 min) – *Thabet Tolaymat, US EPA ORD*

An overview of available research to date on aluminum dross disposal will be presented followed by an in-depth discussed of an EREF funded project exploring the hypothesized reactions that occur when aluminum waste is disposed.

Developing Model Practices and Research Direction (90 min)

Presentations will be given by industry personnel summarizing current aluminum waste disposal practices at existing landfills. These presentations will be followed by a panel discussion on developing model practices for aluminum waste disposal as well as identifying directions for research needed. Research needs, as well as how they must be translated into practical action, will be discussed with facilitated Q&A from the audience.

Panelists:

Dr. Bryan Staley, EREF (moderator)
Dr. Tim Stark, Univ. of Illinios-Chicago
Dr. Mort Barlaz, NCSU
Brad Hartz, Veolia
Dr. Thabet Tolaymat, US EPA ORD
Paul Ruesch, US EPA Region 5
Pam Allen, Ohio EPA

LUNCH/NETWORKING (On Your Own, 12 – 1:30 pm)

Workshop #2: Bioreactor Landfills – State of Practice & Research (1:30 – 5 pm)

Session Introduction & Bioreactors 101 (25 min) – *Mort Barlaz, NCSU & Tim Townsend, UF*

A basic introduction of bioreactor landfills and the history of the bioreactor landfill concept will be provided.

The State-of-the-Practice (60 min) – *Chris Bareither, UW and Mort Barlaz, NCSU*

The current state of bioreactor landfill practice will be summarized that highlights how prior research and implementation of that research has advanced the bioreactor landfill concept.

Industry Experience (60 min) – *Roger Green, Waste Management and Thabet Tolaymat, USEPA ORD*

Industry perspectives on bioreactor landfills will be provided that highlight lessons learned at field scale.

Regulatory perspective (30 min)

State of legislative affairs and RDD rule - *Craig Dufficy, US EPA*

State/region perspective - *Rebecca Geyer, US EPA Region 5*

Research Directions (30 min) - *Tim Townsend, UF*

Question & Answer Session (30 min)

speaker bios

Joshua Adams has been an Environmental Specialist II/Inspector with Ohio EPA, Division of Solid and Infectious Waste Management (DSIWM) Northeast District Office (NEDO) since March 2006. He was assigned as the lead inspector/field lead for Countywide Recycling and Disposal Facility (CWRDF) since early 2006 and is directly involved in each step of the process, including: co-writing and reviewing numerous Director's Final Findings and Orders (DFF&Os), Memos of Understanding (MOUs), consent agreements, and complaints; overseeing remediation work including capping, well drilling, installation of monitoring instrumentation, excavation of waste, and sampling; writing/reviewing/revising operations, maintenance and monitoring (OM&M) plan; reviewing weekly/monthly/quarterly/etc. activity and progress reports; conducting frequent field inspections; overseeing mass waste excavation projects (Isolation Break in 2008-2009 and South Slope Excavation 2011). With respect to Exit C&D he developed and reviewed action plan to maintain and monitor site; installed numerous piezometers and temperature/gas quality monitoring points surrounding a "hot" area; coordinates activity between contractor, state and county agencies; and coordinates sampling events to gain information on future leachate disposal options. Mr. Adams' A&L Salvage experience consists of participating in agency site visits and installing numerous temperature/gas quality monitoring points throughout site. He is a member of Ohio EPA's Landfill Fire Resource Group whose charter is to "develop expertise for identifying, monitoring, and responding to subsurface fires at all types of landfills (MSW, RSW, ISW, and C&DD)."

Peter Augustin is one of the founding Members and serves as Treasurer of American Environmental Group, Ltd. Mr. Augustin has over 21 years of experience in the solid waste and environmental industry. Prior to his entry into the solid waste industry, he was involved in heavy civil, specialty foundation, and underground utility construction. Mr. Augustin has been responsible for the development and management of several large scale design-build solid waste construction projects including landfill closures, groundwater remediation, slurry trench containment systems and green field landfill site developments. He holds a BS degree in Civil Engineering from the University of South Florida.

Chris Bareither received his BS in geological engineering in 2004 from the University of Idaho. He did his graduate work at the University of Wisconsin-Madison (UW) in geological engineering, and completed my MS in 2006 and my PhD in 2010. His research at UW has focused on the mechanical properties of geomaterials, particularly the shear strength of naturally occurring sands and gravels and compression mechanisms of municipal solid waste. He is currently a research associate and instructor at the University of Wisconsin-Madison**.**

Morton A. 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.

Michael Beaudoin is a Principal with Civil & Environmental Consultants, Inc. in the Detroit, Michigan area. He has a Masters Degree in Civil Engineering with an emphasis on geotechnical engineering from Purdue University. He has over 30 years of experience in the solid waste management and recycling field including: siting, planning, design, compliance management, construction inspection, construction management, closure, remediation, financial analysis, due-diligence, presentation at public hearings, and expert testimony. He has developed a national reputation for negotiating difficult projects through the regulatory approval process.

Jean Bogner is a Research Professor at the University of Illinois at Chicago and President of Landfills +, Inc. She has more than 30 years experience with field and laboratory research related to landfill gas generation, emissions, migration, and recovery. She was the Coordinating Lead Author for the chapter on Waste Management for the 2007 Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report Working Group III (Mitigation). In 2007 the IPCC was awarded the Nobel Peace Prize with former Vice President Al Gore. Formerly, she worked at Argonne National Laboratory for more than 20 years. In addition, she works extensively with U.S. and international landfill gas recovery and utilization projects, including Clean Development Mechanism (CDM) projects in developing countries.

Michael Darnell is the Division Manager Republic Services' Countywide Remediation Unit located in East Sparta, Ohio. Mr. Darnell's primary responsibilities include construction management, data collection and evaluation, technical decisions, reporting, and all aspects of compliance with the Operations, Monitoring and Maintenance Plan for the 88-acre Remediation Unit as required by Federal, State, and local agencies. He is experienced in the areas of landfill gas and leachate system management, as well as the unique challenges that aluminum dross reactions present to solid waste facilities. Mr. Darnell has been intricately involved with daily site operations, construction, and regulatory management of the reaction area and has represented Republic Services remediation effort to Stark County Health Department, Ohio EPA and Federal EPA. He was able to reduce the scope of cited monitoring requirements initiated in the State Findings and Orders and instate an Operations and Maintenance Monitoring Plan that constituted a significant reduction and cost savings in enforced monitoring requirements that continues to be the regulatory standard for the cells affected by the dross reaction. Mr. Darnell specializes in proactively identifying dross reaction movement and has significant experience in the development of safe construction practices associated with dross reactions.

Craig Dufficy is the lead Environmental engineer on Bioreactor development for the United States Environmental Protection Agency. He is responsible for developing new Federal Regulations on the design and operation of Bioreactor landfills under 40 CFR Part 258. He is currently on the coal combustion residual site assessment team to determine structural integrity at electric utilities ash pond impoundments nationwide.

Rebecca Geyer is an Environmental Scientist with EPA Region 5 serving Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota and 35 Tribal Nations. Rebecca has been with the EPA for over three and half years working in the Land and Chemicals Division. She currently focuses on a variety of solid waste disposal projects and emergency response activities. Previously, Rebecca worked with Ohio EPA for two years in their Division of Surface Water. She holds a B.S. in Biology from Denison University.

Roger Green is a scientist with Waste Management, Inc., in Cincinnati, Ohio. His responsibilities include: the development and evaluation of chemical and biological processes for waste treatment and remediation and providing technical support to the company's soil bioremediation facilities and bioreactor landfill projects. He is involved in the company's work on greenhouse gas emission quantification and modeling and biologically active landfill cover systems. Mr. Green has been employed by Waste Management since 1993. He earned Bachelor of Science and Master of Science degrees from the University of Cincinnati.

Brad Hartz is currently the Senior Regional (Eastern) Engineer for Veolia Environmental Services – Solid Waste North America. He has over 25 years of professional experience in the solid waste industry, environmental consulting, the mining industry, and the construction industry. Mr. Hartz's focus has been on the construction of waste disposal facilities. His areas of expertise consist of the management and supervision of projects that include: the construction of solid waste disposal facilities; wetland mitigation, permitting and construction; the supervision of regional geologic/hydrogeologic studies to determine the potential for solid waste landfill development; and the completion of required state and federal permits associated with the design, construction, and operation of waste facilities. In the mining industry Mr. Hartz was responsible for the engineering, exploration, mineral evaluation, financial analysis, mine design, permitting, budgeting, regulatory compliance, and governmental affairs for mining operations in Indiana, Illinois, Kentucky, Missouri, and Pennsylvania. In addition, Mr. Hartz has experience in the construction industry having served as Vice President and General Manager of a construction/mining company. Mr. Hartz received a B.S. in Mining Engineering from the Pennsylvania State University and an M.B.A. from Indiana Wesleyan University. He is also a registered Professional Engineer in Indiana, Ohio, Kentucky, Illinois, and Missouri. Mr. Hartz is a member of the Society of Mining Engineers, served on the Board of Directors (Chairman) of the Indiana Coal Mining Institute, served as the President of the Citizens Advisory Committee of the West Central (Indiana) Solid Waste Management District, and the Indiana Manufacturing Association's Environmental Policy Committee.

Joe Holland has been an Environmental Specialist II for Ohio EPA since 1995. Prior to that he served as District Sanitarian for the Ohio Department of Health for ten years .

Milind V. Khire is an Associate Professor at Michigan State University. He received his PhD at the University of Wisconsin-Madison. He has worked on landfill and waste related projects for over 20 years as a consultant, researcher, and as an instructor of undergraduate, graduate, and professional courses. He has published over 75 technical papers, and three edited books related to soil, water, and waste. He has been awarded three U.S. patents on technologies he developed to extract gas from landfills, treat landfill leachate, and measure in-situ properties of landfills and soils in real-time using sensors. He is a recipient of the Croes Medal and Exemplary Service Award from the American Society of Civil Engineers.

Jim Levis is a Ph.D. Candidate at North Carolina State University. His research focuses on systemic analyses of solid waste management processes and systems, with particular focus on how climate change policies and changes to the energy system will affect the costs and environmental impacts of solid waste management operations. My 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 the processes that constitute the SWM system under various greenhouse gas pricing schemes.

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'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.

Jeremy Morris is a Senior Engineer at Geosyntec Consultants. He 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.

Kurt Princic has been with Ohio EPA Northeast District Office since 1991. He received his Bachelor Degree in Environmental Engineering Technology from the University of Dayton and a Master Degree in Public Administration from Cleveland State University. Kurt has over 19 years of experience in the solid waste program and has served as an Environmental Specialist II and as an Environmental Supervisor and Manager in the Division of Solid and Infectious Waste (along with 7 years as manager of the Division of Hazardous Waste Management). Kurt was recently promoted to District Chief of the Ohio EPA Northeast District Office.

Krishna R. Reddy is a Professor of Civil and Environmental Engineering and the Director of Geotechnical & Geoenvironmental Engineering Laboratory at the University of Illinois, Chicago. His research expertise is Waste Management, Landfill Design, Environmental Site Remediation, Groundwater Flow and Contaminant Transport Modeling, and Sustainability Engineering. He is the co-author of the widely used book: "Geoenvironmental Engineering: Site Remediation, Waste Containment & Emerging Waste Management Technologies", published by John Wiley, 2004. He has received the University of Illinois Scholar Award, ASTM Hogentogler Award and several other awards for excellence in research and teaching. He received Ph.D. in Civil & Environmental Engineering from the Illinois Institute of Technology, Chicago, and he is a Registered Civil Engineer in Illinois and participated in several major geotechnical and environmental consulting projects.

Paul Ruesch currently works as an On-Scene Coordinator at Superfund time-critical removal sites and emergency responses in the Great Lakes Region. He has worked since 1991 as an environmental engineer in the RCRA solid waste program in which his principal responsibilities included implementation of Subtitle D, addressing challenged waste management sites, disaster debris planning & management, design & implementation of recycling programs as well as community-based environmental projects. He obtained a Bachelor of Science Degree in Civil Engineering from the University of Notre Dame in 1991 and established the 'Recyclin' Irish,' a volunteer-based recycling program for all residential, administrative and classroom buildings.. Mr. Ruesch also served as a Peace Corps volunteer in Mexico from 2004-2007 on a cooperative project with the National Council of Science & Technology and Petroleros Mexicanos (PEMEX) on remediation projects within the state-run oil refinery system and currently assists U.S. AID in continuing efforts to enhance the solid waste management system in Central America countries and Caribbean islands.

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.

Timothy Stark is a Professor at University of Illinois at Urbana-Champaign and has been conducting research on the behavior of landfill liner and cover systems and geosynthetics for the last twenty years. His research on static and seismic stability of waste containment facilities has lead to a better understanding of design values of geosynthetic interface strength for stability analyses, the importance of interim slope conditions in landfill operations, and three-dimensional slope stability analyses for the design of landfill slopes. He has contributed to guidance documents in Ohio and Missouri and consulted on a variety of landfill related topics. Dr. Stark also teaches courses on the Geotechnics of Landfill Design, Landfill Waste Fires, Static and Seismic Stability of Waste Containment Facilities, Introduction to Geosynthetics, and a short course "Geosynthetic Clay Liners for Waste Containment". He has received a number of wards for his research and teaching activities.

Eben Thoma is a scientist with EPA's Office of Research and Development, National Risk Management Research Laboratory in RTP NC. Dr. Thoma received his PhD in physics and laser spectroscopy from Wake Forest University in 1997. Dr. Thoma joined EPA in 2003 and his research interests include devolvement and application of advance measurement strategies for assessment of difficult to measure air pollution sources and the environmental applications of nanotechnology.

Thabet Tolaymat has worked for the U.S. EPA Office of Research and Development National Risk Management Research Laboratory in Cincinnati, Ohio since 2003. Currently, he leads EPA's national research program in the area of solid waste research. He also leads the National Risk Management Research Laboratory's research in the area of nanoparticles. His main research areas are fate and transport of engineered nanoparticles, solid waste management, bioreactor landfills, waste containment performance, construction and demolition waste landfills, fate and transport of environmental pollutants. More recently, Thabet started to evaluate best management practices for the disposal of aluminum dross. During his carrier with the EPA, Thabet was the recipient of three bronze medals for commendable services. In 2010, Thabet was awarded by EPA's administrator the USEPA's highest research award the "Science Achievement Award" for his work in the area of bioreactor landfills.

Timothy Townsend is a professor in the Department of Environmental Engineering Sciences at the University of Florida. He received his Doctoral degree from the University of Florida in 1995. Dr. Townsend's area of specialty in teaching and research is solid waste management. He teaches undergraduate and graduate students on a variety of waste-related topics, including landfill design and general solid and hazardous waste management. Areas of expertise include bioreactor landfills, construction and demolition debris, waste leaching, and management of special wastes. Past research efforts included examining the formation of odor-causing compounds as a result of drywall disposal in landfills and developing techniques for minimizing this problem. He has published over 100 technical publications on his research topics. He has consulted on landfill and solid waste issues throughout the US and abroad. Dr. Townsend is a registered professional engineer in Florida and currently serves as the Jones Edmunds Professor of Environmental Engineering at the University.

Todd Watermolen is Vice President of Engineering for Veolia Environmental Services. He is responsible for environmental compliance, as well as the development, permitting and engineering design of the company's North American Solid Waste facilities. These facilities consist of landfills, transfer stations, material recovery facilities and other alternative waste treatment alternatives. Watermolen participated in founding Superior Services (now Veolia ES Solid Waste, Inc.) in 1993. Watermolen has more than 26 years of experience in the environmental engineering industry and is a licensed professional engineer. He is a graduate of the University of Wisconsin-Madison, with both a B.S. and M.S. in Civil and Environmental Engineering. Watermolen is on the Research Council of the Environmental Research and Education Foundation and also participates in international R&D work within Veolia. He enjoys the outdoors, family, friends, and a spiritual foundation.

Ramin Yazdani is the Senior Civil Engineer in the Division of Integrated Waste Management at the Yolo County Planning and Public Works Department. Dr. Yazdani received his Ph.D. in Civil-Environmental Engineering from the University of California at Davis. He also holds an M.S. in Biological and Agricultural Engineering from University of California at Davis, and a B.S. in Agricultural Engineering from California Polytechnic State University. He is a registered Professional Engineer in California. His research and professional interests include biogas, anaerobic and aerobic bioreactors, anaerobic digestion of organic waste, biocover and biofilters for treatment of gas emissions, composting, and renewable energy. He has over 20 years of experience in environmental engineering applied research, design, construction and operation of various solid waste management projects. He has conducted numerous research and demonstration projects for state and federal agencies and has published numerous reports and articles in leading environmental engineering and science journals.

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