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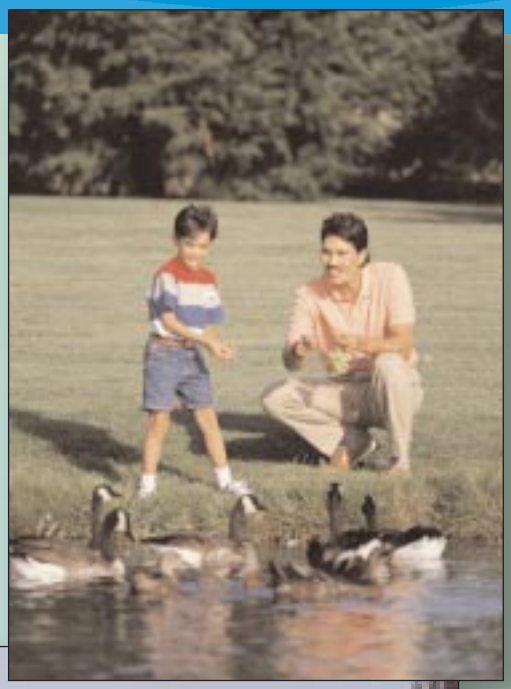
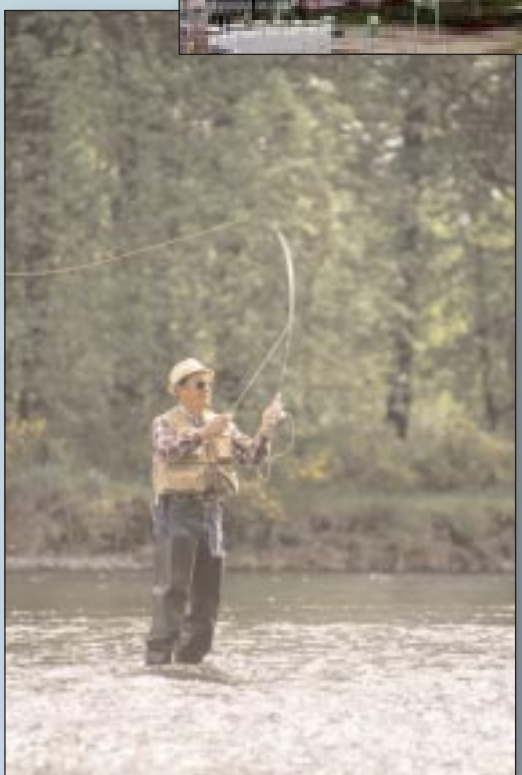
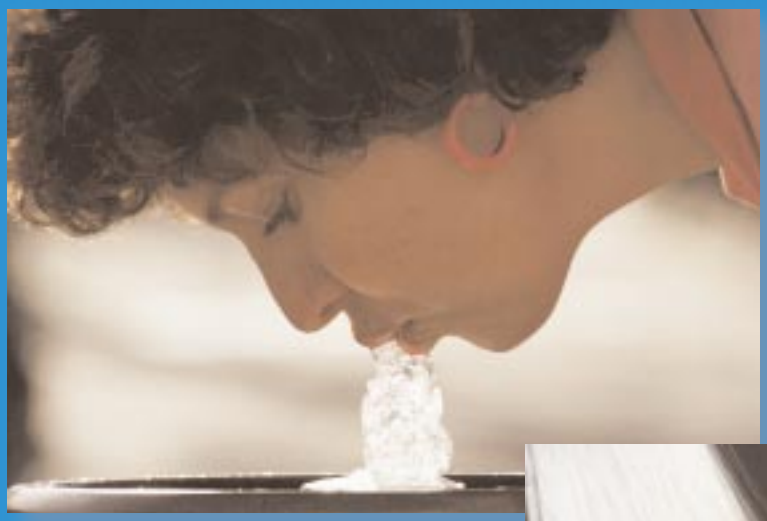
National Decentralized Water Resources Capacity Development Project

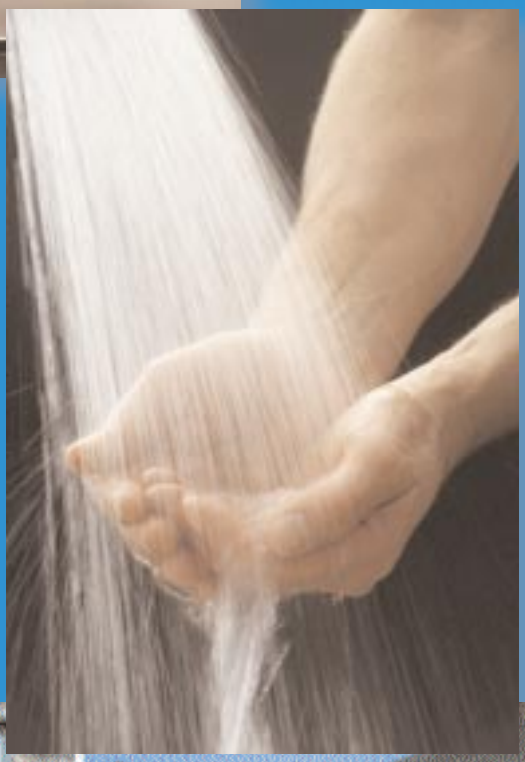




Training, Research and Development Plan

National Decentralized Water Resources Capacity Development Project





National Decentralized Water Resources Capacity Development Project

Upgrading Methods and Practices Through the Support of Training, Research, and Development

The National Decentralized Water Resources Capacity Development Project (NDWRCDP) was formed in 1996 to coordinate and implement a national training, research, and development agenda in decentralized water resources. The NDWRCDP is a collaborative effort of the Coalition for Alternative Wastewater Treatment, the Consortium of Institutes for Decentralized Wastewater Treatment, the Electric Power Research Institute, the National Rural Electric Cooperative Association, and the Water Environment Research Foundation.

Funding for the Project was initiated by the U.S. Congress in response to growing needs for cost-effective water resource management in rural and suburban areas, and is through the Environmental Protection Agency's Office of Research and Development. The priority for the first five years has been in decentralized wastewater management, but in the future, other soft-path sectors in an integrated water resource management framework, such as distributed storm water management and low-impact development practices, will be explored as well.

The NDWRCDP engages national academic and professional leadership in the development of better tools and practices, not just in science and technology, but also in management, regulations, and economics. Curriculum development for training centers and universities is supported, along with other projects to disseminate research findings and innovative practices.

This training, research, and development plan describes currently funded initiatives and the long-term agenda for decentralized wastewater management. It also discusses the several conferences and workshops that were convened to solicit input and coordinate plan development.

Contents

Decentralized Wastewater Management

Challenges and Opportunities

"Adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas."

EPA, 1997

About one-quarter of all American homes are not connected to central sewers and instead utilize individual septic systems or other treatment technologies on their properties. These homes are predominantly in rural areas, but these treatment approaches are also in use in many small town centers and suburbs. Traditionally, septic systems were viewed as temporary "disposal" solutions, eventually to be replaced by sewers as densities increased or performance problems developed. However, EPA's 1997 report, "Response to Congress on Use of Decentralized Wastewater Systems," established the long-term viability of "managed" septic systems as "treatment" units, and has stimulated widespread interest in upgrading methods and practices in the field.

Technologies

The conventional septic system consists of a tank that provides for removal of flotable and settleable solids and a soil-based system that further treats liquid effluent from the tank before dispersing it to the environment. Depending on the characteristics of the soils, the nature of the wastewater, and other climate and site conditions, this system usually can produce effluent superior to a conventional secondary wastewater treatment plant.

Pre-treatment filters, aerobic treatment units, disinfection, and other units in a treatment train can enhance removal of organic carbon, nutrients, and pathogens (tertiary treatment), and with proper management, these systems can provide an effluent that meets water quality requirements for reuse in irrigation, toilet flushing, etc. These enhanced systems can compensate for adverse soil or site conditions, or be responsive to special needs of environmentally sensitive resources, such as estuaries or drinking water supplies. The term "decentralized" applies to both individual onsite systems as well as small, neighborhood "cluster" systems.

Management

Since publication of the 1997 report, EPA's major emphasis has been on promoting management of decentralized wastewater systems. Traditionally, the homeowner has been responsible for pumping out the septic tank and otherwise maintaining the system through routine maintenance and repair. However, professional site evaluation, design, inspection, and operation/maintenance can improve the performance and reliability of decentralized systems. EPA has developed a framework for matching program management and regulatory requirements to the complexity and level of risk associated with different types of systems in different locations.

Onsite system regulations are the responsibility of state and local agencies, not the federal government. In this regard, following EPA's guidance is voluntary.

EPA's Response to Congress identified the following major barriers to more effective use of onsite and cluster systems:

- Misinformation and limited public knowledge about onsite systems
- Legislative and regulatory constraints
- Lack of system management
- Inadequate existing engineering practices
- Restricted access to funding

These factors formed the backdrop to the first round of training, research, and development funded by the NDWRCDP. Key areas of emphasis included development of practitioner training and engineering curriculum materials, model state regulatory codes, and tools for community wastewater decision-making.

More recently, EPA has expanded its agenda beyond management, to include updating its design manual on onsite systems, supporting development of new technologies and appropriate solutions, and encouraging implementation of management programs at the state and local levels.

Risks to Public Health and the Environment

In May 2000, a research needs conference, "Risk-Based Decision Making for Onsite Wastewater Treatment" was convened by the NDWRCDP in St. Louis, Missouri. More than 200 public officials and experts had participated in one of three regional workshops, at the University of South Florida, the University of Rhode Island, and the University of Washington prior to the National Conference. Issues and concerns raised in these workshops led to a request for five separate white papers. These white papers, presented at the National Conference, focused on key areas of risk management and science (EPRI, 2000).

In 1996, EPA's Office of Research and Development reorganized research priorities and strategies using risk assessment and risk management principles and criteria, as a means to understand and evaluate the magnitude and probability of risk posed to human health and ecosystems by environmental stressors. Risk management combines these risk characterizations with statutory, legal, social, economic, and political factors in assessing regulatory or other options to manage risks. The NDWRCDP sought to replicate this process in the decentralized wastewater field.

White Papers for the Research Needs Conference

Integrated Risk Assessment/Risk Management as Applied to Decentralized Wastewater Treatment: A High-Level Framework

Dan Jones, Oak Ridge National Laboratory

Jones describes the engineering, ecological, public health, and socioeconomic aspects of a decentralized wastewater problem. A subsequent project funded by the NDWRCDP at Oak Ridge National Laboratory (ORNL) will facilitate the development of a detailed risk assessment/management framework, and incorporate known data to assess the risk of individual onsite systems in these four areas.

Design and Performance of Onsite Wastewater Soil Absorption Systems

Robert L. Siegrist, Colorado School of Mines; E. Jerry Tyler, University of Wisconsin; Petter D. Jenssen, Agricultural University of Norway

The understanding and predictability of performance of a soil absorption system as a function of design, installation/operation, and the environment, as well as the risk of inadequate performance and its effects are not fully understood. This lack of understanding makes it difficult to develop natural system design principles and methods. This paper highlights high-priority research needs in clogging zone genesis, treatment in unsaturated zones, and modeling tools for design. A number of these issues are being addressed by NDWRCDP-funded research at the Colorado School of Mines (CSM).

Research Needs in Decentralized Wastewater Treatment and Management: Fate and Transport of Pathogens

Dean O. Cliver, University of California, Davis

This paper describes pathogens of concern in domestic wastewater, treatment in standard and alternative onsite systems, and uncertainties about pathogen risks at the micro and macro scale. The CSM project, as well as a new U.S. Geological Survey (USGS) project, will address a number of these issues.

Research Needs in Decentralized Wastewater Treatment and Management: A Risk-Based Approach to Nutrient Contamination

Arthur J. Gold, University of Rhode Island and J. T. Sims, University of Delaware

This paper describes nitrogen and phosphorous pathways and risks through individual treatment systems and beyond into broader ecosystems, such as the ground and surface water receptors in a subwatershed. Nitrate contamination is being addressed in the CSM and USGS studies, and in addition, a project to develop a guidance manual on phosphorous-removal mechanisms and technologies is being initiated by the NDWRCDP.

Economics of Decentralized Wastewater Treatment Systems: Direct and Indirect Costs and Benefits

Carl Etnier, Agricultural University of Norway; Valerie Nelson, Coalition for Alternative Wastewater Treatment; and Richard Pinkham, Rocky Mountain Institute

This paper describes important direct and indirect costs and benefits to be considered in decentralized wastewater treatment decision making. It also describes decision making structures that, in the future, would integrate public health, environmental, engineering, and socioeconomic risks. Several economic and social factors are being studied in a Rocky Mountain Institute study, co-funded by EPA and the NDWRCDP. Other benefit-cost questions will be addressed as part of a long-term effort to assess management, regulatory, and policy strategies to improve reliability and performance of decentralized systems.

The research needs identified in this process have been folded into the long-term research agenda of the NDWRCDP. These white papers may be downloaded from the NDWRCDP website at: ***www.ndwrcdp.org***.

Mapping the Future of Decentralized Wastewater Management

How Training, Research, and Development Can Improve Prospects for Reform

In March 2001, the NDWRCDP sponsored a two-day strategic retreat on the future of the decentralized wastewater sector. Thirty-five invited participants from around the country attended, including academics, EPA officials, manufacturers, engineers, regulators, utility experts, and others with an interest in the field.

The goal of the retreat was to map alternative scenarios or endstates for how the field might evolve by 2010. A strategic consulting firm, Nervewire, was hired to facilitate the meeting and to implement its copyrighted scenario-building exercises called Future Mapping®. Working groups were formed to develop the driving forces and details of four different endstates, along with research recommendations appropriate to each scenario.

A two-day strategic retreat on the future of the decentralized wastewater sector featured scenario-building exercises called Future MappingÒ.

Watershed Management

In this endstate, watershed management is the organizing structure for the water and wastewater sector. Large public utilities manage central sewer systems, cluster systems, and individual onsite systems. The driving forces behind watershed management are total maximum daily load requirements, a crisis in decaying wastewater infrastructure, and water shortages. The public is prepared to make a substantial investment in water quality protection, and the federal government is increasing funding levels.

The tools needed for watershed management are watershed assessment and modeling techniques, cost-benefit methodologies that properly characterize centralized and decentralized alternatives, reliable decentralized and reuse technologies, and public management approaches that incorporate all water-related infrastructure, including that located on private property.

This endstate was ranked the most desirable of the four, as it had been in a prior Water Environment Research Foundation (WERF) retreat in 1999. However, it may not be attained, largely because of institutional inertia and the lack of a sufficient crisis to force changes in practices or increases in funding levels.

In 2002, the NDWRCDP took watershed management concepts to a higher level and cosponsored a second workshop on integrated water resource management, that included water, wastewater, storm water, low impact development, and other soft-path technologies in a comprehensive framework.

Community-Based Management

Community activism at the local level is the primary driver for decentralized wastewater systems in this endstate. Local citizens identify their water quality problems and develop solutions that suit their needs. This local orientation allows for holistic, sustainable approaches to emerge, which incorporate watershed, and land use planning, and cost-effective infrastructure. Innovation is supported, because flexible experimentation at the local level allows successful models to be developed.

NDWRCDP-funded projects will provide guidance for community-based management on how to use innovative technologies and to facilitate land-use choices.

Mapping the Future of Decentralized Wastewater Management

Local communities need tools for making decisions about wastewater projects in the context of all the issues that impact the future of the community. Several of the initial NDWRCDP-funded projects will be helpful to communities, including the use of geographic information systems (GIS) mapping tools and guidance on how to use innovative decentralized technologies to facilitate land-use choices.

Utility/Business Management

Both consumers and regulators understand that, by 2010, a responsible management entity is needed as a single point of contact that can be held responsible for water quality infrastructure in an affected area. In this endstate, public and private utilities build on their management and financial capabilities to develop business approaches for decentralized wastewater management, and homeowners pay the "true cost of services."

For this endstate to emerge, tools of asset management and marketing analysis will need to have been developed. This endstate was considered the least desirable, because of concerns that private utilities would "cherry pick" only the most profitable customers, and consolidation and monopoly power might emerge. To avoid these pitfalls, proper regulatory oversight would be necessary.

Risk-Based Research and Regulation

Over the next decade, in this scenario, increased public perception of public health risks from failing septic systems would lead to better research, which in turn would lead to higher standards of treatment and tighter regulations and enforcement for monitoring and maintenance of decentralized technologies. The research that facilitates this endstate would be largely focused on quantifying pathogen and nutrient risks, and on improving predictions of the performance of soils and pre-treatment units.

Another recommendation by participants in this group was for development of a national regulatory framework or model code that would be performance-based. The NDWRCDP will be co-funding with EPA an ongoing effort by the National Onsite Wastewater Recycling Association (NOWRA) to develop such a framework. This framework will specifically focus on a methodology for predicting treatment in various soils and site conditions, in order to determine pretreatment requirements and other components necessary to meet environmental and public health performance goals.

Depending on site conditions, various solutions to wastewater management are possible.

Five-Year Plan

Short- and long-term research priorities listed on the following pages were developed primarily by synthesizing recommendations from the research needs white papers and the Future Mapping retreat. Input was also incorporated from state onsite regulators, community demonstration projects, and other communications.

Priorities are categorized by the NDWRCDP subcommittees that will be responsible for addressing these needs.

Environmental Science and Engineering

One of the most persuasive arguments for the formation of the NDWRCDP was that substantial gaps in the science of onsite wastewater systems were making it difficult to promote new technology and decentralized approaches in the field. Without solid science, designers of systems would lack the tools to rigorously match technologies and designs to the conditions of the sites and to the risks to nearby wells or surface waters. Also, without a full understanding of treatment mechanisms and cumulative impacts of systems in communities with sensitive resources, it would be hard to convince policymakers and regulators that decentralized systems should be considered permanent, reliable wastewater solutions.

The papers for the first research needs conference in 2000 were primarily focused on identifying gaps in the science of treatment in soil absorption systems, and of fate and transport of nutrients and pathogens. The 2001 strategic retreat, with input from a wide range of policy and industry experts, helped to further prioritize these topics.

Environmental Science

An early, multi-faceted NDWRCDP-supported project to identify and fill in some of the gaps in decentralized wastewater science has been directed by Professor Robert Siegrist at the Colorado School of Mines, with the involvement of the Electric Power Research Institute (EPRI), Summit County Environmental Health Department, and the United States Geological Survey (USGS) in Colorado. This project includes field and laboratory research on the transport/fate of microbes and chemicals in soil-based systems, which will enable the development of site-scale models and improved engineering design. The project also includes analysis of cumulative impacts of onsite systems in Summit County. EPRI's surface water quality Watershed Analysis Risk Management Framework (WARMF) model used for making Total Maximum Daily Load (TMDL) decisions in a watershed is being enhanced to incorporate the impact of dispersed onsite systems on water supply wells as well as on downstream surface waters.

A second project to be funded by the NDWRCDP will be an effort by USGS in Oregon. USGS has already developed nitrate fate and transport models for the La Pine National Community Demonstration Project, which is focused on protecting a sole source aquifer from onsite system nitrate contamination. This research will focus on both coliphage attenuation (as a surrogate for viruses) in conventional and innovative treatment systems in the demonstration project, as well as on fate and transport of coliphage in receiving groundwaters. The project will also research treatment and fate of pharmaceuticals in onsite systems.

Environmental Engineering

Several new projects of the NDWRCDP will fill engineering and technology gaps in guidance to designers of decentralized wastewater systems. Phosphorous has become an increasing concern as a cause of eutrophication in lakes and other freshwater resources throughout the country, and in sensitive coastal areas, such as the Florida Keys. This project will result in the development of a concise guidance manual that explains the geochemistry of phosphorous removal and that identifies existing and promising new phosphorous-removal technologies.

A second guidance project concerns the hydrogeological impacts of large cluster systems and high-density installations of individual onsite systems. Groundwater mounding below infiltration systems and lateral breakout can contribute to system failures if site hydrogeologic conditions are not adequately addressed in the planning and design process. The objective of this study will be to provide an evaluation of and guidance on the use of available methods and models for analyzing hydrogeological impacts.

A priority of the Subcommittee will be research on the reliability of onsite and cluster systems. In collaboration with other subcommittees, work will be supported to develop a computer-based model to assess the causes and consequences of mechanical and hydrologic failures of systems, the costs of repair and replacement, and the strategies for code design, management, education and training, telemetry, and other tools to improve performance and reliability. This work will be conducted in parallel with similar central system reliability studies potentially funded by WERF and others. Comparison of these studies should yield a strong basis for side-by-side consideration of all wastewater options.

Environmental Science and Engineering

Research Priorities

The following are environmental science and engineering research priorities:

- Develop integrated wastewater risk assessment tools
- Assess/quantify risks due to microbial pathogens
- Develop/evaluate methods for incorporating centralized, onsite and storm-water contributions in TMDL calculations
- Develop/evaluate models designed to reliably predict fate and transport of nutrients for use in assessing risks to watershed water quality
- Identify and characterize the basic mechanisms by which pathogens are contained or inactivated in conventional/alternative/advanced wastewater systems
- Characterize the effect of pretreatment on soil clogging and wastewater soil absorption systems (WSAS) hydraulic and purification performance
- Develop effective methods to estimate pollutant contributions (nutrients and pathogens entering watersheds from new or existing WSAS)
- Quantify the deterioration of centralized and decentralized wastewater infrastructures
- Conduct review of existing monitoring and treatment technologies
- Develop effective models to predict soil treatment (residence time, loading rates, dose frequency, biomat effects, soil profiles)
- Determine the relationship between system performance and age of operation for similar WSAS in similar environments
- Develop effective site evaluation methods to facilitate design of soil-based treatment systems that maximize use of soils and minimize mechanical pretreatment (smart designs)
- Identify appropriate levels of pretreatment/pretreatment technologies (black boxes) needed to allow minimal reliance on soil treatment
- Develop/evaluate methods for identifying and quantifying sources of pollutants
- Evaluate actual life spans and failure rates of onsite and decentralized systems
- Develop/evaluate methods for assessing the treatment capacity (nutrients and pathogens) of a site
- Identify/develop appropriate models for predicting treatment efficiency (system performance) as a function of siting, design, and operation
- Develop/evaluate effective methods to assess the hydraulic capacity of a site for use with large/cluster WSAS
- Evaluate (quantify) fate and transport (including survival) of pathogens in saturated soils
- Evaluate pathogen containment and inactivation in cluster systems
- Conduct epidemiological studies to quantify public health risks
- Develop/evaluate appropriate site evaluation methods to support performance-based standards

NDWRCDP-supported projects identify and fill in some of the gaps in decentralized wastewater science, engineering, and technology.

Management and Economics

The 2001 strategic retreat accentuated the importance of management and economics research outputs to enhance the quality of planning for a wide variety of decision-makers and constituencies. The 1997 EPA Response to Congress highlighted the need to develop and disseminate management models and information, and subsequently the EPA is developing and promoting various levels of management of decentralized systems for voluntary adoption by states and communities. Many questions remain, however, about the practical implications of implementing these models and about their relative cost-effectiveness.

Management

Management of decentralized wastewater systems can encompass a wide range of possible functions, including public participation, site evaluation, design, construction inspections, routine inspections, operation and maintenance (O&M), financing, billing, monitoring, service provider licensing/certification, regulatory reporting, enforcement, and planning.

Greater knowledge and more information about what management functions are necessary, including who can perform them and who pays for them, are important to the business side of decentralized wastewater, whether those functions are performed by small contractors, utilities, or larger private companies. More information is also important to communities grappling to understand the implications of developing a plan to centrally manage decentralized systems, rather than install conventional sewers.

Management and economics research enhance the quality of planning for a wide variety of decision-makers and constituencies.

Policymakers are also greatly concerned and want to quantify what the actual benefits and costs of management are, if and when new requirements are to be imposed on their constituents. Indeed, the primary research issue raised by state onsite system regulators has been documentation of how the benefits of various management functions for various types of systems or settings relate to the costs. EPA officials stress the need to document what reduction in pollutant loads would result from the increased cost of management or other changes in policy or regulations that have been proposed in recent years.

To date, the NDWRCDP has directed most of its research funding in this area to community management and decision-making tools. The University of Rhode Island (URI) has been funded to develop guidance to communities on how to plan for decentralized technologies to meet the land use and development vision of the community. A second URI project will help communities utilize GIS data sources and mapping in identification of sensitive environmental resources and treatment needs, and in the prediction of impacts of alternative decentralized wastewater projects on these resources. A guidance manual is also being prepared for the NDWRCDP by Lombardo Associates about when to consider and how to manage cluster systems in new and existing developments.

In the future, there will be more emphasis on some of the business aspects of management, including research on adapting asset management approaches to the decentralized field. However, there is also a recognition that data are lacking on long-term reliability and performance of various technologies, and on the cost-effectiveness of inspections and routine maintenance in enhancing reliability. Policymakers are also concerned about understanding these concepts through better and more uniform definitions of failure rates, and significant NDWRCDP resources will be directed to these questions, as part of the comprehensive reliability model and analysis described in the Environmental Science and Engineering section of the plan. The NDWRCDP is also considering a workshop on different management and planning models under development in the U.S. and in Europe, where a greater emphasis has been put on formal analytical modeling of choices.

Management and Economics

Economics

Core economic questions about resource allocation and market structures have also emerged in recent years. Government officials and constituents question how much additional funding ought to be directed at decentralized wastewater technology and management and for what purposes. The 2001 strategic retreat highlighted the needs for communities and watershed managers to identify and have the tools to measure the totality of costs and benefits. Non-monetary costs (those not easily quantifiable in dollars) of various centralized and decentralized wastewater infrastructures need to be included. The NDWRCDP has funded a Rocky Mountain Institute project jointly with EPA to research and catalogue important, but not well understood, economic and cultural aspects of various choices, including differential financing costs, land use and development implications, hydrologic considerations, equity and fairness issues, and other important community factors.

To date, NDWRCDP has directed most of its research funding in management and economics for the creation of community management and decision-making tools.

A range of other economic issues will also be addressed in response to questions raised in both the 2000 risk-based research conference and the 2001 strategic retreat. If markets are going to mature and new business models emerge, then more needs to be known about the values and preferences of the customer. Primen, an affiliate of EPRI, will be analyzing an extensive survey of homeowners in North Carolina, with a goal of estimating the level of knowledge, buying preferences, and willingness to pay for improved onsite system performance, advanced onsite systems, and sewers. Other market-oriented questions will also be addressed in the future, such as the benefits and costs of various policy and regulatory approaches and the potential implications of privatization or concentration of supplies in the industry.

Research Priorities

The following are management and economics research priorities:

- Develop/evaluate effective cost/benefit analysis methods and business models
- Develop/evaluate methods to facilitate fair comparisons of decentralized and centralized approaches in terms of long-term O&M, real capital, and environmental costs
- Develop/evaluate effective management models
- Evaluate the cost-effectiveness of management and remote monitoring systems
- Develop/evaluate cost/benefit analysis methods that include non-monetary costs for use in comparing centralized and decentralized approaches
- Develop/evaluate business models that incorporate cost components and identify economic risks
- Conduct "true costs"/benefit studies of standards and practices in the industry for comparison with public health/water quality benefits

Regulatory Reform

State and county onsite system regulations have typically been "prescriptive" codes which specify site and design requirements, such as characteristics of the soils or depth to groundwater, and have left ongoing maintenance responsibilities, such as septic tank pumping, to the homeowner. In recent years, EPA, NOWRA, and others have suggested that a "performance" code would be preferable, which allows the designer greater flexibility in both determining the treatment standards needed for the site and surrounding resources, and in utilizing a range of innovative technologies and soil-based designs under professional management. However, a transition to a performance code requires both the development of model codes and practices and an analysis of the consequences of shifting from prescriptive to performance codes. The National Small Flows Clearinghouse (NSFC) has convened several annual state onsite regulators conferences to discuss these and other issues, and the NDWRCDP has financially supported those efforts as part of a "regulatory roundtable" to seek input from regulators on NDWRCDP research priorities and projects.

In the early round of funding, the California Wastewater Training and Research Center at California State University-Chico was supported in an effort to prepare a model ordinance for onsite sewage treatment and management. Criteria are being developed for locating, designing, installing, inspecting, operating, maintaining, and monitoring onsite systems within a performance-based context. This project has become particularly relevant in California, as the State Water Resources Control Board together with the nine Regional Water Quality Control Boards have been directed by the legislature to develop new approaches for assuring that onsite systems are upgraded properly to protect impaired waters.

NDWRCDP supports a "regulatory roundtable" to seek input from regulators on NDWRCDP research priorities and projects.

The 1997 EPA Response to Congress identified regulatory fragmentation and lack of clear accountability between state and local levels as a barrier to effective onsite system use. The Environmental Research Institute of the States has been funded to survey the states and to develop recommendations for improvements in integrating and consolidating existing state and local wastewater authorities and programs, regulations, and environmental and public health responsibilities. A pilot study for innovative approaches and methods to achieve better coordination has been funded in New Mexico as part of this project.

Model Performance Code

In 2000, NOWRA initiated a long-term project to develop a National Model Performance Code for Decentralized Wastewater Systems. EPA has funded an initial task to develop classification matrices for treatment system outputs and quality assurance measures, and for varying performance standards for treatment and management.

The NDWRCDP is funding a subsequent task to develop a set of matrices for categorizing the treatment capability of various soil conditions under differing methods of distribution of effluent to the soil. This information can be used by the designer to determine the need for pretreatment units or other components in a treatment train predicted to meet the performance standards required for a given site. A second part of this project will be identification of ongoing activities throughout the country to develop performance codes at the state or county level, and research on the challenges and/or barriers to adoption of these codes by regulators and policymakers.

Regulatory Reform

Elements of Performance Code Development

The NDWRCDP strategy will be to support generation of alternative approaches and evaluation of the following aspects of model code development and adoption:

Model Code Framework

Under a performance code, performance requirements would be established for various receiving environments based on potential risks to public health and the environment. Elements may include renewable/revocable operating permits, monitoring of actual performance to demonstrate compliance, practitioner training/certification, periodic regulatory program audits, technical guidelines, and other performance-related provisions.

Procedural Options

A model code provides a structure, but the administrative procedures that are used to support the structure can differ. These procedures include permitting, compliance assurance, record keeping, licensing/certification, and establishment of performance requirements.

Administrative Tools

A performance code will result in increased administrative, technical, and management costs. To minimize costs, tools should be developed to simplify tasks as much as possible.

Costs/Benefits

Implementation of a performance code will be costly. The regulatory authorities, practitioners, and public all need to see the value of the increased costs, either through improved water quality, reduced public health risks, higher property values, enhanced standard of living, reduced repair/replacement costs, or increased local employment.

Public Awareness Campaign

The public needs to be informed and involved in identifying the benefits and the need for a performance code. If the information is comprehensible and persuasive, "grassroots" support for a proposed code can be engendered.

The NDWRCDP supports the evaluation and development of a performance code.

Research Priorities

The following are regulatory reform research priorities:

- Evaluate existing delegation of wastewater authorities and programs between state and local agencies, and environmental and public health agencies, and develop models for effective consolidation and/or inter- and intra-agency coordination
- Define and develop the necessary elements of performance-based codes (for example, permitting and tracking systems)
- Evaluate the potential for national performance standards to increase the acceptance of decentralized systems
- Develop minimum performance standard(s) (not prescriptive)
- Evaluate the costs and benefits of performance-based codes
- Develop model performance standards
- Create a national model framework addressing standards and performance evaluation for adoption by states

Training and Education

EPA has recognized that both misinformation and limited public knowledge about onsite systems and their role in water quality impairment, and poor existing engineering and practitioner practices are barriers to more widespread implementation of effective decentralized wastewater management.

In the first round of NDWRCDP projects, the Consortium of Institutes for Decentralized Wastewater Treatment was funded to develop consistent, state-of-the-art training materials for use by all state onsite training centers that reach a broad range of constituencies, including designers and installers, public officials, and homeowners. The Consortium also will develop curricula for professional education in colleges and universities, where the concepts of decentralized wastewater management are inadequately covered. These materials are scheduled to be completed in 2003, and will be disseminated nationwide, through Consortium channels as well as through the National Small Flows Clearinghouse (NSFC) and the National Environmental Training Center for Small Communities (NETCSC) at West Virginia University (WVU).

Another recently funded project with the Consortium is for the creation of a student design competition in decentralized wastewater management, with the goal of motivating and engaging undergraduates in the challenges of this emerging field.

Key Audiences

Other strategic targets for education and information dissemination are the small community service providers, local decision-makers and, more broadly, the public. To impact these audiences, insights must be developed to understand how they receive information, what their values are, and how best to maximize their willingness to consider decentralized infrastructure alternatives to central sewers and treatment solutions that have long been engrained in the engineering profession as the only acceptable solution.

Most small communities are unable to consider alternatives properly without the guidance and input from trusted external public or private resource providers who have the knowledge to find technical and funding assistance.

Onsite wastewater treatment system training can reach a broad range of constituencies.

The NDWRCDP has contracted with the Green Mountain Institute for Environmental Democracy to conduct workshops to evaluate existing or emerging decentralized wastewater treatment tools and to identify needed tools to facilitate the work of these service providers with small communities. The summation of these workshops will be available for distribution by early 2003.

Public Involvement

Without effective public involvement in the processes of both making decisions on wastewater-derived problems and setting up effective decentralized system management entities, such a program is not likely to be a sustainable long-term solution. Public involvement and education are being stressed in upcoming EPA documents entitled *Voluntary National Guidelines for Management of Onsite and Cluster Wastewater Systems* and the accompanying handbook for implementation of those guidelines.

Tools developed to involve the public must be non-technical and readily understood, but also must be factually-based and comprehensive enough to allow small communities to make their own determinations on wastewater, drinking water, storm water runoff, and overall watershed infrastructure issues based on local conditions.

Training and Education

To develop effective tools, the NDWRCDP must understand why, when, where, and how they will be used. Several projects have been funded in this regard. First, the Rocky Mountain Institute project described under the Management and Economics section, is developing case studies of several communities that have evaluated decentralized versus centralized wastewater options, with the goal of clarifying key dimensions and issues, such as land use considerations, and financing advantages. Second, the Green Mountain Institute project has been funded to conduct two workshops with small community resource providers and leaders from a sampling of communities in the Mid-Atlantic and Pacific Northwest. The goals of these projects are to gain insights on how to strengthen both the delivery of services to communities dealing with decentralized wastewater choices and the process of considering wastewater and storm water problems and solutions at the local level. These projects are being coordinated with related efforts by the NSFC, National Environmental Services Center (NESC) at WVU, and the EPA Office of Wastewater Management (OWM).

Training centers, such as this one in Michigan, are valuable for educating practitioners and developing training materials.

Both the process and the tools need to be responsive to the values and attitudes of regulatory and other officials, and the public. The Primen study of homeowner values and preferences, which was also described in the Management and Economics section of the plan, will help in designing effective public outreach materials.

Subsequent activities will be generated by the outcomes of this initial round of projects, and will likely be concentrated in the area of tool development to assist in overcoming opposition to implementation of decentralized wastewater solutions and to provide easy-to-follow guidance for local decision makers and citizens on how to effectively use this information.

Research Priorities

The following are training and education research priorities:

- Survey the preferences and values of homeowners and evaluate their influence on selection of wastewater technologies
- Evaluate public attitudes and values (acceptance/fear) and their relation to public health and ecosystem risk perception
- Develop education campaign materials to increase acceptance of decentralized wastewater management and the potentially increased costs
- Develop tools for effective public involvement
- Develop tools for improving public awareness
- Develop effective risk communication tools

National Community Decentralized Wastewater Demonstration Projects — Information Exchange

The National Community Decentralized Wastewater Demonstration Project was initiated by the U.S. Congress in the FY'99 appropriations bill for EPA, in order to "jump start" the process of technology transfer of information on the relative advantages of various decentralized options. Since then, seven projects have been funded:

- Warren, Vermont
- Block Island/Green Hill Pond, Rhode Island
- La Pine in Deschutes County, Oregon
- Monroe County, Florida Keys
- Mobile, Alabama
- Skaneateles Lake, New York
- Table Rock Lake, Missouri

The Warren, Vermont project is one of seven projects that have been funded under the National Community Decentralized Wastewater Demonstration Project.

These are comprehensive, multi-faceted projects, that combine:

- Identification of environmentally critical resource areas
- Evaluation of a full array of risk-management methods that include use of advanced treatment in hot spots
- Stakeholder and community participation in integrated wastewater and land use planning
- Long-term monitoring programs
- New regulatory and management structures that support innovation and accountability at the local level

Creative approaches can be used for community design and wastewater management.

The NDWRCDP has funded a "Coordinated Information Exchange Project" for technical outreach to the community demonstrations. The goals of this exchange are to promote communications among the demonstration projects and the NDWRCDP, to assist the demonstration projects in accessing state-of-the-art information and adapting it for local consideration, and to gain an understanding of the gaps in knowledge and/or implementation experience that these demonstration projects uncover. Achieving these goals will assist the NDWRCDP and EPA in defining future national research and development efforts.

Integrated Water Resources Management: Soft Path Approaches

In February 2002, the NDWRCDP co-sponsored a strategic retreat to discuss the future of distributed and nonstructural approaches to integrated water resources management. Participants included public policy and environmental advocates and experts in design of distributed storm water runoff impact minimization. Areas of expertise included low impact development practices that retain natural infiltration/treatment zones and distribute infiltration and bioretention throughout a development, in use of agricultural stream buffers and other best management practices, and in employment of soft-path flood control measures such as parkland stream buffers. These participants were mixed together with more conventional engineering advocates and decentralized wastewater experts.

Workshop participants discussed a range of environmental, economic, and community benefits that could result from decentralized and nonstructural approaches to water quality protection and integrated water resource management. They developed recommendations for reform of engineering practice, regulatory structures and management, and for research and demonstration projects. Detailed recommendations were made for reform of the water and wastewater financing system, which in the past has favored centralized solutions. These discussions also provide a framework for the future expansion of training, research, and development activities of the NDWRCDP, as it expands beyond wastewater into other sectors of decentralized and nonstructural water quality protection. A summary of this workshop can be downloaded from the NDWRCDP website: ***www.ndwrcdp.org.***

Integrated Water Resources Management: Soft Path Approaches workshop discussions provide a framework for future expansion of NDWRCDP beyond wastewater into other sectors of decentralized and nonstructural water quality protection.

Ongoing Research Project List

Environmental Science & Engineering

Quantifying Site-Scale Processes and Watershed-Scale Cumulative Effects of Decentralized Wastewater Treatment Systems

Colorado School of Mines
$627,500

Development and testing of a methodology for assessing the water quality impacts of decentralized wastewater systems including individual and cumulative effects on local water supply wells and downstream receiving waters. Field and laboratory work, modeling, and stakeholder involvement are included.

Evaluation Methods for Conducting Field Hydrogeologic Investigations for the Design of Cluster Systems and for Assessing the Impacts of High-Density Single-Family Wastewater Soil Absorption Systems

Under Development

Preparation of a guide for planning, site evaluation, and design of large-cluster systems and high-density individual systems. The focus will be on understanding subsurface water movement with regard to the potential for groundwater mounding, which may reverse flow or reach the surface, and to lateral movement that may result in contamination of water wells and water bodies and/or down-gradient breakout of wastewater.

Management & Economics

Developing a Risk-Based Management Program for Water Quality Protection in Tisbury, Massachusetts

Town of Tisbury, Massachusetts
$99,962

An environmental risk assessment of water bodies and groundwater, and development of a risk-based management program for decentralized wastewater systems for the Town of Tisbury, MA. This project has been completed and a final report is available at ***www.ndwrcdp.org***.

Wastewater Planning and Creative Zoning

University of Rhode Island Cooperative Extension
$75,000

Guidance for local officials to demonstrate treatment technologies to support zoning for compact and sustainable land use patterns.

Guidance to Municipalities on Decentralized Wastewater Management

University of Rhode Island Cooperative Extension
$89,460

Guidance for small communities on the use of computer-generated maps and other databases for wastewater management planning.

Decentralized Wastewater Treatment Within San Francisco's Centralized Combined Sewage System: Hunters Point Shipyard Site Specific Study

San Francisco Public Utilities Commission
$75,000

Feasibility of decentralized wastewater treatment options at the former Hunters Point Naval Shipyard redevelopment area.

Integrated Risk Assessment for Individual Onsite Wastewater Systems

Oak Ridge National Laboratory
$200,024

A comprehensive risk-based decision-making approach for onsite/decentralized wastewater treatment and management, including risk assessments of engineering, ecological, public health, and socioeconomic factors.

Evaluation of Approaches to Planning and Management of Cluster Wastewater Collection and Treatment Systems Lombardo Associates, Inc. $148,538	Guidance on planning and implementation of cluster systems in existing communities and new subdivisions. Case studies are included.
Case Studies of Economic Analysis and Community Decision-Making for Decentralized Wastewater Treatment Rocky Mountain Institute $106,295	Identification of the benefits and costs of different scale wastewater facility options (onsite, cluster, and centralized options) in dollar or other terms. Case studies that examine the driving issues, motivations, thought processes, and decision-making methods of stakeholders are included.
Evaluating Customer and Stakeholder Response to Decentralized Wastewater Treatment Technology Options *Under Development*	Analysis of a homeowner survey to predict potential customer responses to both distributed wastewater treatment technologies and system management options.
Regulatory Reform	
State Authorities and Practices Regarding Management of Wastewater Systems Environmental Research Institute of the States $307,143	Development of baseline data on existing state and local wastewater authorities and programs, regulations, and environmental and public health responsibilities.
California Model Ordinance for Onsite Sewage Treatment and Management California State University at Chico $152,035	Model ordinance for onsite wastewater treatment and management that can be used by jurisdictions throughout California to promote regulatory consistency.
An Assessment of Performance Code Development and Production of Matrices Relating Soil Characteristics to Onsite and Decentralized Wastewater Treatment Systems National Onsite Wastewater Recycling Association $95,850	Development of matrices defining the treatment contributions of soil components for onsite wastewater systems and identification of activities involving the development of performance codes for onsite systems throughout the U.S.
Onsite Wastewater Regulator Outreach and Coordination Project Chase Environmental Services, Inc. $50,000	Support of state onsite regulators conferences in cooperation with the NSFC.

Training & Education	
Model Decentralized Wastewater Practitioner Curriculum North Carolina State University—Consortium of Institutes for Decentralized Wastewater Treatment $427,540	Development of curriculum for decentralized wastewater field practitioner training programs, including a series of noncredit short courses that address planning, design, installation, operation, and maintenance.
University Curriculum Development for Decentralized Wastewater Management University of Arkansas—Consortium of Institutes for Decentralized Wastewater Treatment $430,410	Development of curriculum materials for use in college and university engineering and environmental studies programs, including modules for a one-semester laboratory and field practicum in onsite and decentralized water and wastewater treatment and natural systems for water reclamation.
Student Design Competition for Decentralized Wastewater Treatment University of Arizona $70,220	Development of an ongoing student design competition for decentralized wastewater treatment, in order to provide a forum for bringing young professionals into the field. Includes multi-disciplinary teamwork among engineering, soil science, hydrology, watershed science, communications, and public policy disciplines.
Convening Community-Assistance Resource Providers to Build Capacity in Decentralized Wastewater Technology Selection Green Mountain Institute for Environmental Democracy $93,600	Workshops to identify tools and methods needed by community and service providers working with communities to address their wastewater needs.

Founding Organizations and 2002 Project Steering Committee

NDWRCDP Founding Organizations

Coalition for Alternative Wastewater Treatment (CAWT)
Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT)
Electric Power Research Institute (EPRI)
National Rural Electric Cooperative Association (NRECA)
Water Environment Research Foundation (WERF)

2002 Project Steering Committee

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Scott Drake, PE – NRECA
Jeff Moeller, Ph.D., PE – WERF
Dick Otis, Ph.D., PE – At-Large Member
Jerry Stonebridge – At-Large Member
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