

WERF Research on the Treatment and Management of Residuals and Biosolids

On July 1, 2009, WERF began an open access policy for research reports which are more than two years old. These reports are free to the public as downloads from the [WERF Web site](#). These open access reports are marked in blue in the chart below.

Key Highlights:

- Almost a third of WERF's research projects have focused on the treatment and management of residuals and biosolids.
- This research is valued at over \$20 million. Two of the six programs in WERF's new program-directed research process launched in 2005 will continue work in this area – they include Solids Treatment, Residuals & Reuse and Wastewater Treatment & Reuse.
- Key subscriber challenges are related to residuals and biosolids, including the Operations Optimization research programs, and Biosolids Pathogen Risk and Communication.
- The biosolids TCR (Targeted Collaborative Research) program was set up by WERF to fund research on key biosolids-related issues identified in the 2003 WERF-EPA Biosolids Research Summit and by the TCR funding partners. Biosolids TCR funding partners include 12 WERF subscribers; each contributed between \$5,000 to \$50,000 per year for five years. To date, 55 projects have been completed and about 15 are ongoing.

Publication Year	Project Number and Project Title	Principal Investigator and Contracting Organization	Research Objectives
1992	90-4, (No Longer Available) Innovative Process Assessment: Sludge Processing, Disposal, and Reuse	Richard Kuchenrither, Ph.D., P.E. Black & Veatch Kansas City, MO	Provides an assessment of diverse research/ development projects regarding the treatment and disposal of biosolids.
1999	91-ISP-1 <i>Evaluating and Measuring Biosolids Incinerator Emissions</i> (Product No. D93006)	John Stukenberg, Ph.D., P.E. Black & Veatch Kansas City, MO	Developed a database on incinerator emission characteristics; users determine performance evaluation for various airborne contaminant control options (including hydrocarbons).
1993	91-ISP-4 <i>Document Long Term Experience of Biosolids Land Application Programs</i> (Product No. D0015)	John R. Stukenberg, Ph.D. Black & Veatch Kansas City, MO	Provides information on the beneficial use of biosolids in land application programs.
1993	91-ISP-5 <i>Polymer Characterization and Control in Biosolids Management</i> (Product No. D43007)	Steven Dentel, Ph.D., P.E. University of Delaware Newark, DE	Provides information on optimal usage of chemical conditioners for biosolids dewatering. Assesses automatic polymer feed equipment. Provides a formal protocol for making decisions on selecting polymers and estimating dosing rates.
1995	91-ISP-5A <i>Guidance Manual for Polymer Selection in Wastewater Treatment Plants</i> (Companion report to project	Steven Dentel, Ph.D., P.E. University of Delaware Newark, DE	Aids wastewater chemists, managers, and operators in the selection of polymers. Systematic processes for polymer selection are divided into modules for each type of polymer application with step-by-step guidance.

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	<i>above) (Product No. D0013)</i>		

1996	92-PUM-1C0,(Not available from WERF) <i>Long-Term Fate of Land Applied Wastewater Materials</i>	New York State Energy Research and Development Authority (cooperative project www.nyserda.org)	A collaborative program project that examines the long term effects of land application of biosolids products and evaluates the effects of using various forms of materials on land sites, including compost, pelletized products and liquid applications.
1997	94-REM-1 <i>Defining Biosolids Stability: A Basis for Public and Regulatory Acceptance (Product No. D72002)</i>	Michael S. Switzenbaum, Ph.D. Univ. of Massachusetts Amherst, MA	Provides information on biosolids stability criteria and recommends definitions for stability for various biosolids processes and products.
2000	94-REM-2 <i>Analysis and Fate of Polymers in Wastewater Treatment (Product No. D00301)</i>	Steven Dentel, Ph.D., P.E., DEE University of Delaware Newark, DE	Addresses the impact and fate of polymers used as flocculant agents in wastewater treatment. Evaluates when polymer release to the environment may be harmful. Examines analytical methods to detect polymer.
2004	95-REM-2 <i>Producing Class A Biosolids with Low Cost, Low Technology Treatment Processes</i>	Perry Schafer, P.E. Brown & Caldwell	Describes low tech treatment processes for producing Class A Biosolids. Class A biosolids have been and are now being produced by low-cost, low-technology biosolids treatment processes including lagoon storage, air drying, and cake storage. This project reviewed the available literature and municipal agency data about these processes.
1999	95-REM-3 <i>Understanding Fate, Transport, Bioavailability and Cycling of Metals (Molybdenum) in Land Applied Biosolids (Product No. D93017)</i>	George O'Connor, Ph.D. University of Florida Gainesville, FL	Improves understanding of risks and the pathways associated with metal uptake (focusing on molybdenum) in grazing animals. Enhances scientific knowledge base and provides information relative to EPA's Part 503 regulations on molybdenum.
1997	96-CTS-5 <i>Benchmarking Wastewater Treatment Plant Operations – Collection, Treatment, and Biosolids Management (Product No. D73001)</i>	Roger Patrick Water Research Center (WRC)	Derives performance standards for wastewater treatment operators to help focus their efforts, improve operations, and reduce costs. Highlights approaches, processes, and results that have been used by others to accomplish these objectives.
1998	96-REM-1 <i>Biosolids Management: Assessment of Innovative Processes (Product No. D83004)</i>	Albert Pincince, Ph.D., P.E. Camp, Dresser & McKee Cambridge, MA	Identifies and reports on the development, status and cost effectiveness more than 110 innovative biosolids processing and management technologies.
1999	96-REM-2 <i>Watershed Effects of Biosolids Land Application: Literature Review (Product No. D93003)</i>	Kathryn Draeger Environmental Ground, Inc., St. Paul, MN	Assesses available information (more than 1400 references spanning 100 years) on the uses and impacts of biosolids in watersheds.

2004	97-REM-2 <i>Pathogen Destruction Efficiency in High Temperature Digestion</i>	Donald Gabb, Ph.D., P.E. East Bay Municipal Utility District Oakland, CA	Compiles information available worldwide on high temperature digestion studies. Will develop practical and economical high temperature (mesophilic/thermophilic) digestion protocols to yield Class A biosolids products and augment existing processes to further reduce pathogens.
2000	97-REM-3 <i>Estimating Plant-Available Nitrogen in Biosolids</i> (Product No. D00307)	John Gilmour, Ph.D. University of Arkansas Fayetteville, AR	Practical guidance for biosolids managers and regulatory agencies in using biosolids to benefit crop growth, and in minimizing the potential for nitrogen to migrate to groundwater or cause surface water pollution.
2000	97-REM-4 <i>Investigating the Effects of Electrical Arc Pretreatment of Biosolids</i> (Product No. D00314)	Steven Dentel, Ph.D., P.E., DEE University of Delaware Newark, DE	Investigates the feasibility of electrical arc pretreatment of biosolids as a potential innovative biosolids dewatering process prior to chemical conditioning and dewatering. Addresses fundamental and applied aspects of its operation.
2003	97-REM-5 <i>Assessing Bioavailability of Metals in Biosolid-Amended Soils: Root Exudates and their Effects on Solubility of Metals</i>	Andrew Chang, Ph.D., P.E. University of California, Riverside Riverside, CA	Exploring phenomena that control the fate of metals in biosolids and soil mixtures, and impacts on ecological and human health. Will improve technical basis of 503 Rule, thereby enhancing its acceptability within the scientific community and improving public confidence.
2003	98-REM-1 (Phase 1) <i>A Dynamic Model to Assess Microbial Health Risks Associated with Beneficial Uses of Biosolids</i>	Jack Colford, M.D., Ph.D. University of California, Berkeley	The first phase developed an assessment framework for microbial exposures associated with beneficial biosolids reuse, and a streamlined protocol to assess risks from various exposure pathways.
2006	98-REM1a <i>Application of a Dynamic Model to Assess Microbial Health Risks Associated with Beneficial Uses of Biosolids and Research Digest</i>	Joseph Eisenberg, Ph.D. University of Michigan	The second phase applies the framework developed in Phase I to characterize risk associated with real-world biosolid application scenarios. Risk assessment framework provides a mechanism to discuss biosolids management microbial risk using a common metric for comparison of treatment methods, management alternatives, and to set risk-based standards for microbial contaminants in biosolids. Biosolids producers can use this research to interpret the results and potential health implications of biosolids monitoring data. Treatment plant engineers can evaluate the potential risk-based benefits of making operational changes to existing treatment and/or adding additional treatment processes, and environmental managers can use it to evaluate capital improvements and/or land application site placement issues from a health-based perspective.
2006	98REM1b Research Digest	Joseph Eisenberg, Ph.D. University of Michigan	Research Digest aimed at a more general audience to emphasize the practical aspects of the findings.

2002	99-PUM-1 <i>Evaluating Risks and Benefits of Soil Amendments Used in Agriculture</i> 99PUM1RD research digest also available	Lynne H. Moss, P.E. Camp, Dresser, & McKee Austin, TX	Determines the risks and benefits, advantages and potential disadvantages associated with the use of a variety of soil amendments in comparison to chemical fertilizers. Provides information in determining which soil amendment can be used in or for a specific soil, crop, or climatic condition.
2002	99-PUM-2T <i>Characterizing the Forms, Solubilities, Bioavailabilities and Mineralization Rates of Phosphorus in Biosolids, Commercial Fertilizers and Animal Manures (Phase 1)</i> (PDF available)	George O'Connor, Ph.D. University of Florida Gainesville, FL	Phase I characterized the forms and solubilities of phosphorus in a variety of biosolids products and in biosolids-soils matrices. Phase II will further define this work
2006	99-PUM-2T (Phase II) <i>Characterizing the Forms, Solubilities, Bioavailabilities and Mineralization Rates of Phosphorus in Biosolids, Commercial Fertilizers and Animal Manures</i>	George O'Connor, Ph.D. University of Florida Gainesville, FL	Phase II research will confirm and expand Phase I findings on the fate of phosphorus added to soil from biosolids and manures and will improve our ability to use these amendments for environmentally sound crop production.
2002	99-PUM-3 <i>Developing Protocols for Measuring Biosolids Stability</i>	Michael S. Switzenbaum, Ph.D. Univ. of Massachusetts Amherst, MA	Develops standard, detailed protocols for conducting tests that are commonly used to assess stability in the associated biosolids/products.
NA	99-PUM-5T <i>Manual of Good Practice for Biosolids</i> (Product available from the NBP website: http://biosolids.policy.net/emsguide/manual/goodpractmanual.vtml)	Mark Lang, P.E. Sear Brown Group Rochester, NY	A targeted collaborative project that developed an online resource document on the issues to be considered when designing and implementing a biosolids management program. [Managed by WERF for the National Biosolids Partnership.]
2000	99-PUM-6-ET <i>Evaluating the Use of Near-Infrared Spectroscopy for the Analysis of Biosolids Constituents</i> (Product No. D00306)	Diane F. Malley, Ph.D. PDK Projects, Canada	An emerging technology project that evaluated the feasibility of applying near-infrared spectroscopy (NIRS), widely used in commercial and industrial applications, to analyze nutrient and heavy metal concentrations in biosolids and receiving soils.
2002	98-REM-3 <i>Thickening and Dewatering Processes: How to Evaluate and Implement an Automation Package</i> (Product No. D13006)	Robert Gillette, P.E., DEE Carollo Engineers	Evaluates state of current practices, screens and field tests selected automation processes. Provides information to improve dewatering operations to cut the cost of dewatering biosolids in POTWs and in downstream operations.

2003	00-CTS-8 <i>Membrane Technology: Feasibility of Solid/Liquid Separation in Wastewater Treatment (Subscriber Tool)</i>	Glen Daigger, Ph.D., P.E. George Crawford, P.E. CH2M-Hill	Provides a comprehensive assessment of membrane applications and identifies a method to evaluate the use of membrane technologies for specific treatment applications. Results from this research will allow for a direct comparison of membrane technologies with more conventional methods of solid/liquid separation.
2004	00-CTS-10T <i>Minimizing Biomass Production from Biological Treatment</i>	David H. Stensel, Ph.D., P.E. University of Washington Seattle	Will identify and evaluate methods to reduce biological solids in aerated biological reactors. It will determine whether cost savings can practically be realized by reducing the ultimate amount of waste requiring treatment and disposal.
2004	00-HHE-5C (Phase I) <i>Identifying and Controlling Municipal Wastewater Odor Environment – Literature Review</i>	Gregory M. Adams, P.E. Los Angeles County Sanitation District, and Jay Witherspoon, Ph.D., P.E. CH2M-Hill	The primary objective is to evaluate the state of knowledge and science about odors and odor control for all stages of treatment and disposal of wastewater and residuals. It provides a basis from which to begin a multi-phase process to develop efficient, effective odor control technologies at all stages of wastewater treatment and disposal. Phase 1 involves critical reviews and syntheses of published information (includes conventional and grey literature), findings from recent and upcoming odors-related workshops, as well as electronic databases.
2004	00-HHE-5T (Phase II) <i>Identifying and Controlling Odor in the Municipal Wastewater Environment Phase II: Impacts of In-Plant Parameters on Biosolids Odor Quality</i>	Gregory M. Adams, P.E. Los Angeles County Sanitation District, and Jay Witherspoon, Ph.D., P.E. CH2M-Hill	Phase 2 collects objective data to demonstrate the influence of anaerobic digestion system design and operating parameters on the odor quality of the final product. Biosolids odor emissions measured before and after anaerobic digestion and operations and treatment parameters measured to determine the influence of these parameters on biosolids odor quality. A total of 10 POTWS were involved in the Phase 2 research effort.
2004	00-PUM-5 <i>Biosolids: Understanding Public Perception and Participation</i>	Ned Beecher New England Biosolids & Residuals Association, Tamworth, NH	Lessons learned from successful and unsuccessful biosolids recycling programs will be shared to provide guidance in incorporating stakeholder priorities.
2003	00-PUM-7 <i>Development of a Cost Determination Protocol for Use in Benchmarking Biosolids Management Programs</i>	Eliot Epstein, Ph.D. E&A Environmental Consultants, Inc.	Developed a protocol to identify and quantify direct and indirect costs associated with management of biosolids for all reuse and disposal options. The protocol was tested and refined at several sites that represent wide range of biosolids management options in diverse geographic areas. Should help utility managers evaluate the cost of biosolids management programs on a consistent basis with other agencies.
2004	01-CTS-32-ET <i>A New Tool for Measuring Biosolids Floc Strength</i>	Mohammad Abu-Orf, Ph.D. US Filter NATC / Vivendi Water	Established a standard method and set of procedures for measuring floc strength. Will aid in understanding fundamentals of conditioning and enhance full scale dewatering

In production	02-CTS-8-P Advanced Biosolids Flow-Through Thermophilic Treatment (BFT3) Demonstration Project	Billy Turner and Cliff Arnett Columbus Water Works, GA John Willis, Brown & Caldwell Mike Aitken & Mark Sobsey, University of North Carolina – Chapel Hill	Evaluated the BFT3 process for retrofitting existing digestion systems to upgrade them from Class B to Class A. WERF provided peer review of the protocols definition, experimental testing for health risk assessment of microbial contaminants, and full-scale start-up.
2004	02-HHE-1-CO <i>Analytical Method for Endocrine Disruptors in Sewage Sludge</i>	Cooperative Project with UKWIR Contractor: WRc	Will solidify methods for extracting steroidal hormones from biosolids.
2004	03-HHE-1 <i>WERF/EPA Biosolids Research Summit</i>	WERF & Consensus Building Institute	Multi-stakeholder workshop that developed a research agenda to address scientific issues related to the land application of biosolids.
2006	00-PUM-6 <i>Development of a Metals Toxicity Protocol for Biosolids</i>	Katherine M. Banks, Ph.D. Purdue University	A series of toxicity bioassay tests that will provide practitioners with a way to address citizen concerns regarding the human health and environmental impacts of biosolids reuse.
2006	01-CTS-1 <i>Understanding Factors Affecting Polymer Demand for Conditioning and Dewatering</i>	Matthew J. Higgins, Ph.D. Bucknell University	Improves understanding of the nature of flocs and the specific chemical interactions that alter floc properties. Results could lead to better selection of conditioning chemicals, help to reduce chemical costs and/or lead to improved dewatering techniques.
2006	03-CTS-13T <i>Examination of Reactivation of Fecal Coliforms in Anaerobically Digested Biosolids</i>	Matthew J. Higgins, PhD, P.E. Bucknell University Sudhir Murthy, Ph.D., P.E. DC Water & Sewer Authority	A look at the phenomenon of reactivation of pathogens through the digestion process. Demonstrates that pathogens exist in a viable-but-non-culturable state through the digestion process but are induced to become culturable due to the presence of a substrate in the dewatering process, which allows for rapid growth in the final cake material.
2006	99-HHE-3 <i>Control of Human Parasites in Municipal Biosolids</i>	Christine L. Bean University of New Hampshire Durham, NH	Screens, identifies, and selects an appropriate surrogate human parasite(s), in lieu of helminth ova, and develops protocols to recover, detect, and measure surrogate organism(s) for municipal wastewater biosolids.
2 nd 2007	01-CTS-18-UR <i>An Assessment Tool for Managing Cost-effective Energy Recovery from Anaerobically Digested Wastewater Solids</i>	Hugh Monteith, Ph.D. Hydromantis, Inc.	Identifies cost-effective alternatives for energy recovery from solids treatment (anaerobic) based on key factors such as energy costs, regulatory conditions, plant capacity, social values, and more. Information on development of LCAMER model.

2008	01-CTS-19-UR <i>Effects of Biosolids Properties on Membrane Bioreactors (MBRs) and Solids Processing</i>	Slav Hermanowicz, Ph.D., P.E. University of California Berkeley	Will investigate the effects of biosolids characteristics on membrane performance and solids processing. This will help define the operating limits of MBRs in municipal wastewater treatment and improve understanding of the behavior of solids to be processed.
2007	01-HHE-3 <i>Assessing the Fate of Emerging Pathogens in Biosolids</i>	Scott Yates, Ph.D. University of California-Riverside	Will detect and follow the fate of emerging pathogens in biosolids from the treatment process through land application until they are undetectable. Will help address public health concerns regarding land application of biosolids.
2 nd 2007	02-CTS-3 <i>Innovative Technologies to Reduce Water Content of Dewatered Sludges</i>	Sarah Miller CSIRO Manufacturing & Infrastructure Technology	Evaluates methods to improve water removal from dewatered cakes, including innovative equipment, new additives, additive or conditioning agent combinations, physical modifications, or a combination of these or other approaches.
2 nd 2007	02-HHE-2 <i>Biosolids Sample Processing for Analyses of Pathogens</i>	Morteza Abbaszadegan, PhD Arizona State University	Addresses concerns raised by NRC's recent report on biosolids. Will develop sample preparation methods for use with molecular detection techniques such as microarray analysis, quantitative PCR, fiber-optic biosensors, and other new technologies. Will help address public concern over land-applied biosolids by measuring the presence and fate of pathogens.
2007	02-PUM-1 <i>Quantification of Airborne Biological Contaminants Associated with Land Applied Biosolids</i>	Jordan Peccia, PhD Arizona State University	Addresses concerns raised by NRC's recent report on biosolids. Provide fundamental data to assess the potential release and exposure to airborne biological contaminants from land application of Class B biosolids by analyzing current health-impact literature. Data produced will provide basis for a comprehensive, full-scale analytical investigation.
2008	03-CTS-9 <i>Biosolids Processing Modifications for Cake Odor Reduction</i>	Gregory M. Adams, P.E. Los Angeles County Sanitation District, and Jay Witherspoon, Ph.D., P.E. CH2M-Hill	Will build on and enhance an existing process, anaerobic biosolids digestion, to produce lower-odor biosolids. Equipment or process vendors may be invited to demonstrate their processes full-scale at one or two plants, while researchers collect and analyze data and compares results. Builds upon work conducted in Identifying and Controlling Municipal Wastewater Odors (00-HHE-5T).
Ongoing	03-HHE-2 <i>Pathogen Risk Indicators for Wastewater and Biosolids</i>	Judy Blackbeard CRC Water Quality and Treatment Australia	Will compare the accuracy, advantages, and disadvantages of existing indicator organisms with proposed indicators in wastewater and biosolids. If successful, alternative organisms will provide better indicators of public health impacts, more accurate tools for setting appropriate standards, and more effective monitoring of water and biosolids, leading to increased confidence in the quality of effluent and residuals.

2008	04-CTS-3T <i>Fecal and Pathogen Regrowth/ Reactivation From Centrifugation of Anaerobically Digested Sludges</i>	Matthew J. Higgins, PhD, P.E. Bucknell University Sudhir Murthy, Ph.D., P.E. DC Water & Sewer Authority	The focus of this project will be to conclusively determine the extent that reactivation / regrowth of microbes in digested and dewatered biosolids, which has been the focus of 03CTS13T, is occurring for both indicator organisms and pathogens. Special attention will be given to the effect that variability of microbe measurements may be having on observed results, and the best analytical methods to use to assess this observed phenomenon.
2 nd 2007	06-HHE-5PP <i>Methodology for Implementing a Rapid Incident Response Mechanism</i>	Steve Wing, Ph.D. University of North Carolina	This project was the highest ranked priority at the 2003 Biosolids Research Summit. The first phase of the project will develop a protocol to be used in conjunction with established public health investigation procedures and implemented through the existing network of public health organizations.
2 nd 2007	04-CTS-2 <i>Cost/Benefit Analysis of Management Options for Sludge/ Biosolids</i>	Robert S. Raucher, Ph.D. Stratus Consulting, Inc.	Developed a method for evaluating the costs and benefits of various sludge/biosolids disposal and beneficial use options that provides utility and industry managers with the information necessary to make a decision on which option to use. This information can also be shared with the general public to help explain the disposal or beneficial use options made by the utilities.
Ongoing	04-CTS-7T <i>Minimizing Mercury Emissions from Biosolids Incinerators</i>	Carl E. Hensman, Ph.D. Frontier Geosciences, Inc.	Will quantify mercury emissions from representative biosolids incinerators located in the United States. Will establish test protocols that POTWs that practice incineration can use to accurately determine the fate of the mercury that enters their plants. Will identify practices and control technologies to cost-effectively reduce mercury emissions from biosolids incinerators.
Ongoing	04-HHE-6 <i>Fate of Estrogenic Compounds During Municipal Sludge Stabilization and Dewatering</i>	Kathleen Esposito, P.E. & Beverly Stinson, Ph.D., P.E. AECOM, Inc. Ed Furlong, Ph.D. U.S. Geological Survey David Quanrud, University of Arizona	Will investigate the fate of known estrogenic compounds and total estrogenic activity in solids derived from wastewater treatment, in processes commonly used to stabilize, disinfect and dewater municipal wastewater treatment sludges.
2009	04-HHE-7 <i>An Investigation into Biosolids Sampling and Handling Methods for USEPA-Approved Microbial Detection Techniques</i>	Sharon C. Long, Ph.D. University of Massachusetts – Amherst (now with University of Wisconsin- Madison)	Developed scientifically defensible methods for collecting and handling representative samples for microbial analysis from biosolids matrices with the greatest potential impact to public health (liquid, cake, compost).

Ongoing	05-CTS-3 <i>Evaluation of Processes to Reduce Activated Sludge Solids Generation and Disposal</i>	Julian Sandino CH2M-Hill	Develop and demonstrate an evaluation methodology that will be used to independently assess the effectiveness of at least one selected commercially available process. This tool can be used by industrial and municipal wastewater treatment facility owners and operators to technically and economically evaluate processes that can reduce waste activated sludge quantities
In production	05-CTS-2T <i>Evaluation of BMPs for Sustainable Groundwater Protection at Biosolids Land Application Sites</i>	Mike McFarland, Ph.D. Utah State University	Develop a protocol to evaluate the effectiveness of best management practices to mitigate the potential risk of groundwater contamination at biosolids land application sites. Describe the range of groundwater protection BMPs currently in practice at land application sites.
Ongoing	SRSK2R06/SRSK3R06 <i>Applying Advances in Pathogen Risk Assessment and Strategic Risk Communications to Land Application of Biosolids</i>	Sara Eggers, PhD. Decision Partners Patrick Gurian, PhD Drexel University	Provide wastewater utilities, land appliers, regulatory agencies and public administrators' state-of-the-science, practical, locally applicable pathogen risk assessment and communication approaches, with methodologies tailored to a variety of conditions. Appropriate risk assessment methodologies will accommodate varying levels of expertise and resources.
In production	03CTS9a <i>Evaluation of Aluminum and Iron Addition During Conditioning and Dewatering for Odor Control</i>	Matthew J. Higgins, PhD, P.E. Bucknell University	Investigate factors impacting the effectiveness of metal salts in reducing the production of volatile organic sulfur compounds in biosolids, and develop recommendations for applying metal salt addition for odor reduction.
In production	03CTS9b <i>Effect of Aluminum and Iron on Odors, Digestion Efficiency and Dewatering Properties</i>	John T. Novak, PhD, P.E. Virginia Tech University	Investigate the impact of iron and aluminum addition in determining odor generation from dewatered sludge cakes. Iron and aluminum addition to activated sludge for phosphorus removal and directly to anaerobic digestion were studied. Data on sludge dewatering properties also was collected.
Ongoing	03CTS9c <i>Biosolids Odor Reduction - Development of Web-Based Decision Tool</i>	Zeynep Erdal, P.E./Robert Forbes, P.E. Ch2M-Hill	Web-based roadmap to integrate the findings of all four phases of the biosolids-odor-reduction research and encompass real solutions to enhancing biosolids odor quality, beyond the use of odor-scrubbing or masking agents. Incorporates a cradle-to-grave approach from early treatment processes to the biosolids end use or disposal point.
2008	OWSO3R07 <i>State of the Science Report Energy and Resource Recovery from Sludge</i>	Hugh Monteith, P. Eng, Hydromantis, Inc.	A Global Water Research Coalition report on the state of the science for recovering energy and resources, such as nutrients, from wastewater sludge. A triple bottom line approach was applied to identify suitable options.
Ongoing	OWSO5R07 <i>Assessment of Operational and Performance Parameters for Co-Digestion</i>	David Parry, Ph.D. P.E. CDM	A practical procedure developed to assess the potential impacts of a particular organic waste as a co-digestion feedstock in anaerobic digestion. The project provides access to empirical data necessary to support digester design and operational stability parameters. Will result in an economic model to assess the viability of co-digestion.

Ongoing	SRSK4T08 <i>Wastewater Treatment Plant Design Operation and Modification to Improve Management of Biosolids Odors and Sudden Increases in Indicator Organisms</i>	Matthew J. Higgins, PhD, P.E. Bucknell University Sudhir Murthy, Ph.D., P.E. DC Water & Sewer Authority	Provide wastewater treatment personnel and their consultants with practical design and operational procedures that holistically address biosolids odors and sudden increases in indicator organisms.
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Information current as of July, 2009