United States Environmental Protection Agency

Case Studies of Individual and Clustered (Decentralized) Wastewater Management Programs

State and Community Management Approaches

U.S. Environmental Protection Agency

Office of Wastewater Management

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Acknowledgements

The U.S. Environmental Protection Agency (EPA) acknowledges the many state and local officials who helped develop this report, especially those who shared information about their programs and provided photographs. EPA commends the case study sponsors highlighted in this report for developing site-specific approaches that enhance the management of individual and clustered (decentralized) wastewater treatment systems.

For more information on decentralized wastewater systems or how to start a management program, visit EPA's Decentralized Wastewater Management website at **http://water.epa.gov/infrastructure/septic**. The website contains information on treatment system technologies, links to partner organizations, a discussion forum on wastewater management issues, publications for homeowners, and guidance manuals, including additional resources that supplement this report. Electronic copies of this report can also be downloaded from the EPA Decentralized Wastewater Management website.

Cover photos courtesy of:

Training system owners: Deschutes County Environmental Health Department, Oregon

Installing a treatment system: Florida Department of Health

Keuka Lake: Keuka Watershed Improvement District, New York

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Executive Summary

More than one in five homes in the United States are served by individual or small, clustered wastewater systems, which collectively treat more than four billion gallons of sewage every day. Proper management of that vast, decentralized wastewater treatment infrastructure helps to protect drinking water sources and helps to keep our waters clean so that people can swim and fish in our streams, rivers, lakes, and oceans.

EPA intends this document to serve as a resource for decision makers in rural, exurban, and suburban communities across the country who want to provide effective, efficient wastewater treatment. Local decision makers know the wastewater management challenges they face: 1) in existing developed areas with old, undersized, or malfunctioning septic systems; and 2) in newer developments that need high-performance treatment facilities to protect groundwater and nearby lakes, rivers, streams, wetlands, and coastal waters.

This compendium of case studies illustrates how a few communities met—and bested—those challenges. Although the approaches varied considerably, the communities featured in this document assessed existing system performance, created new development requirements, and instituted management measures to ensure that all systems were operated and maintained appropriately. The communities considered a wide variety of treatment technologies, from simple septic systems to advanced treatment clustered units, as noted in the examples in the following sections.

The communities used a mix of public and private sector resources to identify which existing systems needed attention, what type of repair or replacement service was required, and how new development would be served. Local leaders also used new treatment technologies, such as high-performance, clustered treatment facilities for areas with small lots and challenging site conditions (e.g., poor soils, steep slopes, high groundwater table). An added benefit for many communities was the opportunity to create green jobs while improving treatment system management and performance.

The communities highlighted in this document differ in many ways, but they all followed a fairly simple process in crafting and implementing their wastewater management programs. This process, which any community can appropriately adopt, includes the following steps:

- **Conduct initial scoping and outreach—find out what and where the problems are, who is affected and interested, and what some of the potential solutions might be.**
- **Analyze existing information and resources—identify existing and potential funding sources, collect data on water quality, identify existing treatment system locations and their operating condition, and project future development patterns; use this information to further refine treatment options given the local climate, soils, slopes, hydrology, water quality, and available resources.**

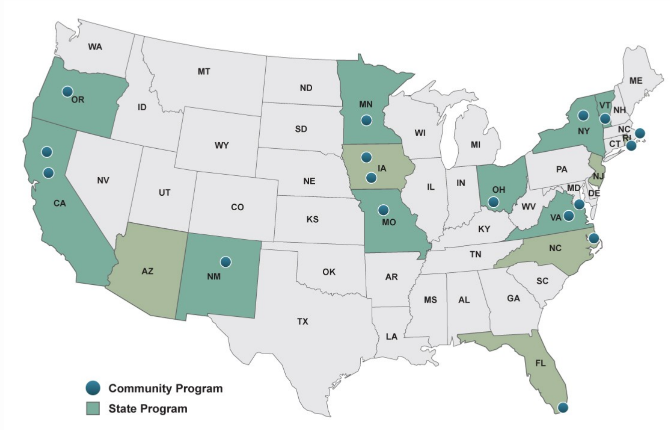
- **Enhance the existing management program or develop a new one—sometimes improvements can be made by fine-tuning local regulatory practices and ordinances. Other cases may require new management entities.**
- **Implement the management program—keep in mind that adopting new ordinances, instituting user fees to pay for services, and starting a system inspection program require a great deal of support.**

EPA has provided additional detail on how to develop management programs for individual and clustered systems in the *Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems*, which can be found at **http://water.epa.gov/infrastructure/septic**. The website also provides other resources and tools.

Non-gravel systems, like this one on a slope, account for half of the onsite systems installed in North Carolina.
Photo: Department of Natural Resources, North Carolina.

Introduction

What do Otter Tail County, Minnesota, and Fairfax County, Virginia, have in common? These two communities, like many others across the country, are working at the local level to better manage some of the nation's 26 million individual wastewater systems. Elected officials and agency staff in these communities reviewed the problems posed by existing, malfunctioning systems, as well as the opportunities presented by proposed new developments outside the currently sewered area, and decided that action to protect water quality and public health required a different approach to wastewater management.



State and Local Decentralized Wastewater Case Studies

Although each community—and each community wastewater management program—differs, certain commonalities exist which are illustrated in this report. In each case, communities identified problems and took deliberate action to deal with them. Both individuals and organizations collected assessment information on system types and locations, water quality conditions, soils and slopes, the future and direction of growth, and other factors. Technicians inspected existing systems and organized the requisite repair/replacement work, and wastewater professionals partnered with planners to identify ways to serve new development.

Elected officials and public agency staff can learn from the experiences of Fairfax County, Otter Tail County, and other communities highlighted in this document. The case study examples on the following pages briefly describe the approaches taken by each community and contain contact information and resources for more details.

What is in This Report

This report builds on EPA's Voluntary National Management Guidelines for Onsite and Clustered (Decentralized) Wastewater Treatment Systems (see green box on page 4), and demonstrates how management programs can be crafted with existing resources. The case studies are grouped under Five Management Models (see page 6) as outlined in the guidelines. Note that management intensity or level of activity increases proportionally with increases in risks posed to public health and the environment, as well as system numbers/densities, and treatment system complexity (i.e., use of pumps, timers, float valves).

This document includes 14 community case studies. The case studies range from very basic to more advanced, reflecting the specific management needs of the community. The exact configuration of each management program varies based on available resources, the nature of the public health and water resource threat(s), and the creativity and involvement of the regulatory agencies and stakeholders. A glossary of terms used in this document and throughout the decentralized wastewater field of practice is also included as an appendix (See Appendix A).

EPA's Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems (EPA 832-B-03-001, published in 2003) was developed to provide guidance on improving the performance of individual and clustered wastewater systems. The guidelines contain Five Management Models (see section on Community Management Programs, and Table 2) that can be combined and tailored to meet specific program needs.

You can view the document at EPA's Decentralized Wastewater website at **http://water.epa.gov/infrastructure/septic**.

Table 2 summarizes the management models and describes how local agencies might apply them in areas with varying environmental sensitivities (e.g., high-risk potential for water contamination).

Who Can Use This Report

Community planners, elected officials, health department staff, state officials, and interested citizens can use this document to explore what other communities are doing and can find examples that fit their own unique needs. No two communities are the same, but program managers can learn what works from each other, who is available to help, and where to find the necessary tools. In many cases, local communities have significant flexibility in developing and implementing wastewater management programs. The case studies contain examples of how some local programs responded to the need for system inspections, pump-outs, and repairs/replacements, among other services. In all the presented cases, people made the difference.

Local Officials

The case studies in this report highlight the wide range of management choices available to communities with wastewater issues. The case studies show how communities can modify EPA's Five Management Models to meet local management needs. Additionally, the case studies provide an opportunity for peer-to-peer interaction and support among local health and environmental officials via the contact information listed for each community. Each case study lists a point of contact that can answer questions and provide additional information about that particular community's program.

Community Members

Community members, including elected officials, planners, citizens, service providers, and practitioners, are important stakeholders in developing a wastewater management program. The many different system management approaches presented in this report can help community members solve local problems.

State Officials

State and tribal health and environmental agency officials can also use this report to enhance local capacity to manage or regulate individual and clustered wastewater systems. State Revolving Fund (SRF) program managers can also use this report to educate loan applicants on the types of decentralized wastewater management options used around the country and encourage better management of decentralized systems.

Photo: University of Rhode Island.

Community Management Programs

The case studies highlight approaches used by communities across the nation to manage individual and clustered wastewater systems. They are grouped under EPA's Five Management Models (see page 6) and describe how communities have crafted management programs using mostly existing staff, funding, and other resources. Readers may recognize elements of their own local situations in these case studies, which include examples from a variety of community types, locations, and environmental settings.

Community Wastewater Issues

While the management programs presented in this report differ, many common issues motivated each one. Table 1 (see page 6) lists some of the wastewater issues that prompted local action in the 14 communities. This chart can be used as a starting point to help pinpoint case studies of interest.

Table 1: Community Wastewater Issues*

Community case study	Inadequate, poor, or no treatment	Poor soils, slopes, site conditions	Population growth in the project area	Risks to the environment/ public health	Real/potential surface water contamination	Real/potential groundwater contamination
Fairfax County	●		●		●	●
Jamestown	●	●	●	●	●	●
Albemarle Region		●	●	●	●	●
Keuka Lake	●				●	●
Lake Panorama		●		●		
Hamilton County	●				●	●
Monroe County	●	●	●	●	●	●
The Sea Ranch	●				●	
Auburn Trails	●	●				
Otter Tail Lake	●			●	●	
Peña Blanca	●				●	●
Blacksburg			●			
Phelps County	●					
Shannon City	●			●	●	

* As identified by the 14 case study communities, 2009.

Management Models

The Five Management Models developed by EPA describe system management approaches (see page 7). In general, the approaches are flexible and range from local regulatory agency support for homeowner operation/maintenance (e.g., through inventories and service reminders) to more rigorous programs that involve maintenance contracts, operating permits, and system operation by trained professionals hired by a responsible management entity.

Table 2: Decentralized Wastewater System Management Models for Use by Local Communities

Typical applications	Program description	Benefits	Limitations
1. Homeowner Awareness: Local agency service reminders, educational information, and inventory			
• Areas of low environmental risk	• Systems sited and constructed according to prescribed criteria • Maintenance reminders • Inventory of all systems	• Ease of implementation • Inventory of systems that is useful for tracking and area-wide planning	• No compliance tracking or monitoring mechanism • Limitations on advanced treatment systems due to operation and maintenance (O&M) requirements
2. Maintenance Contract: State/local requirements that certain systems be professionally managed			
• Areas of low to moderate environmental risk where sites are marginally suitable for individual systems • Small clustered systems	• Use of advanced treatment options and clustered systems • Service contracts for system O&M • Tracking system for services provided • Inventory of all systems	• Previously unbuildable lots can be served • Prompt attention to treatment system problems • Lower risk of treatment system malfunctions	• Higher level of expertise and resources needed by regulatory agencies and system service providers • Requires compliance assurance mechanism
3. Operating Permit: Revocable/renewable state/local permit specifying operation/maintenance requirements			
• Areas of moderate to high environmental risk • Systems treating high-strength wastes, or cluster systems	• Renewable, revocable system operating permits • Performance and monitoring requirements	• Regulatory agency directly checks system operation and performance through permit issuance program	• Agency resource requirements are significant • Effluent monitoring can be expensive
4. Responsible Management Entity (RME) Operation & Maintenance (O&M): Professional, third-party O&M			
• Areas of moderate to high environmental risk • Clustered systems	• System operation, performance monitoring, and repair/replacement is handled by a third party • RME holds operating or NPDES permit; homeowner retains ownership	• Same as #2 above, but removes homeowner from responsibility role • Regulatory agency tracks fewer system managers	• May require code changes to allow RME to hold operating or NPDES permit • RME financial and payment assurance requirements
5. Responsible Management Entity (RME) Ownership: Ownership and O&M by third party entity			
• Areas of greatest environmental risk	• Same as #4 above, but RME also owns system infrastructure/property	• RME has full access to system and all components	• Same as #4 above

Table 2 describes the approaches used in the Management Models, including various methods for addressing the component parts of a management program structure. EPA's *Guidelines for Management of Individual and Clustered (Decentralized) Wastewater Treatment Systems* identify 13 key program elements (see Appendix B) that can compose a management program (see **http://water.epa.gov/infrastructure/septic**).

How to Ensure the Success of Your Management Program

The case studies in the following sections offer examples of planning, implementing, and maintaining a wastewater management program. As stated previously, while the programs differ in their management approaches, each example addresses some common themes:

1. Spend time at the outset with stakeholders to understand the issues.

In each of the case studies, community leaders took the time to understand their communities' wastewater issues. Local officials worked closely with state agencies, service providers, planners, homeowners, and other stakeholders to collect data and information in order to identify issues and management options. An important part of the process of setting up a management program is to understand key issues and provide stakeholders—citizens, system owners, service providers, and staff from sister agencies—with an opportunity to participate.

2. Research the applicable regulatory framework and legal authority to determine how to support a management program.

Effective decentralized wastewater management programs derive their structure from appropriate legal authorities. In these case studies, local health departments and local governments used existing authorities or newly adopted powers to address wastewater management challenges posed by existing and new development. In some of the case studies, local health departments, authorized under state law, used their powers to implement management program measures. Other communities adopted new local ordinances to ensure authority for management in the face of public health or water resource threats. Communities can determine the type of program allowed under existing statutes and evaluate whether they need additional authority to implement their desired program.

Installation of an advanced treatment system.

3. Adopt a process that targets environmental risk and supports sustainable technologies.

A key action in each case study is matching the wastewater treatment system(s) to site conditions, such as soil, slopes, geology, and hydrology. For example, clustered facilities that collect wastewater from dozens—or even hundreds—of septic tanks can be used to provide advanced treatment in areas with small residential lots and environmentally sensitive receiving waters. The case studies describe methods used to sustain more complex technologies (e.g., those with timers, pumps, float switches), such as more frequent inspections and greater attention from better-trained service professionals.

4. **Design a sustainable program.**
A long-term strategic plan to monitor and continually assess the performance of wastewater treatment systems will enable a community to more effectively meet its public health, resource protection, and other water quality goals. Water quality and performance monitoring are common tools for determining the effectiveness of a management program and identifying additional issues and needs. Securing a sustainable source of program funding is critical to the success of a program. Communities may collect user fees or secure loans and grants to create and sustain management programs (see **http://water.epa.gov/infrastructure/septic** for more information on funding resources).

Case Study Structure

The 14 case studies reflect each community's efforts to identify relevant public health or environmental threats, assess the local situation, set goals for system management, and craft an appropriate wastewater management program. Each of the case studies includes the following:

- **An overview of the problem(s) facing the community**
- **The proposed system management solution**
- **A general description of the program and its key features**
- **Funding sources**
- **Results**
- **Resources and contacts**

Installing a treatment system.
Photo: Florida Department of Health.

The program summaries offer a synopsis of the Five Management Models reviewed in the previous section. Each program generally follows the Management Model descriptions provided in Table 2, on page 7. Table 3 (see page 10) identifies some of the common program activities featured in the case studies.

Table 3: Wastewater System Management Program Activities Supported by the Case Studies

Community case study	Inspections	Maintenance reminders	Database	Reporting/ recordkeeping	Maintenance contracts	Licensed svc. providers	Permitting	Performance monitoring	Management entity	Water quality monitoring
Fairfax County	●	●	●	●	●					
Jamestown	●	●	●	●	●	●				
Albemarle Region	●	●	●	●	●	●	●	●	●	●
Keuka Lake	●	●	●	●	●	●	●	●	●	
Lake Panorama	●	●	●	●	●	●				
Hamilton County	●	●	●	●	●	●	●			●
Monroe County	●	●	●	●	●	●	●	●		●
The Sea Ranch	●	●	●	●	●		●	●	●	●
Auburn Trails	●	●	●	●		●		●	●	●
Otter Tail Lake	●	●	●	●	●	●				
Peña Blanca		●	●	●	●	●	●		●	
Blacksburg	●	●	●	●	●	●	●	●	●	●
Phelps County	●	●	●	●	●	●	●		●	●
Shannon City	●	●	●	●	●	●	●	●	●	●

Management Model 1: Homeowner Awareness

Management Model 1: Homeowner Awareness targets the maintenance of individual wastewater systems in jurisdictions with limited resources. Communities may want to select this model where systems pose a relatively low risk to public health and water resources—such as low-density development in upland areas away from surface waters, where soil moisture is low to moderate, groundwater tables are low, and slopes do not exceed 15–25%.

Elements of Management Model 1

Management Model 1 includes three principal elements:

- **A system inventory and database to identify the location, type, and condition of systems**
- **Training and certification of design, installation, and operation/maintenance professionals**
- **Regular maintenance and service attention reminders to encourage system management**

Focus on System Maintenance

Management Model 1 programs promote appropriate system maintenance through requirements, reminders, or provisions for periodic inspections by trained and certified maintenance providers. Management Model 1 programs typically consist of:

- **Local public agency permits for construction of new systems and system repair/replacement**
- **A database containing system locations, types, and owners**
- **Inspection of systems, based on type and/or location**
- **A tracking system for residuals treatment, reuse, or disposal**
- **Permit compliance schedules issued by the regulatory agency to ensure remediation of identified problems**
- **Maintenance reminders for inspections, pump-outs, and other maintenance activities**

Program Characteristics

- **Easy to implement, low administrative requirements**
- **Wastewater data and information available for use in local and regional planning**
- **No additional compliance mechanisms beyond conventional public health and nuisance powers**
- **Limited ability to review, inspect, and regulate complex advanced treatment system**
- **Largely dependent on homeowners for operation and maintenance (O&M) of systems**

Two Case Studies

Many homeowner awareness programs are operating across the country. The most successful ones not only involve homeowners, but also support the homeowner in conducting maintenance (e.g., checking septic tank sludge levels). This section reviews two such programs:

- **Jamestown, Rhode Island**
- **Fairfax County, Virginia**

Fairfax, Virginia requires all new and repaired individual wastewater systems to install a flow diversion valve, like this one pictured, to allow the drainfield to dry out and avoid saturation problems.

JAMESTOWN, RHODE ISLAND

PROBLEM

Jamestown is a small, island town dependent on private drinking water wells and individual wastewater systems. Poorly maintained onsite wastewater systems on undersized lots with high seasonal water tables were affecting groundwater quality. Studies revealed that 32% of the wastewater treatment systems in the area were contributing to nutrient and pathogen problems in private water wells (Legislative Press and Public Information Bureau, 2006).

SOLUTION

Jamestown adopted an ordinance requiring routine inspections of individual wastewater systems. A High Groundwater Table District also guides future development to protect drinking water quality.

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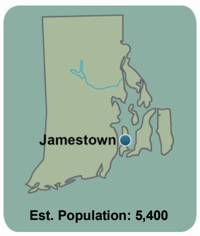

OVERVIEW

Jamestown is located on a small island situated in the middle of Narragansett Bay in Rhode Island. It is approximately nine miles long and one mile wide. In 2001, Jamestown passed an ordinance to better accommodate growth and manage individual wastewater systems to protect its fresh water supplies. The program consists of:

- **Routine inspections**
- **Maintenance reminders**
- **Web-based system database**
- **Siting and installation rules**
- **Designation of a High Groundwater Table District**

MAINTENANCE INSPECTIONS AND WEB-BASED TRACKING

Jamestown's program provides a framework for the inspection, maintenance, and repair of individual wastewater systems. The town conducted an initial round of inspections in 2003 aimed at identifying and evaluating the condition of 1,608 individual systems. Jamestown then began a routine maintenance inspection program in 2006 under which systems are inspected every three or five years based on size, type of system, and water use. Inspectors record the inspection information in the town's web-based database. The town has the authority to pump tanks at the owner's expense and, if necessary, can place liens on property for failure to reimburse the town for the pump-out.

HIGH GROUNDWATER OVERLAY ZONE AND IMPERVIOUS LAYER DISTRICT

Jamestown adopted a High Groundwater Overlay Zone and Impervious Layer District Ordinance in 2003. The ordinance applies to designated areas in the town that have substandard-sized lots served by private wells. Provisions of the ordinance include a total impervious surface area limit of 15% (calculated for individual lots and excluding wetlands), a requirement to control runoff volume—using low-impact techniques—to maintain predevelopment infiltration for a 25-year storm, and a mandate to use advanced wastewater treatment technologies capable of 50% nitrogen removal.

FUNDING SOURCES

Jamestown's program is funded through an annual user fee of $30 paid by system owners. The fee funds the town's part-time wastewater management specialist.

RESULTS

- **To date, 94% of all septic systems have had an initial maintenance inspection.**
- **Of the systems inspected:**
  - **35 failed (2%)**
  - **85 (5%) were found to be substandard systems (e.g., cesspools, systems with steel tanks)**
  - **1,488 passed (93%)**
- **Since 2003, 50 systems have been subject to repair/replacement actions initiated by the town.**

Property owners are responsible for ensuring that their system is operating properly and that it is maintained in good repair. Systems that do not meet applicable performance requirements can be subject to a repair or replacement order. Addressing malfunctioning systems helps to reduce nitrogen and pathogen pollution that pose threats to Jamestown's drinking water sources.

References and Resources

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FAIRFAX COUNTY, VIRGINIA

PROBLEM

During the past three decades, the population of Fairfax County has grown to more than one million people. With sanitary sewers at or near capacity, the number of individual wastewater systems began to multiply, eventually rising to more than 24,000. Inappropriately sited, improperly designed, and/or poorly managed individual systems have the potential to contribute to the pollution and degradation of the county's 900 miles of perennial and intermittent streams and a number of freshwater lakes and ponds.

SOLUTION

Fairfax County adopted an ordinance requiring routine pumping of septic tanks every five years and alternating drainfields and drainfield reserve areas to ensure system performance.

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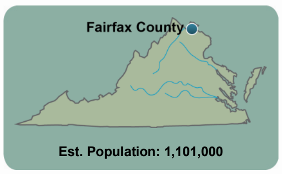

OVERVIEW

Fairfax County's decentralized wastewater management program has evolved since the first measures to improve onsite treatment were enacted in 1928. The program now includes:

- **A treatment system inventory and database**
- **Requirements for alternating drainfields and reserve areas**
- **Tank pump-outs at least once every five years, and pump-out manifests provided to the county health department**

ALTERNATING DRAINFIELDS AND RESERVE AREA

The Fairfax County Health Department issues permits and provides inspections and evaluations for new and existing individual wastewater system repairs and expansions. All new and repaired systems are designed with a flow diversion valve to allow portions of the drainfield to dry out; this improves treatment and avoids soil saturation problems. A suitable reserve area is required in the event that the system needs to be repaired or replaced.

FIVE-YEAR PUMP-OUT AND MANIFEST SYSTEM

An ordinance specifies that septic tanks must be pumped every five years. The service provider and the system owner both provide copies of the pump-out manifests to the county health department which tracks maintenance. The information is maintained in a database and is used to track compliance with the local ordinance. The database generates five-year pump-out reminder notices that the Health Department mails to system owners. The health department also offers $200 individual system inspections if required by a mortgage lender at the time of property transfer.

FUNDING SOURCES

Fairfax County sustains its annual $1.5 million onsite program through user fees and dedicated funds. The fees cover approximately 30% of the program costs. The remainder is financed through dedicated state and local funds.

RESULTS

A recent study found that the average malfunction rate for systems in the county was only 2.1% of the 15,401 systems reviewed. In addition, many systems thought to have outlived their life expectancy are still functioning satisfactorily.

The creation of a database for system inventory has allowed the county to track septic tank pump-outs and categorize all systems according to system type, greatly assisting the enforcement of existing codes and regulations. The use of alternating drainfields has increased the average lifespan of sewage disposal systems.

The five-year pump-out requirement has resulted in better maintained systems and the identification of system malfunctions that would otherwise go undetected. As a result of these measures, fewer owners are facing costly major repairs or system replacements.

Through its program, Fairfax County now better understands and manages its many onsite systems even in light of a fast-growing population.

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Management Model 2: Maintenance Contract

Management Model 2: Maintenance Contract targets areas at higher risk of environmental degradation due to higher system densities, more complex treatment technology maintenance, or other factors. Local authorities establish site evaluation criteria, identify appropriate treatment technologies, and require that certain systems (e.g., electro-mechanical, advanced treatment, disinfection) submit to ongoing and regularly scheduled operation and maintenance efforts via contracts with approved service professionals.

Program Characteristics

- **Problems identified quickly in order to lower risk of malfunctions**
- **Systems have longer life spans and better overall performance**
- **Homeowner or service provider maintains contract and reports issues to regulatory agency**
- **Regulatory agency develops a procedure to track current and delinquent contracts**
- **Regulatory agency may have limited authority to remedy problems and assure compliance**

Elements of Management Model 2

Management Model 2 includes three key elements:

- **Minimum performance criteria for all approved systems and components**
- **Maintenance contracts for clustered systems and advanced individual systems**
- **Responsibility for system maintenance with service professionals trained and certified by the appropriate regulatory agency, and in accordance with relevant O&M procedures, standards, or practices**

Focus on Maintenance Contracts

Management Model 2 promotes proper performance of advanced and clustered systems through the use of required maintenance contracts. Management Model 2 programs typically consist of:

- **A certified and licensed contractor inspects and maintains the system as appropriate given the type, size, and location**
- **System owners must submit a copy of the system O&M manual or standards of practice after installation to the regulatory authority, enter into an ongoing maintenance contract with a certified service provider, and submit a signed report directly to the regulatory agency after each inspection or service event**
- **The program uses databases to track maintenance contract status, services provided, and overall system compliance**

Case Studies

The most effective Management Model 2 programs employ mechanisms to ensure that maintenance contracts are kept current and implemented properly. This section reviews three of these programs:

- **Albemarle, North Carolina**
- **Keuka Lake, New York**
- **Lake Panorama, Iowa**

ALBEMARLE REGION, NORTH CAROLINA

PROBLEM

Rivers and streams of the Albemarle Region of North Carolina are nutrient-sensitive and require nutrient input controls such as upgrades for wastewater treatment plants and septic systems. Both strategies are being pursued by state and local officials. Much of the area is unsuitable for conventional gravity-flow individual systems due to low-permeability clay soils and high water tables. In past decades, these limitations prompted the extensive use of sand-lined trench leaching systems in the region. A 1991 study found that 30% of those systems were malfunctioning and posing risks to groundwater and surface water quality.

SOLUTION

Local governments authorized a regional management entity to inventory and monitor individual wastewater systems, improve system management, and develop site-specific design criteria for new and replacement systems incorporating advanced treatment technologies.

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OVERVIEW

Individual wastewater system malfunctions, water quality risks, and the explosive growth experienced in the Albemarle Region prompted 11 North Carolina counties to form the Albemarle Septic Management Entity (ASME) in 1993. ASME has instituted a management program that consists of:

- **Routine inspections**
- **Use of advanced treatment system designs for difficult site conditions**
- **Maintenance contract requirements and reminders**
- **Operating permit requirements for advanced units**
- **Alternating drainfields and reserve areas**

MAINTENANCE AND INSPECTION AGREEMENTS

ASME oversees individual and clustered systems in an 11-county area. ASME requires owners of all advanced and innovative systems to enter into inspection and maintenance agreements with the program. In addition, ASME requires that all repaired or replaced systems be included in the system management service area.

ASME works with low-income system owners to identify grant and low-interest loan funding to address repairs and replacements for problem systems using a combination of Community Development Block Grants, the North Carolina Clean Water Trust, and other sources.

ASME inspects systems in its jurisdiction at least annually. The system owner must complete all repair and maintenance activities. If an owner fails to make repairs, ASME is authorized to make the needed repairs and bill the owner and, if needed, place a lien on the property until payment is secured.

OPERATING PERMITS FOR ADVANCED SYSTEMS

ASME allows the use of advanced pressure-dosed systems, which incorporate fixed aerobic film and/or suspended growth pretreatment followed by soil absorption. Advanced systems require an operating permit. The local health department issues operating permits in accordance with state and local rules.

FUNDING SOURCES

The annual budget for the ASME wastewater program is $290,000. The program is sustained through its $300 per home permit fees, annual $50 system inspection fees, and county funds.

RESULTS

Local officials note that the management entity has prevented system malfunctions through more rigorous design, inspection, and operation/maintenance requirements. In the early 1990s, estimates of system malfunctions ranged as high as 30%. During 2007–2008, the program inspected 2,153 of the 4,240 systems under its management purview, and fewer than five of the newly installed systems were found to be malfunctioning.

New system installations and increasing the number of properly functioning systems through inspections will help to reduce nutrient pollution in the Albemarle watershed.

References and Resources

Hollowell, R. 2001. The Public Management Entity Program: Albemarle Regional Health Service. 2001 National Onsite Wastewater Recyclers Association Meeting, Preconference Workshop; Virginia Beach, VA.

Hughes J., and Simonson, A. 2005. Government Financing for Onsite Wastewater Treatment Facilities in North Carolina. **www.sog.unc.edu/pubs/electronicversions/pg/pgfal05/article4.pdf**.

KEUKA LAKE WATERSHED, NEW YORK

PROBLEM

Approximately 20,000 residents in the Keuka Lake watershed rely on groundwater and the lake for their drinking water. Nearly all of the residents in the watershed also depend on individual wastewater systems that are densely positioned and that discharge to the soil for treatment. However, testing revealed that poorly maintained individual onsite systems were contributing excessive levels of bacteria to the lake and contaminating drinking water wells.

SOLUTION

Eight municipalities formed a regional watershed cooperative that implemented a uniform permitting and inspection program to identify and repair or replace malfunctioning treatment systems. As a result, Keuka Lake's water quality ranks among the highest of the water bodies in the Finger Lakes region.

Keuka Watershed Improvement Cooperative
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OVERVIEW

In 1994, eight municipalities—Barrington, Jerusalem, Hammondsport, Milo, Penn Yan, Pulteney, Urbana, and Wayne—bordering Keuka Lake formed the Keuka Watershed Improvement Cooperative (KWIC) to better manage individual and decentralized wastewater systems in the region. KWIC has instituted a management program that consists of:

- **Uniform regional ordinances**
- **System inspection requirements based on health and environmental risk factors**
- **Maintenance contract requirements for mechanized units**
- **Operating permit requirements for new or modified systems**

ROUTINE INSPECTIONS AND MAINTENANCE CONTRACTS

Municipalities participating in the KWIC program must adopt a uniform wastewater management ordinance and hire a coordinator to inspect treatment systems in their communities. All 3,000 wastewater systems within 200 feet of Keuka Lake or its tributaries are inspected at least once every five years. Inspection reports are filed with KWIC. Aerobic and advanced treatment systems are inspected annually, at which time the system owner must show evidence of an active maintenance contract. Systems are also inspected when property is sold.

The regional ordinances require a KWIC operating permit for all new or modified individual wastewater systems. A system that is malfunctioning must be repaired to meet specific performance requirements. Additionally, KWIC could require the system owner to upgrade or replace the malfunctioning system using the best available technology.

KWIC utilizes a computerized database to track inspections and system compliance. KWIC reviews lake water quality information and evaluates the performance of advanced systems. KWIC's enforcement authority includes fines and compliance timetables in addition to corrective actions.

FUNDING SOURCES

The KWIC program is financed by permit fees and dedicated funds from each municipality's budget. The program's annual budget is $70,000.

RESULTS

Water quality monitoring results indicate very good lake conditions, though runoff from stormwater and agricultural sources after storm events can result in high bacteria levels. The relatively clear water in the lake contains low nutrient levels and supports excellent fisheries. Monitoring results from 2005–2009 show lake water quality improving or holding steady for nearly all parameters. The local lake association attributes this progress, in part, to the septic system inspection program.

References and Resources

Keuka Lake Association. 2001. Phase II, Keuka Lake Sewage Study. **www.keukalakeassoc.org**.

Landre, P. 1995. The creation of Keuka Lake's Cooperative Watershed Program. Clearwaters Magazine, Summer 1995, 28-30.

Smith, J.C. 1995. Protecting and Improving the Waters of Keuka Lake. Clearwaters Magazine, Summer 1995, 32-33.

Population data—Keuka Lake Association. **http://www.keukalakeassoc.org/**

LAKE PANORAMA, IOWA

PROBLEM
Residential growth is a challenge in unsewered resort communities like Lake Panorama, Iowa, due to the need to protect lake water quality from septic system impacts. Lake Panorama is one of the largest private lake resort communities in Iowa. Installing conventional, soil-discharging wastewater systems is difficult in this community because of steep slopes, ravines, low-permeability soils, and small and oddly shaped lots.

SOLUTION
The community created a management district to accommodate growth and protect water resources through the use of advanced, clustered, and innovative onsite wastewater treatment systems.

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OVERVIEW

In 1980, the Lake Panorama Association and the Guthrie County Board of Health worked together to create the Lake Panorama Onsite Wastewater Management District. A county ordinance authorized the district's formation, which operates under the supervision of the Guthrie County Health Department. The program consists of:

- **Routine inspection requirements for treatment systems**
- **Maintenance contract requirements and service reminders sent from the management district**
- **Licensing requirements for system inspectors and septic tank pumpers**
- **System inventories to track installations, repairs, and replacements**

ROUTINE INSPECTIONS AND MAINTENANCE CONTRACTS

The Lake Panorama Onsite Wastewater Management District manages six clustered systems, 17 sand filter facilities, 25 aeration units, 25 aeration/drip dispersal systems, one mound unit, and one gray water collection/treatment system.

Inspections are authorized through the homeowners' association and performed by the county sanitarian. Individual systems are inspected every three years for full-time residents and every six years for part-time residents.

Maintenance contracts with manufacturer-certified technicians are required for mechanical aerobic systems. Inspections are conducted quarterly for those systems, and reports are filed with the county. Owners are responsible for system maintenance, including pumping and repairs. The district has the authority to request that the homeowners' association terminate water service for owners with noncompliant systems.

FUNDING SOURCES

Guthrie County Health Department funds the program through the collection of annual fees. The annual fee for conventional system owners ranges from $5 to $10, plus any repair or pumping costs. The fee for permitting a system is $225, and the inspection fee is $30. Tank pumping averages $225. Cluster system users are billed at a rate of $50 a year.

RESULTS

The management programs for Lake Panorama have likely provided ongoing protection for Lake Panorama as indicated by water quality monitoring results. Bacteria concentrations at the Lake Panorama outlet are lower than that of other reaches of the Raccoon River system. Over the past few years, the district has logged only one aeration treatment unit malfunction annually, out of more than 1,000 homes on line. Additionally, system costs—though a bit higher initially—are lower than previous totals overall, as costs focus more on routine maintenance than replacement of malfunctioning systems.

The communities of Lake Panorama now better understand their onsite systems and can manage these systems appropriately to accommodate growth in the area.

References and Resources

Mancl, K. 2000. National Onsite Demonstration Program Case Study Report: Lake Panorama, Panorama, Iowa. Prepared for the National Onsite Demonstration Program, West Virginia University, Morgantown, WV.

Mancl, K. 2001. Onsite Wastewater Management: A Model for Success. In Proceedings of the 9th National Symposium for Individual and Small Community Sewage Systems, American Association of Agricultural Engineers, St. Joseph, MI. March 11-14, Fort Worth, TX.

Mancl, K., and Patterson, S. 2001. Twenty Years of Success in Septic System Management. In Proceedings of the 9th National Symposium for Individual and Small Community Sewage Systems, American Association of Agricultural Engineers, St. Joseph, MI. March 11-14, Forth Worth TX.

Population data—Lake Panorama Association. **http://www.lakepanorama.org/home.asp**

Management Model 3: Operating Permits

Management Model 3: Operating Permits is recommended for situations in which the ability to verify system performance is critical to protect public health and water quality. Management Model 3 includes regular review of system operation and performance by a regulatory agency and is appropriate for areas of moderate to high environmental risk.

Program Characteristics

- **Design based on performance objectives rather than standard system types**
- **Sustained resources and technical expertise needed to implement an effective permitting program**

Elements of Management Model 3

Management Model 3 includes three key elements:

- **Renewable or revocable operating permits issued to the system owner**
- **Specific and measurable performance criteria and regular submission of compliance reports**
- **An inventory and tracking system for system permits and inspection/compliance reports**

Focus on System Performance and Licensed Inspectors

Because of the focus on performance criteria, this management model allows the use of individual or clustered systems at sites with a greater range of site characteristics. Systems must meet performance criteria established to protect public health and water quality resources for the receiving waters (i.e., groundwater or surface waters).

Management Model 3 programs typically consist of:

- **Operating permits for continuous oversight of system performance**
- **Inspections by licensed inspectors usually required before permit renewal**
- **Permits that are valid for a specified period (e.g., three to five years), as determined by the regulatory entity based on performance (determined via effluent samples), surface water quality, or compliance with specific operational parameters**

Case Studies

Effective Management Model 3 programs often reward good system performance with extended permit renewal terms while requiring shorter permits and more frequent inspections for owners with poorly performing systems. This section reviews four such programs:

- **Hamilton County, Ohio**
- **Monroe County, Florida**
- **The Sea Ranch, California**
- **Auburn Lake Trails, California**

Sand filter systems, like this one being installed in Hamilton County, use sand to treat effluent. The effluent from the sand filter is then discharged, in pressurized doses, to a soil absorption bed.

HAMILTON COUNTY, OHIO

PROBLEM
Potential public health threats posed by bacteria and viruses in surface waters prompted the Hamilton County Board of Health to investigate some 10,000 mechanized onsite wastewater systems. The inspections revealed that 3,400 (34%) of the systems—mostly serving individual homes—were substandard or malfunctioning.

SOLUTION
The Hamilton County General Health District upgraded its onsite wastewater program to include operating permits and routine inspection requirements to maintain system performance.

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OVERVIEW

In 1993, the Hamilton County Board of Health adopted more stringent rules to better manage an estimated 20,000 individual wastewater systems, half of which were aeration units discharging to soil absorption fields or surface waters. The board has since adopted additional changes to its program, which now consists of the following:

- **Routine inspections for treatment systems**
- **Renewable operating permit requirements**
- **Maintenance contract requirements**
- **An integrated database and geographic information system (GIS) used to track system location and condition**

MAINTENANCE CONTRACTS AND INSPECTIONS

The Hamilton County General Health District approves plans, issues permits, and conducts inspections for all individual and small flow treatment systems (with the exception of the cities of Cincinnati, Norwood, Springdale, and Sharonville). Individual systems are inspected every five years, while mechanical systems, such as mounds, dosed leach lines, and aerobic treatment units, are inspected once per year. The Health District issues one-year or five-year renewable operating permits based on the system's complexity. The county is authorized to revoke permits for noncompliance; penalties include injunction, criminal prosecution, or other measures if required corrective actions are not taken. Owners of mechanical systems are required to have annual maintenance, monitoring, and service contracts. Maintenance providers must be registered, bonded, and must meet specific training requirements.

INTEGRATED GIS DATABASE

Hamilton County developed an integrated GIS database to track the location and condition of individual and clustered systems. The county also uses the database to compare any waterborne disease outbreaks with the latest system inspection surveys and collector line sampling results.

FUNDING SOURCES

The county's 2008 decentralized wastewater program budget was $1.24 million, funded by $850,000 in user fees and $390,000 from the Hamilton County Storm Water District. Fees include $40 for inspecting mechanical systems and $85 for inspecting conventional, gravity-flow, individual systems. Legislation authorizing property liens has helped to eliminate delinquent inspection fees.

Results

The program has identified and required the repair/replacement of thousands of noncompliant systems, many of which were discharging poorly treated sewage to area streams or directly to the ground surface. Since its inception, more than 2,300 malfunctioning systems have been replaced and over 32,000 system repairs have been completed.

Studies conducted in 2000 and 2001 found a 54% improvement in suspended solids, a 36% improvement in biochemical oxygen demand, and a 60% improvement in fecal coliform over baseline data collected five years earlier.

In addition, mechanical system malfunctions dropped from a high of 44% to a consistent and predictable rate of around 18%. Non-mechanical system malfunctions were over 23% in 2003 and have currently dropped to 2.6%. Onsite sewage treatment system nuisance complaints dropped from 371 in 2003 to 258 in 2009.

References and Resources

McKenzie, M.C. Hamilton County Ohio: An Onsite Wastewater Management Success Story. Small Flows, Vol. 12, No. 4, Fall 1998.

Ingram, T. 1999. Onsite Wastewater Management - An Integrated Approach to Improving Water Quality and Preventing Disease. Journal of Environmental Health, Vol. 62, 1999.

Sweeney, M., Quinn, T., Quinn, B., and Allen, R. 1998. GIS Involving the Community: The Hamilton County Environmental Priorities Project. ESRI Annual Conference, 1998. **http://proceedings.esri.com/library/userconf/proc98/proceed/TO550/PAP510/P510.HTM**. Accessed March 31, 2010.

Population data—Census Bureau, State and County QuickFacts, Hamilton County, 2011. **http://quickfacts.census.gov/qfd/states/39/39061.html**

MONROE COUNTY, FLORIDA

PROBLEM

Monroe County, Florida, is home to the Florida Keys and a complex and dynamic marine ecosystem—including the world's third-largest coral reef. The county is also home to 30,000 individual wastewater systems that may contribute to excessive nutrients in near shore and offshore waters, leading to the deterioration of the reef and marine resources. Additionally, more stringent wastewater treatment standards adopted by the state also created challenges for conventional onsite systems.

SOLUTION

A state wastewater treatment standards law targeting Monroe County now requires the countywide use of advanced nutrient reduction systems, renewable operating permits, maintenance contracts, and annual inspections.

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OVERVIEW

Protecting the health of coastal waters and marine habitats is paramount to the region's economy, health, and quality of life. In 1999, Florida adopted more stringent treatment standards for wastewater systems in Monroe County including:

- **Renewable operating permit requirements**
- **Routine treatment system inspection requirements**
- **Homeowner requirement to enter into a contract with an O&M entity**
- **System inventory, maintenance contract requirements, and delivery of service reminders**

RENEWABLE OPERATING PERMITS

Regulations enacted by the Florida Department of Health's Bureau of Onsite Sewage Programs and implemented by the county health department set effluent standards, dispersal requirements, and associated compliance schedules for existing and new individual/clustered systems in Monroe County. All systems are now required to use advanced treatment technologies to meet stricter wastewater treatment standards for nutrients. New systems in the Florida Keys must be designed to achieve an effluent limit of 10 milligrams per liter (mg/L) or less for nitrogen. Systems are regulated by the county through the use of renewable operating permits, required maintenance contracts, and annual inspections.

System owners must renew a one-year operating permit annually at a cost of $100. The health department also issues construction permits for new systems and repair permits for existing systems.

MAINTENANCE CONTRACTS AND INSPECTIONS

Individual treatment system owners must enter into contracts with a maintenance entity to oversee the system's operation. System owners must renew the maintenance contract each year for the life of the system. Maintenance entities are registered contractors certified by the product manufacturer to conduct maintenance services. The maintenance entity submits inspection reports and sampling results to the state as specified in the operating permit.

Maintenance contractors inspect permitted systems at least semiannually, and the county health department inspects the systems annually. The county health department maintains system data in a statewide, web-based database that tracks all permits and inspections.

FUNDING SOURCES

The Monroe County program has eight full-time employees and an annual budget of $330,000. The program is funded through a statewide trust fund supported by fees collected from permits and contractor licensing. Since 1999, the local governments in Monroe County have received nearly $50 million in federal and state funds to improve wastewater treatment at the nearly 50,000 residences in the Florida Keys region.

RESULTS

Currently, 3,065 individual wastewater treatment systems have been permitted, including 327 advanced treatment units. Florida Department of Health effluent limits for new systems discharging less than 100,000 gallons per day to the soil—including individual and clustered systems—include 10 mg/L for biochemical oxygen demand, total suspended solids, and total nitrogen, and 1 mg/L for total phosphorus, representing greater than 75% reductions over conventional septic systems. Effluent is sampled prior to soil discharge.

References and Resources

Sherman, K.M., Chase, P.K., and Ebelherr, D. 2003. Implementation of Model Programs 3 and 4 of the USEPA Voluntary Management Guidelines in the state of Florida. National Onsite Wastewater Recycling Association Annual Conference, Franklin, TN.

Population data—Census Bureau, State and County QuickFacts, Monroe County, 2011. **http://quickfacts.census.gov/qfd/states/12/12087.html**

THE SEA RANCH, CALIFORNIA

PROBLEM
Just a two-hour drive from San Francisco, The Sea Ranch community extends 10 miles along the northern California coastline. Built in the 1960s and 1970s, many of the homes relied on individual wastewater systems. Half of the homes were built in areas susceptible to high groundwater, with coastal meadows and terrace soils causing wastewater system malfunctions. Aging infrastructure, challenging conditions, and poor system maintenance in the upscale resort community posed a threat to local and coastal waterways. As a result, a moratorium was placed on future development in the community.

SOLUTION
Sonoma County, the California Water Resources Control Board, and The Sea Ranch community reached an agreement to improve performance and track compliance of new and existing wastewater systems by forming a wastewater management zone. The moratorium was lifted after the solutions were implemented.

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OVERVIEW

The residents of The Sea Ranch are served by a combination of clustered and individual wastewater systems. Of the 2,300 platted lots, approximately 1,500 have homes with individual systems and about 600 are on two large clustered systems. Treated effluent from the clustered systems is used to irrigate golf courses and other areas. In 1987, Sonoma County authorized The Sea Ranch Association Onsite Wastewater Disposal Zone (the Zone) to operate the individual and clustered system management program. The program consists of:

- **Operating permit requirements and performance standards**
- **Routine inspection requirements**
- **Maintenance contract requirements**
- **Establishment of an enforcement authority**
- **Maintenance of inventory and recordkeeping**
- **Surface and groundwater quality monitoring**

PERFORMANCE-BASED PERMITS

The Zone inspects conventional and advanced systems to ensure compliance with permits and performance standards. The Zone conducts inspections of conventional septic systems every three years. Inspections of advanced designs—including mounds, sand filters, and pressure distribution dispersal units—are conducted annually and include monitoring for nitrates, ammonia, and fecal/total coliform. The Zone sends system owners an inspection notice one month before the inspection date.

Homeowners are responsible for obtaining permits from the Zone and installing and repairing systems as required under county regulations. Inspectors from the Zone conduct regular system inspections using an online template tailored for this use. The Zone issues a renewable operating permit for advanced systems and holds the system owner accountable for proper operation and performance. If the system is operating properly and does not require preventive maintenance or repairs, the Zone issues a renewable, three-year operating permit. If the system functions but is not operating optimally, the Zone issues a one-year operating permit and monitors the system performance. Performance indicators

Photo: Sea Ranch Water Company.

include standard hydraulic parameters (no backups, no sewage surfacing), as well as wet and dry weather groundwater and surface water monitoring in the vicinity of some drainfields. Monitoring parameters include biochemical oxygen demand, bacteria, some metals, and total suspended solids. If the system has structural integrity problems or leachfield malfunctions, the owner must obtain a sewage disposal repair permit from the Zone. If the owner does not repair the system in a timely manner, the county can attach a notice to the land records or revoke the building's certificate of occupancy. Moreover, the Zone is authorized to revoke an operating permit at any time for noncompliance. In these cases, the Zone can compel the repair or replacement of a wastewater system under county rules. The Zone also operates the potable water supply system and can suspend water service if its requirements are not met.

FUNDING SOURCES

The annual budget of the wastewater management program is $250,000 as approved by the Sonoma County Board of Supervisors. The budget is funded through an annual, per-system fee of $180.

RESULTS

Surface and groundwater monitoring results have found no evidence of groundwater pollution associated with the hundreds of individual systems and two clustered wastewater systems in The Sea Ranch community. System malfunctions, such as the sewage surfacing and groundwater contamination that spurred the creation of the program no longer pose a significant threat due to routine operation, maintenance, and management procedures.

References and Resources

Hantzsche, N., Moore, R.A., and Smiell, J. No date. Data Management System for Onsite Wastewater Inspection Program at The Sea Ranch, California. National Onsite Demonstration Program, West Virginia University, Morgantown, WV.

The Sea Ranch Association. 2004. Onsite Wastewater Disposal Zone Homeowner's Guide. **www.tsra.org/Zone.htm**. The Sea Ranch Association, Sea Ranch, CA.

Population data—derived from Census Bureau, The Sea Ranch, 2010. **http://www.census.gov/** and **http://www.census.gov/geo/www/gazetteer/files/Gaz_places_national.txt**

AUBURN LAKE TRAILS, CALIFORNIA

PROBLEM
The Auburn Lake Trails Subdivision in California was developed during the 1970s and 1980s as a recreational community near Auburn Lake, with more than a 1,000 relatively small lots in an area with shallow, low-permeability soils and steep topography. When developers discovered that local soils could not treat the waste adequately to protect water resources upon full build-out, they proposed building a centralized sewage collection and treatment system. However, it was opposed by residents as too costly.

SOLUTION
The community authorized the Georgetown Divide Public Utility District (PUD) to design and manage conventional and advanced treatment individual and clustered wastewater systems. The PUD developed an approach that links the required performance levels for treatment systems to health and environmental risk and where maintenance and monitoring schedules depend on the system type.

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OVERVIEW

The Auburn Lake Trails Subdivision lies between the Middle and South Forks of the American River in El Dorado County. In 1985, the Auburn Lake Trails Onsite Wastewater Disposal Zone (the Zone) was formed to support the management of individual and small community systems in the subdivision in lieu of a centralized sewage system. The Georgetown Divide PUD has jurisdiction over the Zone. The program consists of:

- **Operating permit requirements with performance standards**
- **Routine inspection and maintenance agreement requirements**
- **System inventory**
- **Groundwater and surface water monitoring data collection**

MANAGEMENT UNITS CLASSIFIED BY ENVIRONMENTAL RISK

The subdivision's hydrology and geology was mapped and classified in order to divide the area into five management units based on environmental risk. Wastewater systems in each unit were designed to achieve certain water quality performance levels. The technologies included mounds, intermittent media filters, and pressure-dosing, soil-dispersal systems. One clustered system serves 134 homes using a gravity sewer collection line and a series of dispersal fields.

EMPHASIS ON INSPECTIONS AND MAINTENANCE

The PUD has the authority to investigate, design, inspect, monitor, operate, maintain, and repair treatment systems. Because of liability concerns and costs, the district no longer maintains the systems. Homeowners or contractors are required to make any necessary repairs under the oversight of the PUD. If repairs are not made, the PUD can pump or repair the system and place a lien on the property for noncompliance. The district conducts annual inspections of all systems.

FUNDING SOURCES

The 2008/2009 annual budget for the program was $365,000, funded through monthly user fees that range from $14.63-$22.51 for individual onsite systems, to $50.87 for septic tank effluent pump/septic tank effluent gravity (STEP/STEG) systems. Property taxes also contribute to program support. A loan program was established to help residents repair or replace their tanks. Typical management services include an annual system inspection, issuance of permits, performance of repairs, and collection and analysis of monitoring data.

"It is **critical that septic tank and pump tanks be watertight** and constructed with a level of uniformity to facilitate pump installation, operation, and maintenance. This requires watertight testing on all new construction.

In addition, the Georgetown Divide PUD has initiated watertight testing on all septic tanks that are connected to the STEP (septic tank effluent pump) clustered system that are 20 years or older and/or prior to property transfer.

We have found an **80% failure rate** on all **tanks 20 years or older**. These leaking tanks have contributed significant inflow/infiltration into this STEP system, which can result in sanitary sewer overflows and can hydraulically overload the dispersal leachfields."

Becky Siren, *Operations Manager, Georgetown PUD*

RESULTS

Of the 134 septic tanks inspected in 2009, five were found to be defective and were replaced. The inspection and management program has prevented onsite system malfunctions and has been an effective alternative to costly centralized sewers. The annual inspection of all systems provides for early detection of problems that could lead to a malfunction. Water quality sampling since 1985 has found no degradation of groundwater or surface water.

Of the 999 systems in the subdivision, most of them (63%) are more than 20 years old, and 36% are more than 30 years old. Only 10 systems have malfunctioned in the last 25 years; malfunctions were mostly due to tree roots, hydraulic overloading and other problems such as improper grading, construction activities, etc.

By identifying the location of systems and ensuring their proper operation, the community can make smart decisions to accommodate residential development.

Photo: Florida Department of Health.

References and Resources

Georgetown Divide Public Utility District. Website **www.gd-pud.org**.

Mancl, K. 2001. Onsite Wastewater Management: A Model for Success. In Proceedings of the 9th National Symposium on Individual and Small Community Sewage Systems, American Society of Agricultural Engineers, Fort Worth, TX.

Population data—Auburn Lake Trails Property Owners Association.

Management Model 4: Responsible Management Entity (RME) Operation and Maintenance

Management Model 4: Responsible Management Entity (RME) Operation and Maintenance is best used in areas with high environmental risk and a need for professional oversight to ensure consistent system operation and maintenance. The model applies to situations where site, soil, or other environmental conditions present a need for complex treatment units and customized system designs (e.g., high-strength wastes, advanced treatment clustered systems). Communities typically use Management Model 4 where the density of systems (e.g., more than two per acre) can pose a threat to water resources and/or public health.

Elements of Management Model 4

Management Model 4 includes two key elements:

- **Professional operation and maintenance services provided through an RME (public or private)**
- **Regulatory agency oversight provided through operating permits issued directly to the RME**

Focus on RME Operation and Maintenance

Management Model 4 programs use an RME to operate and maintain individual and clustered treatment systems. The RME can be a private or a public utility, a private company, or other governmental or nongovernmental organization. Rural electric cooperatives, sanitation districts, and other special districts can all serve as RMEs under Management Model 4. Many RMEs contract out certain tasks, such as maintenance and septic tank pumping, to service providers.

Program Characteristics

- **RME responsible for long-term system performance and accountability**
- **RMEs, not homeowners, conduct operation and maintenance**
- **Local authority adopts legislation enabling the RME to conduct O&M and ensure performance**
- **Homeowner/local jurisdiction grants easement/right of entry approval**

Management Model 4 programs typically involve:

- **The RME has responsibility and legal authority to operate the systems in order to meet regulatory and performance requirements**
- **The regulatory agency oversees and issues permits to the RME in order to ensure compliance**
- **The RME inspects systems and conducts routine operation and maintenance**
- **System owners pay for new construction, repairs, upgrades, and system replacement that the RME implements**

Case Studies

Effective Management Model 4 programs ensure that the RME has sufficient authority to conduct operation and maintenance activities that assure system performance. This section reviews two such programs:

- **Otter Tail Lake, Minnesota**
- **Peña Blanca, New Mexico**

OTTER TAIL LAKE, MINNESOTA

PROBLEM
The community around Otter Tail Lake in western Minnesota saw a decline in lake water quality. An environmental assessment revealed that substandard wastewater systems, untreated sewage discharges to surface waters, and intensive shoreline development contributed to high levels of phosphorus in the lake, causing elevated algae growth and an overall decline in water quality.

SOLUTION
The community formed a management district to identify and repair/replace malfunctioning systems and manage the wastewater treatment systems of four townships situated on six area lakes.

Otter Tail Water Management District
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OVERVIEW

Otter Tail Lake—a popular fishing and recreational lake—lies in the heart of Otter Tail County. Residential and commercial development surrounds the majority of the lake. In 1984, the Otter Tail Water Management District (OTWMD) was formed under the authority of the Minnesota statute which governs the formation of subordinate sanitary sewer districts. The OTWMD assumed responsibility for maintaining 1,640 individual wastewater systems and 13 clustered systems. The program consists of:

- **Operating permit requirements**
- **Routine inspection and maintenance contract requirements**
- **Maintenance of a system inventory**
- **Collection of groundwater and surface water monitoring data**

ACTIVE OR PASSIVE MANAGEMENT

The district's authority includes planning, design, construction, operation, and maintenance of wastewater treatment systems. The district maintains systems for active (permanent) customers. Permanent systems are inspected every two years. System owners maintain passive (seasonal use) systems, with oversight by the district and inspections every three years. The OTWMD contracts with independent, state-licensed, service providers in order to provide management services. The district also maintains a list of accepted installers and pumpers that homeowners can hire.

The preventive maintenance program includes inspecting tanks and checking lift stations to ensure proper functioning. The OTWMD has the authority to issue compliance orders and to assign repair costs and penalties to customers' property tax statements.

Monitoring wells around clustered drainfields sample groundwater quality. The OTWMD also conducts surface water monitoring.

FUNDING SOURCES

The annual operating budget for the OTWMD is $200,000, funded by user fees ranging from $43 for seasonal residences to $151 for permanent residences. The district has one full-time and two part-time employees.

RESULTS

After the program's inception in 1984, the OTWMD upgraded 850 treatment systems. The district installed 16 clustered systems for 260 connections and repaired or replaced 590 other treatment systems. The district also serviced a total of 350 other systems, including full inspections, septic tank pumping, and installation of new tank risers and covers. In the past decade, the district has replaced or repaired only 17 systems (out of nearly 1,500).

The district's actions resulted in documented water quality improvements. For example, surface water monitoring of the lake has revealed declining phosphorus and algae concentrations and overall improved water quality. Nitrate concentrations have dropped from 1 mg/L to approximately 0.2 mg/L; Secchi depth has increased from 2.4 feet to about 4 feet.

References and Resources

Christopherson, S. and Anderson, J.. 2004. Twenty Years of Successful Onsite Wastewater Management, The Otter Tail, Minnesota Water Management District. National Onsite Wastewater Recyclers Association Conference, Albuquerque NM.

National Onsite Demonstration Program. No date. Phase IV Case Study. **www.nesc.wvu.edu/NODP**.

Population data—Otter Tail County Coalition of Lake Associations.

PEÑA BLANCA, NEW MEXICO

PROBLEM

Outdated, neglected, or nonexistent wastewater systems posed a public health risk to the 800 citizens of Peña Blanca, New Mexico. Open cesspools and seepage pits emptied into yards and irrigation canals. Surveys revealed that 86% of the individual wastewater systems needed repair or replacement. Residents rejected a proposed centralized sewer system that would have cost $3.1 million.

SOLUTION

The community opted to repair or replace 133 of the existing 185 treatment systems with the water and sanitation district serving as the operator/manager of the upgraded and new facilities.

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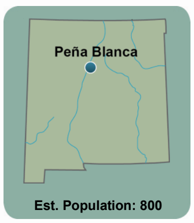

OVERVIEW

Local officials worked closely with federal and state agencies to establish the Peña Blanca Water and Sanitation District (WSD) and to develop a wastewater management program with an emphasis on maintenance. This Management Model 4 program features:

- **Operating permit and maintenance contract requirements**
- **Requirement to pump tanks every two years**
- **Maintenance of system records and reporting requirements**

WATER AND SANITATION DISTRICT SERVES AS THE RME

The Peña Blanca community received an EPA Clean Water Construction Grant of about $760,000 to repair and replace individual wastewater systems and develop new clustered systems. The WSD was formed in 1990, under the authority of a New Mexico statute, to manage the systems. The WSD adopted an ordinance that provided for the operation, maintenance, and repair of wastewater treatment systems. The district maintains an inventory of the systems, collects user fees, requires pumping of all tanks at least once every two years, contracts pumping services, maintains all active systems, and coordinates with the City of Albuquerque to accept septage pumped from the tanks.

ORDINANCE SERVES AS MAINTENANCE CONTRACT

The WSD ordinance essentially serves as a maintenance contract and authorizes the district to pump septic tanks every two years. Homeowners retain the option of hiring their own pumpers but must maintain documentation of the service and pay a base fee of $4 per month. Residents installing new individual wastewater systems must sign an easement allowing for maintenance. All systems must also obtain an operating permit from the New Mexico Environment Department. The WSD is responsible for maintaining pumping records. Systems are inspected in response to citizen complaints.

FUNDING SOURCES

According to septic tank size, WSD charges a monthly service fee, which ranges from $9 to $20 per month. The 2008–2009 operating budget was $27,000.

RESULTS

The decentralized wastewater option was less than half of the projected cost of central sewage treatment for the 133 homes served by repaired or replaced systems. Sewage surfacing and cesspool discharges throughout the community no longer occur. Post-construction groundwater monitoring found nitrate levels at 1 mg/L or less in the project area, far below the 10 mg/L standard for groundwater used as drinking water.

References and Resources

Falvey C. 2001. Cleanup at Peña Blanca. Small Flows Quarterly 2(1):30–32. **www.nesc.wvu.edu/pdf/ww/publications/smallflows/magazine/SFQ_WI01.pdf**.

New Mexico Environmental Finance Center. 2006. How to Form a Water and Sanitation District in New Mexico. **www.nmenv.state.nm.us/cpb/Final%20Report%20-%20July%202006.pdf**.

Management Model 5: RME Ownership

Management Model 5: Responsible Management Entity (RME) Ownership takes decentralized wastewater management to a high level of accountability. Under the model, the RME serves as owner and manager of the onsite wastewater systems, in a manner similar to centralized systems. Instead of the homeowner, the management entity takes responsibility for operation and maintenance and for scheduling needed repairs or service. Communities experiencing high-density growth in areas with close proximity to sensitive or high-quality water resources (e.g., recreational waters, cold water aquatic habitat, drinking water sources) may want to consider utilizing Management Model 5. Additionally, communities with excessive compliance problems may be interested in adopting this approach.

Program Characteristics

- **RME provides a high level of system oversight**
- **RME owns systems, thus reducing entry/ access concerns**
- **RME ensures O&M instead of homeowner**
- **RME may need legal authorization to form a management entity**
- **Community makes a significant financial investment, including higher homeowner fees**
- **Community achieves economies of scale for multiple system O&M and financial management**

Elements of a Management Model 5

Management Model 5 includes these key elements:

- **RME ownership and management of treatment systems**
- **Risk evaluation and prioritization when planning and designing systems**
- **Permit requirements with performance criteria for system operation**
- **Procedures for conducting compliance monitoring and tracking**
- **Certification program requirements for service providers**
- **Oversight of rate structure and financial management**

Focus on Accountability through Professional Management

This management model provides a high level of accountability through professional management and ownership of the wastewater treatment systems. States or other regulatory authorities may need to establish a legal basis for oversight through statute or regulation and develop procedures for implementation.

Management Model 5 programs typically consist of:

- **Operating permits, regular inspections, and monitoring of both treatment systems and water resources to better ensure achievement of performance criteria**
- **Regulators oversee the RME to ensure compliance**
- **Similar to centralized wastewater treatment systems, user fees sustain system operation and administration**
- **Regulatory authority reviews rate structures, ensures independent financial oversight, and executes performance audits**

Case Studies

Effective Management Model 5 programs have RMEs that respond to community needs, resource issues, and market opportunities. For example, in Tennessee and New Jersey, privately owned RMEs are serving local communities and expanding into other states. (see **http://www.nesc.wvu.edu/nsfc/Articles/SFQ/SFQ_sp04_PDF/Brothers.pdf** and **http://www.state.nj.us/pinelands/landuse/waste/WWMgtSummary_web.pdf**). Iowa has taken advantage of its network of independent rural water districts to serve as RMEs. The districts are well suited as RMEs because they have the capability to issue financial bonds, secure bonding for services and infrastructure components, receive state and federal grant and loan dollars, and provide services across municipal and county borders. This section reviews three Management Model 5 programs:

- **Blacksburg, Virginia**
- **Phelps County, Missouri**
- **Shannon City, Iowa**

The Water Supply District serves as the RME in Phelps County, Missouri. The district owns and operates eight recirculating sand filters.

BLACKSBURG, VIRGINIA

PROBLEM

Blacksburg, Virginia, like many growing communities, faced the challenge of meeting development needs with a decentralized system or extending the existing centralized sewer system. The town considered factors such as cost, construction-related traffic disruptions, floodplain and creek impacts due to centralized sewer main construction, collection system infiltration/inflow and leakage, treatment effectiveness, and other factors.

SOLUTION

The town established a workgroup to evaluate wastewater treatment system alternatives. After careful review, Blacksburg chose to conduct a pilot project to test the feasibility of a decentralized, clustered system.

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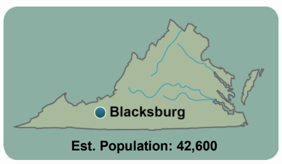

OVERVIEW

When Blacksburg, Virginia, began investigating wastewater alternatives in 2000, it recognized that management was the key to the success of the system (Mattingly and Tremel 2002). The town selected Management Model 5 as a pilot approach for the Tom's Creek community. The program consists of:

- **Operating permit requirements**
- **RME with enforcement authority**
- **Requirement for the use of trained personnel**
- **Remote monitoring and routine inspections conducted by RME**
- **System database maintenance**

PUBLIC WORKS DEPARTMENT SERVES AS RME

Blacksburg chose to have its existing public works department assume the role of wastewater utility—or RME—for the community of Tom's Creek. The town's public works department both owns and manages the clustered system as it does other wastewater infrastructure. The RME chose a hybrid collection system including a Septic Tank Effluent Pump (STEP) pressure system combined with a Septic Tank Effluent Gravity (STEG) system. Users of the clustered system pay the same residential water and wastewater rates as customers served by centralized sewers in the area.

Approximately 200 homes in the Village of Tom's Creek are served by the STEP/STEG system. Trained RME personnel inspect each tank every two years. Each house must have an individual septic tank for which residents have maintenance responsibilities, including avoiding practices such as dumping large quantities of fats, oils, grease, chemicals, or solid waste down drains or toilets. When inspections reveal recurring problems, the RME notifies the resident and takes corrective action.

REMOTE MONITORING RELAYS OPERATING PROBLEMS

Blacksburg uses internet-based, remote monitoring to relay system operating problems. The system sends emails or page alerts to designated maintenance personnel when it detects problems.

RESULTS

Selection of the STEP/STEG system has saved the community more than $1 million in construction, with operation and maintenance costs similar to that of conventional centralized systems. The town's public works department conducts annual inspections of each STEP/STEG system and pumps the 200 septic tanks as needed. The program estimates that pumping should occur every seven years and estimates an average cost of $150 per tank.

One of the town's concerns was centralized sewer collection system leakage. During heavy rains, the STEP/STEG system, by design, shows no infiltration/inflow or leakage and maintains a stable level of treatment. Also, the town is using septic tank effluent gravity collection systems for new developments, where possible, rather than the pump (STEP) approach, in order to minimize costs for maintaining and operating pumps and other equipment.

References and Resources

Mattingly K., and Tremel, M. 2002. A Unique Public Management Entity in the Town of Blacksburg, Virginia. **http://corralesnm.net/wasteWater/resources/21917152844.pdf**. Accessed March 29, 2010.

Toms Creek Sewage Options Working Group. 2001. Recommended Decentralized System. **http://www.tcbsewer.org/MAIN/STEP.htm**. Accessed March 31, 2010.

Population data—Census Bureau, State and County QuickFacts, Blacksburg(Town), 2010. **http://quickfacts.census.gov/qfd/states/51/5107784.html**

PHELPS COUNTY, MISSOURI

PROBLEM

In 1995, Missouri adopted more stringent public health regulations for individual systems on lots of three acres or less. To comply with those regulations, property owners in Phelps County needed to upgrade their individual systems. The need to upgrade systems was underscored by the fact that local lenders would not make loans on houses that were not in compliance with state rules.

SOLUTION

County leaders and the local water supply district expanded services to allow the water district to own and operate decentralized systems that provide affordable and sustainable wastewater treatment.

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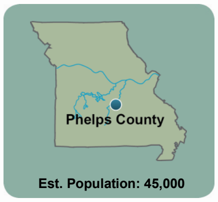

OVERVIEW

Public Water Supply District #2 (PWSD2) provides wastewater management service for residences within its jurisdiction. The program consists of:

- **Discharge authority under an individual National Pollutant Discharge Elimination System (NPDES) permit**
- **District holds bonding authority to fund program**
- **Routine inspection requirement**
- **Financial incentive and low-interest loan opportunities**

NPDES PERMITS FOR CLUSTERED SYSTEM

In PWSD2's first decentralized wastewater project, a developer agreed to donate land and finance a treatment facility if PWSD2 would own, design, construct, and operate the treatment facility. The system consists of a septic tank effluent pump (STEP) collection system and recirculating sand filter (RSF) wastewater treatment system. The system operates under a surface water discharge (NPDES) permit issued by the state of Missouri. The STEP/RSF system serves the new subdivision and other homes in a nearby community. For subsequent projects, the district modified the approach, partnering with developers to construct new RSFs so that both new and existing homes could be served. In return, the district agreed to own and manage the systems.

USER AGREEMENTS AND UTILITY EASEMENTS

Residents in new developments must sign a user agreement, connect to the system, and grant a utility easement to the water district. Owners of existing homes with malfunctioning individual systems may voluntarily connect to the decentralized system at the homeowner's expense. PWSD2 offers incentives (e.g., connection fee waivers) in order for homeowners to connect to the system.

FUNDING SOURCES

PWSD2 issued revenue bonds and borrowed money to finance the start of the decentralized wastewater management program. PWSD2 charges a flat rate of $46.50 per month to fund the program. The district has the power to terminate potable water service for nonpayment of fees.

RESULTS

The county now manages eight clustered systems with septic tank effluent pumps that serve 415 residential units, rather than 450 individual septic systems. The clustered systems serve as upgraded systems for the homes that previously had malfunctioning systems. Actual effluent quality for the clustered systems ranges from 4 to 9 mg/L for biochemical oxygen demand and 1 to 8 mg/L for total suspended solids. Fecal coliform levels have been in the range of 10 colony-forming units per 100 milliliters of effluent.

In addition, local officials believe that the elimination of hundreds of old septic system leachfields has improved groundwater quality, based on the higher quality effluent being discharged from the new systems.

References and Resources

Dietzmann, E.M., and Gross, M.A 2003. Phelps County Update: Case Study of a Public Water Supply District Providing Centralized Management of Decentralized Wastewater. Small Flows Quarterly 4(3):25–34. **http://www.nesc.wvu.edu/old_website/nsfc/sfq_sum03/p25.html**. Accessed March 31, 2010.

Population data—Census Bureau, State and County QuickFacts, Phelps County, 2011. **http://quickfacts.census.gov/qfd/states/29/29161.html**

SHANNON CITY, IOWA

PROBLEM

Small communities like Shannon City face significant challenges in managing individual wastewater systems. The small, rural community had neither the technical nor financial resources to support upgrades of substandard systems and remove straight pipe discharges draining untreated sewage into city ditches.

SOLUTION

City officials partnered with the Southern Iowa Rural Water Association (SIRWA) authority to design, build, own, and operate individual and clustered wastewater systems for the community.

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OVERVIEW

The majority of individual systems that served Shannon City, a small town with a population of 76, did not meet state code requirements. As a result, untreated sewage entered city ditches and receiving streams of the Grand River Basin. The town commissioned a study of wastewater alternatives after the Iowa Department of Natural Resources (IDNR) required the town to upgrade its systems. The study's authors concluded that a decentralized wastewater treatment system was a viable option for the town. Shannon City partnered with the SIRWA and the U.S. Department of Agriculture (USDA) Rural Development Program to design, finance, and construct a new wastewater system owned and operated by SIRWA. The wastewater program consists of:

- **Operating permit and routine inspection requirements**
- **Use of site-specific evaluations and plans to select and design systems**
- **Maintenance program, reporting, and recordkeeping administration**
- **Collection of water quality sampling data**
- **Grant of property easements**
- **Authority to enforce requirements**

RURAL WATER ASSOCIATION SERVES AS RME

SIRWA, which provides drinking water to 10,000 customers, assumed the RME role in Shannon City. SIRWA has experience with operating wastewater systems in nine small Iowa communities, mostly consisting of gravity collection with treatment by facultative lagoons.

SIRWA designed a project composed of a variety of treatment systems so as to provide affordable and effective wastewater service for the community. Each property owner in Shannon City signs an easement allowing SIRWA to design, finance, install, own, operate, and maintain a wastewater treatment system on his/her land.

OPERATING PERMITS

SIRWA operates the systems under Iowa Department of Natural Resources operating permits which specify operating and yearly sampling requirements. A citywide ordinance prescribes enforcement provisions. SIRWA reports annual inspection and monitoring results to state and county health officials.

FUNDING SOURCES

The Shannon City project cost $468,000—about $10,400 per home served. A significant portion of the cost was covered by a USDA Rural Development Program grant and loans from other sources. The O&M user fee is a flat rate of $18 per month.

RESULTS

In 2003 and 2004, SIRWA placed 34 peat filters, eight lateral line absorption systems, and one existing gravity-fed, single-pass sand filter into operation. SIRWA chose the peat filter system because of its small footprint and ease of media replacement compared with a sand filter. The installed systems replaced non-functioning septic systems with appropriate wastewater treatment units and eliminated straight pipe sewage discharges into roadsides, other ditches, and surface waters. The new systems comply with IDNR operating permit requirements and function properly with centralized management.

References and Resources

Carroll, J.A. 2005. Lessons Learned from a Model 5 EPA Management Program for Onsite Wastewater Systems. In Proceedings of 2005 National Onsite Wastewater Recyclers Association Annual Meeting, Cleveland, OH.

Population data—City data - Shannon city, 2010. **http://www.city-data.com/city/Shannon-City-Iowa.html**

Appendix A: Glossary of Terms

Aerobic Treatment Unit (ATU): A mechanized unit that provides secondary wastewater treatment for single homes, clusters of homes, or commercial establishments by mixing air (oxygen) and aerobic and facultative microbes with the wastewater. ATUs typically use either a suspended growth process (such as activated sludge, extended aeration, and batch reactors), fixed-film process (similar to a trickling filter), or a combination of the two treatment processes.

Advanced Treatment System: A wastewater treatment system that includes an additional treatment process unit or step between the septic tank and final effluent dispersal location. Advanced treatment units are intended to improve treatment by increasing aeration, treatment time, and biological decomposition, reducing nutrient concentrations in the effluent, or through disinfection. Examples of components that can be used in advanced systems include sand filters, aerobic treatment units, disinfection devices, and advanced subsurface infiltration designs (e.g., mounds, gravelless trenches, and pressure and drip distribution).

Centralized Wastewater System: A network of sewers designed to collect wastewater from multiple sources in a service area for treatment at a single wastewater facility that typically discharges to a surface water body. Traditionally, such a system has been called a publicly owned treatment works as defined in Title 40 of the Code of Federal Regulations (CFR) section 122.2.

Cesspool: A well that receives untreated sanitary waste (i.e., without a septic tank) containing human excreta, which can have an open bottom or perforated sides (40 CFR 144.3). Cesspools with the capacity to serve 20 or more persons per day (i.e., large-capacity cesspools) were banned by federal regulations promulgated on December 7, 1999. The construction of new cesspools was immediately banned and existing large-capacity cesspools must be replaced with sewer connections or individual wastewater treatment systems.

Clustered System: A wastewater collection and treatment system under some form of common ownership that collects wastewater from two or more dwellings or buildings and conveys it to a treatment and dispersal facility near the dwellings or buildings.

Decentralized System: Individual or clustered system(s) used to collect, treat, and disperse or reclaim wastewater from a small community or service area.

Dispersal System: A system that receives and releases pretreated wastewater into the air (i.e., evapotranspiration), the soil (below or onto the surface), or surface waters. A subsurface wastewater infiltration system is an example of a dispersal system.

Environmental Risk: The relative susceptibility of surface or groundwater to degradation due to chemical, physical, or biological inputs from treated, untreated, or poorly treated wastewater or other stressors. The impacts can be low, acute (i.e., immediate and significantly disruptive), or chronic (i.e., long-term, with gradual but serious disruptions).

Individual Wastewater Treatment System: A system relying on natural processes and/or mechanical components to collect, treat, and disperse or reclaim wastewater from a single dwelling or building. See also Onsite Wastewater Treatment System.

Maintenance: Routine or periodic actions taken to ensure proper wastewater treatment system performance, extend system longevity, or ensure the system meets performance requirements.

Management Model: An integrated, coordinated program of policies, procedures, processes, and activities designed to achieve specified objectives.

National Pollutant Discharge Elimination System (NPDES): A national program under section 402 of the Clean Water Act that regulates pollutant discharges from point sources into waters of the United States. The Clean Water Act requires authorization for such discharges under an NPDES permit.

Onsite Wastewater Treatment System: A system relying on natural processes or mechanical components to collect, treat, and disperse or reclaim wastewater from a single dwelling or building. See also Individual Wastewater Treatment System.

Performance Requirement: An effluent concentration standard, treatment system management practice, or other requirement established by a public health, environmental, natural resource, or other public agency to address health, environmental, or other risks. Performance requirements can be expressed as numeric limits (e.g., pollutant concentrations, mass loads), narrative descriptions of desired conditions or requirements (e.g., no visible scum, sludge, sheen, odors, cracks, or leaks), or specific management practices (e.g., service disinfection units weekly or monthly).

Permit: An authorization, license, or equivalent control document issued by a public agency or other regulatory body that authorizes that specified activities may occur in a manner described and limited by the permit, such as a septic system installation permit or NPDES discharge permit.

Prescriptive Requirements: Mandated specifications for installing a limited set of wastewater treatment system types (e.g., septic tank/drainfield systems, mound systems, aerobic units) on sites that meet stipulated criteria (e.g., certain soil types, maximum slope steepness, minimum setbacks from property lines). Proposed deviations from the stipulated system types or site criteria require formal approval from the regulatory authority.

Regulatory Authority: The unit of government that establishes and enforces codes related to the permitting, design, placement, installation, operation, maintenance, monitoring, and performance of individual and clustered wastewater systems.

Residuals: The solids generated or retained during the treatment of wastewater, including trash, rags, grit, sediment, sludge, biosolids, septage, scum, grease, and treatment system media that have served their useful life and require disposal, such as the sand or peat from a media filter.

Responsible Management Entity (RME): A legal entity responsible for providing various management services with the requisite managerial, financial, and technical capacity to ensure the long-term, cost-effective operation of wastewater treatment facilities in accordance with applicable regulations and performance criteria.

Secondary Treatment: The second step in most publicly owned waste treatment systems in which bacteria consume the organic parts of the waste. It is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. This treatment removes floating and settleable solids and about 90% of the oxygen-demanding substances and suspended solids. Disinfection is the final stage of secondary treatment.

Septage: The liquid and solid materials pumped from a septic tank during inspection or maintenance service.

Septic Tank: A buried, watertight vessel designed and constructed to receive and partially treat raw wastewater prior to soil dispersal or further treatment. The tank separates and retains settleable and floatable constituents in the wastewater—such as solids, fats, oils, and grease—and discharges the partially clarified wastewater for further treatment or dispersal to the soil.

Septic Tank Effluent Gravity (STEG): A collection system that uses septic tanks and moves the resulting effluent to a treatment facility via gravity flow.

Septic Tank Effluent Pump (STEP): A collection system that uses septic tanks and moves the resulting effluent to a pump vault to convey effluent under pressure to a subsequent treatment system component.

Photo: Hamilton County General Health District, Ohio

Appendix B: Management Program Elements and Activities

The table below summarizes the program elements and identifies a range of basic and advanced activities that local management programs can adopt. Management programs address each program element as appropriate, given their technical, managerial, financial, and other resources and the nature of the public health and environmental risks posed by the wastewater treatment facilities in their jurisdictions.

Table B1: Program Elements and Activities

Elements	Purpose	Basic activities	Advanced activities
Administration			
Performance requirements	Link treatment standards to relative risk and health and water resource goals.	Prescribe acceptable site characteristics and system types allowed.	Stipulate that system performance must meet defined standards that consider public health, water resource values, vulnerabilities, and risks.
Planning	Consider site and regional conditions, development patterns, and effects on long-term watershed and public health.	Identify minimum lot sizes, surface water/ groundwater separation distances, and critical areas requiring protection.	Monitor and model regional pollutant loads, tailor development patterns based on environmental and physical limitations, require clustering for large developments.
Record-keeping, inventory, and reporting	Create inventory of systems, operation and maintenance (O&M) logs, and produce regular reports for oversight agencies.	Provide inventory information on all systems. Submit performance reports to health agency.	Provide Geographic Information System-based comprehensive inventories, including web-based monitoring and O&M data input for administrative reporting and watershed assessment studies.
Financial assistance and funding	Provide financial and legal support for management program.	Implement basic powers to apply for/accept funds or other revenue-generation fees; identify legal authority for a sustainable program.	Initiate monthly or quarterly service fees, cost-share or other repair/replacement program, full financial and legal support for management program, equitable revenue base and assistance programs, and regular reviews and modifications.
Public education and participation	Consider public input and solicit public involvement while developing a management program.	Sponsor public meetings, forums, updates, and education programs.	Maintain public advisory groups, review groups, and other involvement opportunities in the program. Distribute educational and other materials.
Installation			
Site evaluation	Assess system site and relationship to other features (groundwater and surface water).	Characterize landscape, soils, groundwater and surface water location, lot size, and other conditions.	Assess site and cumulative watershed impacts, consider groundwater mounding potential and long-term specific pollutant trends; accommodate cluster system development.

Elements	Purpose	Basic activities	Advanced activities
Installation			
Construction	Ensure installation as designed. Record as-built drawings.	Inspect installation prior to covering with soil and enter as-built information into the file record.	Provide supplemental training, certification, and licensing programs for installers. Provide more comprehensive inspection of installations. Verify and enter as-built information into the record.
Operation and Compliance			
Operation and maintenance	Ensure that systems perform as designed.	Initiate homeowner education and reminder programs that promote O&M.	Require service contracts or renewable, revocable operating permits with periodic reporting. Log service reports into master database. Ensure responsibility for O&M.
Inspections and monitoring	Document provider performance, functioning of systems, and impacts.	Perform inspection prior to soil cover-up and property title transfer. Provide complaint response.	Conduct regional surface water and groundwater monitoring, web-based inspection reporting, and system operational monitoring. Require installation and periodic operational inspections.
Residuals management	Remove and treat residuals. Minimize health or environmental risks from residuals handling, use, and dispersal.	Ensure compliance with federal and state codes for residuals dispersal.	Conduct analysis and oversight of residuals program. Provide web-based reporting and inspection of pumping and dispersal facility activities. Provide assistance in locating or developing residuals handling facilities.
Training and certification/ licensing	Promote excellence in site evaluation, design, installation, O&M, and other service provider functions.	Recommend use of only state-licensed/certified service providers.	Provide supplemental training and certification/ licensing programs, offer continuing education opportunities, and monitor performance through inspections. Sponsor mentoring programs.
Corrective actions and enforcement	Ensure timely compliance with applicable codes and performance requirements.	Provide for complaint reporting under nuisance laws. Provide inspection and prompt response procedures and penalties.	Deny or revoke operating permit until compliance measures are satisfied. Set violation response protocol and legal response actions, including correction and liens against property by RME.

Adapted from *Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems* (EPA, 2005)

Case Studies of Individual and Clustered (Decentralized) Wastewater Management Programs

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June 2012