Chapter 2 Developing and implementing elements of the management program

2.1 Program elements and the management continuum

Onsite wastewater management programs can strengthen public health and water resource protection by ensuring that treatment systems meet performance requirements established by the community. The program elements (components) of a comprehensive management program will be fairly universal across the Nation, regardless of the environmental conditions, economic situation, or available resources of the community. How each element of a site-specific management program is developed, supported, and implemented, however, will vary significantly.

A community should develop management programs in response to its needs, resources, and goals. Communities should evaluate their environmental and public health goals, the condition and performance of the systems to be managed, the value and vulnerability of their water resources, and their support capabilities during the management program development process. The regulatory authority (e.g., local health department), service providers, water resource agencies, planning offices, and citizens of the community will all be important sources of support for developing and implementing selected activities under each program element.

> How each element of a site-specific management program is developed, supported, and implemented will vary significantly.

The management program development group should recognize that for each program element there is a range of possible approaches and that the appropriate activities for each element should be based on the needs and capabilities of the community. For example, rural jurisdictions with little new residential or commercial construction will likely have a less developed planning function than a jurisdiction outside a major city facing large-scale development pressure. Some jurisdictions might have a rigorous program for certifying and licensing design professionals, while others might allow only health department staff and certified/licensed designers to design systems. The wide array of different management programs becomes obvious when one considers the list of program elements and the range of activities under each.

Table 2-1 lists the various major categories of management program functions along with the program elements of each. Table 2-2 provides further detail on each program element. The key point in developing a management program is to address real, perceived, and developing problems with actual, on-the-ground resources and programmatic capabilities. Prioritizing, targeting, and addressing human health and water resource threats will likely drive development of program element activities.

In most state, tribal, and local onsite wastewater control systems, a regulatory authority or agency is designated by statute or code to handle permitting, installation inspection, complaint response, enforcement, and other functions. Regulatory authority is typically delegated by the state agency to local health departments, but in some jurisdictions these duties may be executed by water resource agencies, planning and zoning programs, or other governmental organizations. The regulatory role usually involves permitting a system based on site conditions, executing a brief final inspection, and expecting it to perform without any further intervention until a complaint is filed. The homeowner is responsible for all operation and maintenance required. This system of "benign neglect" has worked fairly well for the past century, i.e., it has addressed hydraulic failure with some regard for environmental consequences. However, any improvement in protecting public health and the environment can only be accomplished by developing management programs that address a more comprehensive set of key management program elements.

The elements comprising a comprehensive management program have been under development for several decades, and include sets of activities focused within the following functional categories: 1)program planning and administration, 2) treatment system installation and operation oversight, and 3) compliance assistance and assurance see Table 2-1).

Table 2-1. Functional categories of management and program elements.

Category	Management program elements
Program administration	Public education and participation Planning Establishment of performance requirements Record keeping, inventories, and reporting Financial assistance and funding
System installation and operation oversight	Site evaluation System design Construction or installation Operation and maintenance Residuals management
Compliance assistance/assurance	Training and certification/licensing of service providers Inspections and monitoring Corrective actions and enforcement

Clearly, management programs will vary widely across the Nation. Many communities will elect to adopt a cooperative management program that organizes and coordinates the activities of the regulatory authority, water resource agency, planning department, service providers, and other interested parties (e.g., volunteer monitoring groups, homeowner associations, sanitation districts, etc.). Some jurisdictions might have the resources to develop a responsible management entity (RME) with the technical, managerial, and financial capacity to ensure long-term, cost-effective management, operation, and maintenance of all systems within the designated service area. The exact configuration of local management programs will be based on the resources available, the nature of public health and water resource threats posed by onsite systems, and the creativity and commitment of the regulatory authority and other interested parties.

Table 2-1. Summary of management program elements and possible approaches

Program element	Purpose	Basic activities	Advanced activities
Public education and participation	To maximize public involvement in the need for and implementation of the management program.	Provide public meetings, forums, updates, and education programs.	Provide public advisory groups, review groups, and other involvement opportunities in addition to basic program.
Planning	Consider regional and site conditions and impacts, long-term watershed, and public health protection.	Establish minimum lot sizes, surface/ground water setbacks and/or identify critical areas requiring more protection.	Monitor and model regional pollutant loads of different development scenarios; tailor development patterns and requirements to receiver site environmental conditions and technological capabilities.
Performance requirements	Link treatment standards and relative risk to health and water resource goals.	Prescribe acceptable site characteristics and/or system types allowed.	Require system performance to meet standards that consider water resource values, vulnerabilities, and risks.
Site evaluation	Assess site and relationship to other features.	Characterize landscape position, soils, ground & surface water location, size, and other site conditions.	Assess site and cumulative watershed impacts, ground water mounding potential, long-term specific pollutant trends, and cluster system potential.
Design	Ensure system is appropriate for site, watershed, and wastewater flow/strength.	Prescribe a limited number of acceptable designs for specific site conditions.	Implement requirements for developing alternative designs that meet performance requirements for each site, position in watershed, and wastewater flow/strength.
Construction	Ensure installation as designed; record as-built drawings.	Inspect installation prior to covering with soil and enter as-builts into record.	Provide supplemental training, certification & licensing programs; provide more comprehensive inspection of installations; verify & enter as-builts into record.
Operation and maintenance	Ensure systems perform as designed.	Initiate homeowner education/ reminder programs that promote regular O&M (pumping).	Require renewable, revocable operating permits with reporting requirements; verifiable responsibility for proper O&M activities.

Residuals management	Minimize health or environmental risks from residuals handling/dispersal.	Require compliance with federal and state residuals disposal codes.	Conduct analysis and oversight of residuals program; Web-based reporting and inspection of pumping and ultimate disposal facility activities.
Training and certification/licensing	Promote excellence in site evaluation, design, installation, and other service provider areas.	Recommend use of only state licensed/certified service providers.	Provide supplemental training and certification/licensing programs in addition to state programs; offer continuing education opportunities, and monitor performance through inspections.
Inspections and monitoring	Document proper service provider performance, functioning of systems, and environmental impacts.	Inspection prior to covering; inspections prior to property title transfer; complaint response.	Require regional surface and ground water monitoring; Web-based system and operational monitoring; required periodic operational & installation inspections.
Corrective actions and enforcement	Ensure timely return to compliance with applicable codes and performance requirements.	Complaint reporting under nuisance laws, inspection and prompt response procedures; penalties.	Denial and/or revocation of operating permit until compliance measures satisfied; set violation response protocol & legal response actions, including correction and liens against property by RME.
Record keeping, inventory, and reporting	Provide inventory development and maintenance for administrative, O&M, planning and reporting to oversight agencies.	Provide inventory information on all systems; performance reports to health agency as required.	Provide GIS-enabled, comprehensive inventories, including Web-based monitoring and O&M data for use in administration, O&M, compliance achievement and reporting activities.
Financial assistance and funding	Provide financial and legal support for management program.	Implement basic powers, revenue-generation and legal backup for a sustainable program.	Initiate monthly/quarterly service fees; cost-share or other repair/replacement program; full financial and legal support for management program; equitable revenue base and assistance programs; implementation of regular reviews and modifications.

2.2 Overview of management program elements

Onsite/decentralized systems can be managed by a variety of public or private entities, including health departments, neighborhood associations, special districts, private service providers, and existing centralized wastewater collection and treatment programs (e.g., sanitation districts). This chapter outlines the primary program elements of onsite wastewater management programs across the management continuum, from the smallest to the largest. As noted previously, the mix of regulatory authorities, management entities, and other organizations overseeing the various program elements described in this chapter will vary considerably from place to place. The key consideration in system management is ensuring that these program elements are addressed at the appropriate level so that systems operate properly and public health and environmental resources are protected. Soil-based onsite or cluster systems that serve 20 or more people or treat wastes from certain commercial facilities are subject to state or tribal regulation under the EPA Class V Underground Injection Control Program (EPA, 2001).

Effective management programs issue clear directives, provide technical and other requested assistance to stakeholders, and fairly apply community and regulatory authority oversight controls. Integrating the decentralized systems management program with other watershed or regional planning programs can help clarify program goals, define performance requirements, solidify community support, ensure that the management program elements are appropriate, and address the entire array of environmental challenges. Technical, financial, and other incentives can help ease cost and other burdens for service providers and system owners. Finally, an effective inspection and enforcement program ensures that systems requiring repair, expansion, or replacement are addressed promptly to minimize public health and ecological risks.

2.3 Issues to consider in assigning program element responsibilities

The overarching purpose of the EPA voluntary guidelines for onsite/decentralized systems is to provide guidance that will assist communities in providing an adequate level of management to assure long-term protection of public health and water resources in a cost-effective manner that also protects property values. How this is accomplished will be a product of the creativity, commitment, and capabilities of each local community and regulatory authority. In general, the management program for onsite/decentralized wastewater systems should be evaluated on how it responds to the issues raised by each of the program elements. The extent to which each program element is addressed and how it is implemented is dependent on the management program objectives, the various physical settings, the mix of technologies, jurisdictional boundaries, environmental conditions, and the desired role of the regulatory authority and management entity.

In any locale, the regulatory authority will play a key role in the creation of the management program. The powers and responsibilities of regulatory authorities vary from state to state, but in general, they allow for developing and implementing most activities associated with various elements of the management program (see Table 2-1 and the box below). Staffing, funding, or other limitations will likely prompt regulatory authorities to invite the interest and involvement of public and/or private partners in management program development. These stakeholders ! which might include planning departments, water resource agencies, private firms, service providers, college environmental science programs ! can help the regulatory authority address activities associated with some program elements through a cooperative, coordinated approach.

The distribution of tasks between the regulatory authority, management entity and service providers will vary depending on local circumstances, conditions, and the level of management desired. At higher levels of management (e.g., Management Programs 4 and 5) a RME is typically developed to be responsible for most or all activities associated with various elements of the management program. This facilitates the regulatory authority to focus on permit enforcement, broad oversight, policy development, and cumulative impact analyses.

In this chapter, tables illustrate the distribution of responsible parties for each program element between stakeholders, (e.g., regulatory authority (RA), responsible management entity (RME), service provider (SP) and homeowner (O). These distributions or assignments of responsibility are merely illustrative and are based on certain assumptions by the authors of the USEPA Voluntary Management Guidelines (2003). They may not reflect local political climates, public perceptions, or legal codes of users seeking to create the most appropriate management program for their circumstances.

Responsibilities of an onsite regulatory authority may include some or all of the following:

- Power to propose legislation and establish program rules and regulations
- Land use planning, review and approval of system designs, permit issuing
- Construction and installation oversight
- Routine inspection and maintenance of all systems
- Management and regulation of septage handling and disposal
- Local water quality monitoring
- Administrative functions (e.g., bookkeeping, public education, billing)
- Grant writing, fund raising, staff management, outreach
- Authority to set rates, collect fees, levy taxes, acquire debt, issue bonds, make purchases
- Authority to obtain easements for access to property, enforce regulations, require repairs
- Conduct education, training, certification, and licensing programs for staff and contractors
- Record keeping and database maintenance

(Source: NSFC, 1996)

The management models described in the 2003 *Voluntary Guidelines for Management of Onsite and Cluster (Decentralized) Wastewater Treatment Systems* provides suggested approaches for assigning responsibilities among the many parties interested in improving system management. The models, which feature management tools such as program inventories, operating permits, maintenance contracts, and use of third party management entities, provide a flexible framework for managing systems in relation to environmental and public health risks posed by decentralized systems. Regulatory authorities and other stakeholders can use the models to build their management programs by adapting various features of the models to fit their unique needs, resources, and capabilities.

2.4 Description of management program elements

This section of the handbook discusses the various components of an onsite/decentralized wastewater management program. These components, or *program elements* ! public involvement, planning, design, installation, operation, maintenance, etc. ! comprise discrete focal points for developing a management program. Each program element is presented and reviewed below to provide general information on the range of options available when creating new management programs or enhancing existing ones. The following sections outline some typical approaches for implementing each program element, and provide examples of how activities have been addressed in certain situations across the nation. Each program element is accompanied by suggested approaches for basic, intermediate, or advanced management programs. Selection of the approaches used for any locality should be based on the consensus of the regulatory authority, the management entity, and the community wherever possible. Users of this handbook are encouraged to use the model programs and the range of options presented for each program element in developing their onsite management programs.

2.4.1 Public involvement and education

The success and indeed the existence of any onsite management entity are intertwined with its ability to involve and educate the system owners and the public at large. Unless the public understands the need for a management program there is little chance for its success. Historically, most management entities have come into existence not because of their inherent value in protecting public health and the environment, but because of external forces that threatened to have far greater consequences. Usually, those external forces have been the state regulatory agencies seeking to abate some water quality or public health problem. Indeed, Allee, et al. (2001) point out that effective management is usually the result of the recognition of a local crisis that requires it. The response to the crisis brings together the local officials, the state or regional regulators, and the community to attempt to solve the identified problems that have resulted at least in part because of failing OWTSs. The resulting cooperative efforts on the part of those stakeholders become a relationship-building process that then becomes the basis for subsequent management programs. Even if the process proves to be imperfect, that relationship provides a climate for adjustment and ultimate success of a management program. Olson, et al. (2002) discusses the pitfalls in the early stages of management program formation, pointing out that failure to include inputs from the entire community can be fatal to the process. The management program formation process is discussed in Chapter 4.

In addition to public involvement in the development and implementation of the management program, there needs to be an accompanying effective public outreach and education function. Failure to effectively initiate and perform these tasks risks the spread of misinformation and loss of confidence in the management entity. Mancl (2001) reports that a common characteristic of long-term successful management entities is the hiring of inspectors who have an outgoing, empathetic character and who take the time to chat and explain issues with homeowners. The University of Rhode Island Extension has developed some materials designed to get homeowners involved in creating and participating as volunteers in ongoing management programs (Dow and Loomis,1998).

Gaining public support for onsite maintenance programs

In south Deschutes County, Oregon, a decentralized wastewater demonstration project funded by US EPA determined that education was the key to public support of the onsite maintenance program. The project team determined that homeowners were not the only stakeholders in the education program, and also targeted real estate professionals and contractors working in the onsite industry. The project team held a one-hour training session that could be counted towards the continuing education program. The response from the participants was overwhelmingly positive and some participants suggested that the training be required for all realtors.

(Source: Rich, 2001)

No matter which level of management chosen, the public needs to be kept informed and involved.

With lower management levels (Management Model 1 and sometimes Management Model 2) there are fewer resources and staff to perform outreach activities, but the importance of keeping the community involved is still very important. Higher-level programs with RMEs can more readily perform these functions because of greater resources and staffing.

Even though the role of the homeowner in lower-level management programs may be less than in higher-level programs, their expectations are the same. Therefore, public involvement and education is universally necessary for continued success of the management program. One part of that involvement is to make accessible to all homeowners their onsite system inventory records upon request. Another very important public involvement role is to have a stakeholder review committee that regularly (e.g., on an annual basis) reviews the management program activities and recommends improvements. The makeup of such a review body should be similar to the program initiation steering committee in order to represent the spectrum or diversity of the stakeholders in the district. Some concepts of the variability in this program element are illustrated in Table 2-3.

Table 2-2. Public education and participation activities

Program element	Basic approach	Intermediate approach	Advanced approach
Public education and participation activities	Involved in program development and rule revisions with management entity.	Involved in program development and annual program reviews of the management entity.	Involved in program development, annual program reviews, and public education and outreach efforts with management entity.

Public education is difficult to separate from the public participation or public involvement program element already discussed. In the context of this handbook, education is defined more as an outreach or communications program from the management program to the homeowners. Since the lower-level management programs have a strong dependency on the role of the system owners in providing maintenance, there is a solid basis for this program element, as viewed by the near century of experience with unmanaged onsite systems that homeowners almost universally ignored, with the consequence being a significant and continuous rate of failure.

Caudill (1998) provides an example of an effective public education program developed by Clermont County, Ohio health department staff with assistance from a state regulatory authority. Public education and outreach by the Clermont County outreach program included advisory groups, homeowner education meetings, news media releases and interview programs, meetings with real estate agents, presentations at farm bureau meetings, displays at public events, and targeted publications. Olson and Gustafson (2001) have outlined a comprehensive public education system for homeowners in management programs that provide minimal services. In all management entities, homeowners must be educated about the needs or signs to watch for that require professional servicing, activities that they can undertake to make their systems work better and longer, and property activities to be avoided that would have the opposite impact.

Table 2-3. Public education approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Education/training for homeowners	Acquire and circulate multimedia materials on basic system operation and maintenance needs; send reminders to owners when O/M should be scheduled.	Develop locally specific educational materials with information on local impacts and currently approved service providers. Provide information for system owners on system O/M, health and environmental impacts, causes of failure, and management program procedures at workshops, fairs, schools, etc.	Educate homeowners about management program advisory boards, variance and complaint review panels, etc. Work with homeowners in system design phase and in regular reviews to optimize management program performance and acceptability. Conduct outreach programs at civic, school, and other events to answer questions and obtain feedback from homeowners.

2.4.2 Planning

There are two types of planning related to decentralized wastewater management entities. The first type is the planning that is integral to the development of the management entity discussed in Chapter 4. The second type is participation in the comprehensive land use planning of the potential growth scenarios for the area.

At lower management levels the regulatory authority provides some minimal input upon request to the comprehensive land use planning process. In the past, this has resulted in comprehensive plans that reflect soil maps and minimum lot size regulations, often resulting in undesirable land-intensive development patterns that are either relatively insensitive to or overly restrictive of development in the context of the watershed. In the former case, a plan may emerge that considers only soil types and minimum lot sizes, with no concern for sensitivity of the water resources. In the second case, growth may be restricted in sensitive areas based only on the limitations of conventional onsite systems. More sophisticated risk assessments and risk management plans have been successfully employed by certain locations such as New Shoreham, RI, where the MANAGE risk assessment model was applied to determine relative risks and the degree of onsite treatment required to minimize those risks (Loomis, et al., 1999). In similar efforts, Massachusetts Department of Environmental Protection has identified "nitrogen sensitive zones" that limit the amount of nitrogen that can be discharged from onsite pretreatment systems in the designated zones, thus encouraging alternative onsite/cluster approaches in a performance-based requirement (Mass. Environmental Code, 1996). Hoover, et al. (1998) and Otis (1999) have also proposed methods risk assessment for areas served by onsite and/or cluster systems that use soil infiltration (see Chapter 4). Table 2-4 describes a range of land use planning activities in which the management program may be involved.

Table 2-4. Planning activities

Program element	Basic approach	Intermediate approach	Advanced approach
Planning	Coordinate wastewater program with regional planning office by sharing rules and soils data.	Identify critical areas and sites requiring higher levels of treatment based on soils and hydrogeological information or requiring restricted development.	Assess vulnerabilities of receiving waters and identify treatment standards for each zone based on health/water resource risks. Establish overlay treatment zones based on environmental sensitivity and health impact potential for evaluation of proposed developments.

Comprehensive land use planning, if available in the area, can provide valuable information and support for onsite system management and regulatory programs and should serve as the basis for managing existing systems and permitting future installations. At a minimum, planning should include the identification of the planning region, development of program goals, and coordination of multiple agencies involved in health, resource protection, and economic development activities. Comprehensive planning provides one of the best vehicles available for ensuring that onsite management issues are seamlessly integrated into future growth and development scenarios. Comprehensive planning and zoning are closely related and are usually integrated. Comprehensive planning sets overall guidance and policies, while zoning provides the detailed regulatory framework for implementation. Comprehensive planning that addresses environmental protection can be administered through zoning regulations that

- Specify performance requirements for onsite or clustered systems, preferably related to each surface and ground water resource in the area.
- Limit development on sensitive natural resource lands and critical areas.
- Encourage development within urban growth areas serviced by cluster or sewer systems, if adequate capacity exists.
- Require consideration of factors such as system densities, hydraulic and pollutant output, proximity to water bodies, soil and hydrogeological conditions, and water quality for all new development or system repairs.

Even relatively simple planning approaches can consider existing and potential public health and water quality problems and combine them with the physical characteristics of the problem area and input from regulators and the public in developing management strategies. If an RME exists or is developed, it should be intimately involved in land use planning and zoning program decisions. Traditional approaches to land use planning have relied upon soil maps and minimum lot size ordinances, resulting from prescriptive onsite wastewater treatment codes. Lot size restrictions and prescribed conditions for treatment sites have unintentionally served to misguide development in many cases. Performance requirements are based on actual site limitations and locations in the watershed to assure that systems are designed to meet site conditions rather than requiring site conditions to meet the treatment capabilities of a limited number of onsite system types. Thus, planning decisions can be made on a rational watershed basis, rather than on arbitrary site-alone requirements.

Maryland partnership develops septic system impact study

The Department of Environmental Resources and Health Department in Maryland's Prince George County worked together to develop geographic information system (GIS) tools to quantify and mitigate nonpoint source nutrient loadings to the lower Patuxent River, which empties into the Chesapeake Bay. The agencies developed a database of information on existing onsite systems, including system age, type, and location, with additional data layers for depth to ground water and soils. The resulting GIS framework allows users to quantify nitrogen loadings and visualize likely impacts under a range of management scenarios. Information from GIS outputs is provided to decision makers for use in planning development and devising county management strategies.

(Source: *County Environmental Quarterly*, 1997)

A regular review of the planning and zoning activities and development proposals by the management program will help the planners to anticipate growth and development trends and the roles of onsite, cluster, and central sewer systems in minimizing impacts on the watershed and on public health. For example, proposed development and land use plans may require the application of new technologies for wastewater management. Recognition of this fact in internal planning allows the management program to investigate the performance of technological alternatives that appear to be able to appropriately treat and disperse wastewater under locally specific circumstances, thus permitting informed review of proposals from equipment purveyors in the future. Another specific example of value added to planning would be development of an evaluation protocol for new development proposals that can be used to determine if the development is best served by clustered or individual systems, or some combination of the two, in the context of performance requirements that must be met. Such a protocol could be shared with developers to assist them in planning new developments, knowing that they will be judged accordingly.

More advanced planning approaches ! through an enhanced effort led by the regulatory authority, regional planning department, or RME ! might involved other, more complex issues. There is a general movement on the part of the states and federal agencies to manage water resources based on watersheds. At present most states utilize watershed models to determine pollutant loadings allowable from sewage treatment plant discharges in their NPDES permits. For the last few years all the states have been evaluating their watersheds and stream segments to determine the pollutants that exceed required levels in order to develop plans to bring them into compliance with their designated uses. Approximately 40 percent of the Nation's waterways fall into this category, with the primary pollutants causing noncompliance being sediments, nutrients, pathogens, metals, lack of dissolved oxygen, and altered habitat. Although this analysis is part of a proposed and controversial regulatory process called TMDLs, the watershed assessment process has been found to be valuable to the states and tribes in that it allows them to identify the primary sources of pollutants and to create strategies for improving those affected streams. This approach will surely impact the role of onsite wastewater technologies in regional watersheds.

Besides watershed/TMDL efforts, drinking water source protection studies are leading to consideration of onsite wastewater system restrictions in order to protect groundwater resources. In Washington County, Utah, a mass balance approach based on the assumed loading of nitrates from conventional septic tank systems to shallow, unconfined ground water is being applied. Based on this analysis, the county is considering imposing minimum lot sizes for future development relying on this technology. The more rational performance-based approach is the use of appropriately managed nitrogen-reduction onsite and/or cluster technology. Certain counties in Colorado and Minnesota are similarly approaching ground water protection in this manner. Although both will accomplish the protective needs of those areas, the performance approach invites more creative and less land-intensive (and revenue-generating) development.

The role of a comprehensive onsite management program (i.e., an RME) in watershed or ground water protection planning creates an additional means of effecting change in the overall water pollution abatement strategy since onsite wastewater systems can be a significant source of certain pollutants. This is particularly true where a metropolitan sewerage agency takes management responsibility for regional onsite and cluster systems. By having this increased flexibility to control all or most of the sources of certain pollutants, the management entity can find and implement the most cost-effective pollutant management plan for the region (Kreissl and Otis, 1999).

Planning is further enhanced when the entire spectrum of wastewater (onsite, cluster, and central sewer systems) and storm water pollution abatement measures are managed by a single RME working closely with the planning agency. As the watershed approach becomes more predominant in water resources management, the value of broad wastewater management approaches will become more evident. Existing municipal sewer authorities should be reviewing the potential for incorporating small and onsite systems in their immediate proximity to take advantage of the efficiencies and effectiveness of such a comprehensive approach (Kreissl and Otis, 1999).

2.4.3 Performance requirements

Performance requirements are established by regulatory authorities to ensure compliance with the public health needs of the community and water quality in the watershed. Performance requirements are based on broad goals (e.g., eliminating health threats from contact with inadequately treated effluent or direct/indirect ingestion of contaminants), standards for water quality and restoration or protection, and can be both quantitative (e.g., total mass load or concentration of pollutants per unit of time) and qualitative (e.g., no odors or color in discharges). Water-quality performance requirements normally state the specific location at which water quality criteria are to be met. The means of meeting the requirements becomes the responsibility of the designer.

Performance requirements for OWTSs can be grouped into two general categories: numeric requirements and narrative criteria. Numeric requirements set measurable concentration or mass loading limits for specific pollutants (e.g., nitrates, nutrients, or pathogen concentrations). Narrative requirements describe acceptable qualitative aspects of the wastewater (e.g., no color or odor). A numeric performance requirement might be that all septic systems in environmentally sensitive areas must discharge no more than 5 pounds of nitrogen per year or that concentrations of total nitrogen in the pretreatment system effluent can be no greater than 10 mg/L. Some of the parameters for which performance requirements are commonly set for OWTSs include:

- Fecal coliform bacteria (as an indicator of pathogens).
- Biochemical oxygen demand (as an indicator of biodegradable organic content).
- Nitrogen (major estuarine and marine water nutrient).
- Phosphorus (major fresh and marine water nutrient).
- Nuisance parameters (e.g., floating matter, fats, oils, grease).

Performance requirements may explicitly state treatment effluent standards, and should be based on risk assessments that consider the potential hazards of each pollutant in the wastewater by estimating its transport and fate, potential exposure opportunities, and projected effects on humans and environmental resources. Water quality standards already have been established by a variety of governmental agencies for a wide range of surface water uses. These include standards for waters used for recreation, aquatic life support, shellfish propagation, aquatic habitat, and drinking water.

Local needs or goals must be considered when performance requirements are established (see Table 2-5). Watershed or ground water site-specific conditions may warrant lower pollutant discharge concentrations or mass pollutant limits than those required by existing water quality standards. Existing water quality standards, however, provide a good starting point for selecting appropriate decentralized system performance requirements. By estimating cumulative mass contributions of a pollutant from all sources discharging to the receiving water, the relative contributions from and the location of each source, and calculating the assimilative capacity of the receiving waters, a determination of the maximum mass of pollutants that can be contributed by wastewater sources can be made. From this total allotment, any point sources already permitted will be subtracted. The rest is allotted to decentralized wastewater systems, and forms the basis for the performance standard. Other significant contributing nonpoint sources of pollutants in rural watersheds include yards and landscaped areas, agricultural crop lands, forests, and animal feeding operations.

Performance requirements related to onsite system discharges are evaluated at a specified performance or design boundary, which can be a physical boundary or a property boundary. Physical boundaries are wastewater migration transport points where conditions abruptly change. A physical boundary can be at the intersection of treatment unit processes or between soil conditions, (e.g., the infiltrative surface, the unsaturated soil (vadose zone), the saturated soil (ground water) zone), or at another designated physical location, such as a property line, drinking water well or nearby surface water body.

The establishment of performance requirements for onsite treatment systems should be based on established water quality standards for the receiving waters and the assimilative capacity of the environment between the point of wastewater release (soil) and the performance boundary designated by the management agency. If the assimilative capacity of the receiving environment is overwhelmed because of increases in pollutant loadings, pretreatment system performance should be improved. High-density developments located near sensitive receiving waters may be subject to more stringent requirements than those serving lower-density housing farther away from sensitive water resources. Nitrogen, for example, exhibits only minor removal in conventional soil infiltration systems, and would therefore require special pretreatment in onsite systems located nearby nitrogen-sensitive surface waters or in the receiving aquifer that is the source of local drinking water supplies for which a nitrate limit is codified.

Many other pollutants are almost completely removed in a properly designed septic tank and soil absorption system (including vadose or unsaturated soil treatment). These pollutants include biodegradable organics, total suspended solids, certain toxic organics, heavy metals, and parasites. If these pollutants were the main concern of the regulatory agencies, there would be little value in considering special pretreatment needs. Other pollutants, such as viruses, bacteria, and phosphorus, can fall somewhere in between these two examples, which suggests the need for a comprehensive evaluation of the onsite wastewater contributions in a watershed or wellhead protection zone for which performance requirements may be needed.

Table 2-5. Performance requirements approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Performance requirements	Prevent direct and indirect contact with raw or partially treated wastewater through prescribed hydraulic loading restrictions, setbacks and separation distances.	Specify alternative technologies for certain sites or conditions that do not meet prescribed separations or other physical requirements. Establish inspection and maintenance reporting requirements to ensure proper system functioning or to renew revocable operating permit.	Characterize watershed water resources against quality designations. Evaluate cumulative impacts/allotments for all sources and or key pollutants. Establish numeric and/or narrative performance requirements for onsite/decentralized systems. Develop protocols for measuring (monitoring/ inspections) compliance against performance requirements.

Establishing performance requirements at a watershed scale

Establishing performance requirements involves a series of steps that move from landscape-level to site scale considerations. The following steps describe the general process of establishing performance requirements for onsite systems:

- Identify receiving waters (ground water, surface water) for OWTS effluent.
- Define existing and planned uses for receiving waters (e.g., drinking water, recreation, habitat).
- Identify water quality criteria associated with designated uses (check with state water agency).
- Determine types of OWTS pollutants (e.g., nutrients, bacteria) that might exceed water quality criteria.
- Identify confirmed problem areas and areas likely to be at risk in the future.
- Determine whether OWTS pollutants pose risks to receiving waters; if so, then:
    - Estimate existing and projected onsite wastewater contributions to pollutant loads
    - Determine if OWTS pollutant loads will cause or contribute to water quality violations.
    - Establish maximum output level (mass or concentration) for specified OWTS effluent pollutants.
    - Define performance boundaries for measurement of OWTS effluent and pollutant concentrations.

Performance requirements for onsite wastewater systems are a subject of much discussion. Depending on the level of management, this issue could be either unimportant or extremely important. With most state regulations prescriptive restrictions, there is an assumption that if the site meets stated prescriptive requirements, the system will be protective of public health. The only protections provided for ground water and nearby surface water quality are minimum horizontal and vertical separations. Evaluations of waterborne disease outbreaks have not shown these separations to be consistently effective due to hydrogeological conditions that were not evaluated as part of the prescribed site evaluation process (Kreissl, 1983). Similarly, surface and subsurface water quality studies do not correlate well to these arbitrary horizontal separation distances.

The last resort of most states with severe soils restrictions has been to permit direct discharge of onsite systems. Because of the enormity of the problem of regulating and permitting large numbers of very small systems under the NPDES program, these states employ what is known as a general permit. In essence, the state provides a set of standards for a variety of pollutants and the required frequency of monitoring for compliance with these standards. This is a true performance standard in that a set of effluent limitations is provided without direction on how they shall be met. The penalties for not meeting them are clearly specified in the permit. For example, the new draft Ohio General Permit for household systems specifies concentration limits for TSS, carbonaceous biochemical oxygen demand, fecal coliform, ammonia-nitrogen, dissolved oxygen, and total residual chlorine, along with the frequency and type of sampling necessary to monitor compliance (Ohio EPA, 2001). The samples analyzed for those constituents are also to be evaluated with regard to turbidity, odor, and color.

At a minimum, the management program should meet a performance goal of eliminating surface seepage and backups that directly threaten public health. This performance requirement generally calls for a minimum of Model Programs 1 or 2. When ground water and surface water quality problems are evident and they need to be abated, it will generally require a management program resembling Management Programs 3 or higher. In either case, the operation and maintenance needs of the technologies employed must be analyzed and a plan should be developed to ensure that those are met.

One of the primary benefits of a comprehensive management program implemented by an RME is the ability to meet performance requirements, (i.e., system technologies are chosen, managed, and monitored that meet public health and ecosystem (watershed) goals based on established risk management standards, at specific locations in the watershed). In simple terms, the system can be designed, operated and managed to meet whatever public health or ecosystem requirements imposed by the regulatory authorities. Since performance requirements are not yet in place in most states and regions, a comprehensive management program can also operate under the more common prescriptive regulatory framework presently in use. Prescriptive standards are less exacting for the RME since they are based on assumptions of safety (which may be either overestimated or underestimated) based on certain site condition measurements and reduce the demand for technically skilled staffing.

2.4.4 Site evaluation

Evaluating a proposed site in terms of its environmental conditions (climate, ground water, and surface water aspects), physical features (geology, slopes, soils, property lines, wells, and structures), and wastewater characteristics (anticipated flows, pollutant content, and generation patterns) provides the information needed to size, select, and locate the appropriate wastewater treatment system. Onsite regulatory authorities issue permits—legal authorizations to install a particular system at a specific site—based on the information collected and analyses performed during the site evaluation and the designer's interpretation of that information. Prescriptive site evaluation, design, and construction requirements are based on experience with conventional septic tank/soil absorption systems and empirical relationships that have evolved over the years. Site evaluation approaches can vary from total dependence on percolation tests to total dependence on soil and subsurface analyses via deep pits, and a number of permutations that may incorporate aspects of these and other site measurements.

Effective site evaluations are crucial to meeting the treatment objectives of the system and the public health and water quality goals of any management entity. There are many excellent site evaluation references in the literature (e.g., WEF, 2001; Tyler and Converse, 1994; Tyler, 2001; NSFC, 2000). Nearly all of these, however, are geared to determining hydraulic acceptance for systems that rely on treatment in the soil. Existing state codes are primarily prescriptive in that they provide the system design that must be used if the site fits the conditions determined by prescribed site evaluation procedures. These codes do not directly deal with ground and surface water impacts, but assume that certain vertical and horizontal setback distances will protect these waters. Significant variation is evident among these empirically determined state setback requirements (Kreissl, 1982), and the likelihood of under or over protection is great. Typical site evaluation program element content is provided in Table 2-8.

Table 2-6. Site evaluation approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Site evaluation	Require assessment of site hydraulic acceptance and other physical features, including slope and vertical and horizontal setbacks for soil-based systems to determine compliance with prescriptive rules. Require licensed/certified site evaluators.	Prescribe broader set of site conditions to permit prescribed alternative technologies. Require licensed/certified site evaluators. Designate alternative systems for sites not meeting conditions prescribed for conventional systems.	Provide protocol for comprehensive site assimilative and treatment capacity. Characterize critical design and performance requirements and boundaries. Provide supplemental certification/licensing training for site evaluators to meet local needs.

Performance-based approaches require a more comprehensive site evaluation to ensure that onsite systems do not adversely affect water resources. Site evaluation protocols may include presently employed empirical tests, tests that evaluate specific soil properties such as texture, bulk density, consistence, structure, etc., and soil pits to characterize soil horizons, mottling, and a variety of other properties. Usually, prescriptive codes are designed to determine the hydraulic capacity of the soil and empirically "assure" proper treatment by specifying horizontal and vertical separations. Generally, all management programs allow conventional onsite systems to be sited in areas with appropriate soil conditions and specified setback/separation distances and unsaturated soil depths. Higher-level management entities should specify which site evaluation tests and procedures are to be followed for each area of identified vulnerability and class of technology allowed or possible. Table 2-9 provides a guide for the general progression of a site evaluation processes. Site evaluation for alternative technologies should be based on demonstrated past performance at similar sites or performance requirements that specify the type of pollutant to be controlled and how and where it will be measured (i.e., the performance boundary).

Site evaluation (in the absence of performance requirements) should include:

- Vertical distance to seasonal high water table, bedrock, or other restrictive layer.
- Soil characteristics versus related infiltration area size requirements for each approved treatment and distribution technology.
- Site slope, cover, terrain position, and hydrogeology.
- Horizontal distances and direction of surface water bodies or groundwater wells and their present and designated quality requirements.
- Horizontal distances to other physical features, particularly those in likely plume path.
- Site location and geometric orientation possibilities.

Because of the difficulty in properly characterizing wastewater flow and pollutant loads, evaluating critical site conditions, a significant level of education, training, and experience is required of personnel conducting these tasks.

Many states and local management programs require that onsite system service providers be specifically trained, licensed and/or certified. Angoli (2001) reported that 68 percent of the onsite regulatory agencies that responded to a NSFC survey stated that they required site evaluators to be licensed/certified. In many cases, local regulatory staff performs site evaluations, which is a questionable concept since it represents a conflict of interest. Some states require registered soil scientists to conduct the necessary assessment of soil conditions and site suitability. All onsite management programs should require licensing or certification of both private sector and staff site evaluators. All onsite programs should benefit from this requirement, but no quantification of these benefits has been published at this time.

Site evaluations and performance requirements in Texas

The state of Texas in 1997 eliminated percolation test requirements for onsite systems and instituted new performance requirements for alternative systems (e.g., drip systems, intermittent sand filters, leaching chambers). Site evaluations in Texas are now based on soil and site analyses, and service providers must be certified. Officials in the Lone Star State took these actions after onsite system installations nearly tripled between 1990 and 1997.

(Source: Texas Natural Resource Conservation Commission, 1997).

Table 2-7. Site evaluation and assessment activities for SWIS applications

Preliminary activities	Information from research
Preliminary review	▪ Site survey map ▪ Soil survey, U.S. Geographical Society topographic map ▪ Aerial photos, wetland maps ▪ Source water protection areas ▪ Natural resource inventories ▪ Applicable regulations/setbacks ▪ Hydraulic loading rates ▪ Criteria for alternative OWTS ▪ Size of house/facility ▪ Loading rates, discharge types ▪ Planned location of water well
Scheduling	▪ Planned construction schedule ▪ Date and time for meeting
Field activities	**Information from field study**
Identification of unsuitable areas	▪ Water supply separation distances ▪ Regulatory buffer zones/setbacks ▪ Limiting physiographic features
Subsurface investigations	▪ Ground water depth from pit/auger ▪ Soil profile from backhoe pit ▪ Presence of high water table ▪ Percolation tests
Identification of recommended SWIS site	▪ Integration of all collected data ▪ Identification of preferred areas ▪ Assessment of gravity-based flow ▪ Final selection of SWIS site

(Source: Adapted from ASTM, 1993).

Logically, a management entity could build upon good conventional SWIS site evaluation for other soil-based systems by adding other tests that would be dictated by the type of wastewater, the treatment system characteristics, specific soil properties, ground water movement and hydrogeology, and the performance requirements to be met at a specific location. For example, nitrogen removal could be significant if soil/aquifer materials were high in organic content. Similarly, phosphorus removal is usually excellent in the soil immediately surrounding the SWIS, but an estimate of long-term removal capacity might be needed if that is the pollutant of concern. For advanced pretreatment systems, the soil may only be a means of effluent dispersal into the surrounding environment, necessitating a similar site evaluation to that presently performed for conventional systems.

2.4.5 Design

The design program element provides a means of ensuring that new or replacement onsite systems have the capability of meeting performance requirements to protect public health and water quality through the establishment of credible protocols for design evaluation. With low-level management programs prescriptive codes restrict the choices to either the conventional system or a few approved alternative systems, and system components are specified with little allowance for variation. Use of prescriptive codes limits the potential for matching site conditions with a treatment system capable of meeting whatever performance requirements are needed to meet health or water quality goals.

Most lower intensity management programs rely on the state code for design, thus there is usually no need to develop any special design protocol. However, in sensitive environments where performance codes are employed, there is a requirement to develop a design protocol, but it may or may not be prescriptive in its allowable designs (see Table 2-10). Under a performance-based approach, performance requirements, site conditions, and wastewater characterization information drive the selection of treatment technologies at each site.

For known technologies with extensive testing and field data, the management agency can institute performance requirements prescriptively by designating system type, size, construction practices, materials to be used, acceptable site conditions, and siting requirements. For example, the Arizona Department of Environmental Quality has proposed an onsite rule that establishes definitions, permit requirements, restrictions, and performance criteria for a wide range of conventional and alternative treatment systems (Swanson, 2000).

Table 2-8. Design program approaches

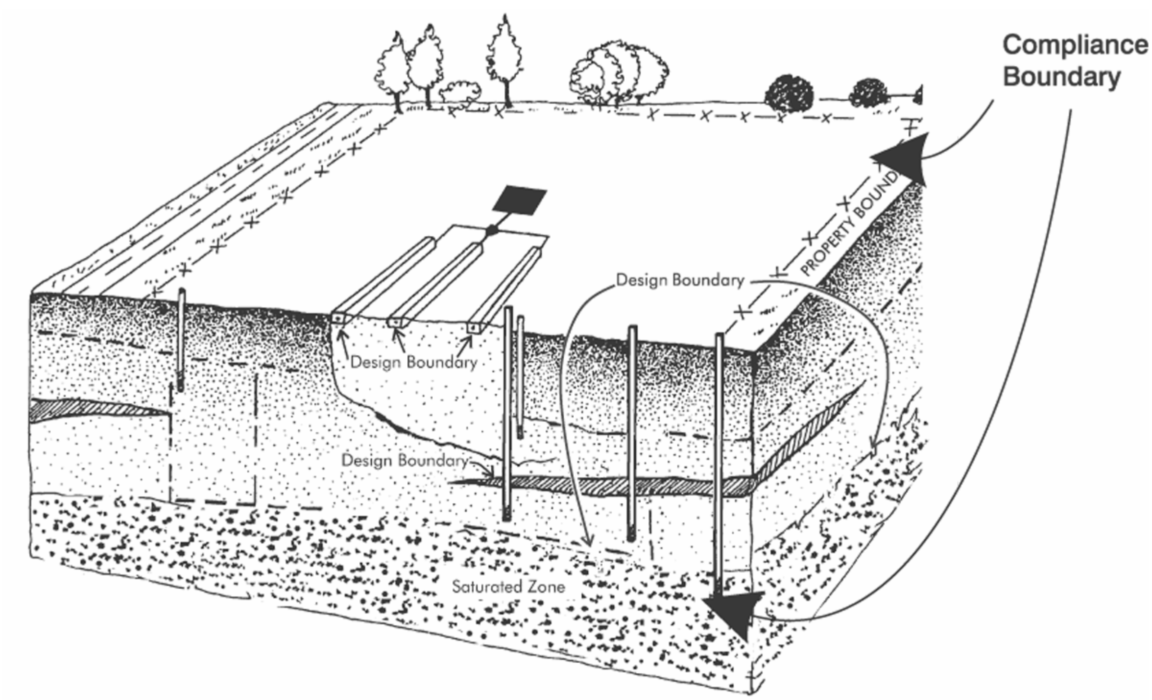
Program element	Basic approach	Intermediate approach	Advanced approach
Design	Design only conventional septic tank/gravity fed soil discharging systems on sites meeting code-described prescriptive criteria. Require state certified/licensed designers.	Allow limited number of alternative designs on certain specific non-compliant sites. Require state certified designers. Provide potential for engineered alternative designs for large systems.	Institute protocols for use of risk-based designs based on site evaluation results and specific wastewater sources. Provide supplemental training and licensing/certification for designers based on specific needs of local water resources.

True performance codes merely note that specific water quality goals must be met at specific locations, and leave how those goals are attained to the designer. Some permitting programs broadly characterize required performance requirements for onsite installations in sensitive areas by designating overlay zones. These zones are based on soil type, topography, hydrology, or other characteristics and can specify maximum system densities, system design, performance requirements, and operation/maintenance requirements. Establishing onsite system overlay zones requires making some broad assumptions and generalizations, however, and should be supplemented with comprehensive site-specific evaluations.

Some states have recently developed performance-type codes consisting of a series of accepted or approved design packages for a variety of site conditions. These packages and performance assumptions represent a significant advance over the more restrictive prescriptive codes, but they are not true performance-based codes. They do, however, simplify the regulatory role by allowing implementation of a broader array of technologies without demanding the level of staff expertise that a true performance code would.

Design protocols should address the potential implications of water conservation fixtures, impacts of different pretreatment levels on hydraulic and treatment performance of soil-based systems, and the operation and maintenance requirements of different treatment and soil dispersal technologies. They should include a required pre-design or pre-construction meeting between the permitting agency, the management entity (if it does not have permitting powers), the designer and the owner of the property. All of these parties have a stake in the design and questions for which they need answers before the installation proceeds. The protocol should be as complete as possible, but should feature a rational, defensible evaluation procedure for proposed designs and materials specifications that were not anticipated at the time that the review protocol was developed in order to encourage innovation and advancement. Also, the protocol should be dynamic and should be regularly reviewed and updated as new information and experience is gained.

Figure 2-1 Example of design boundaries for onsite wastewater treatment systems



Source: EPA, 2002

A cooperative approach for approving innovative/alternative designs in New England

The New England Interstate Water Pollution Control Commission (NEIWPCC)is a forum for consultation and cooperative action among six New England state environmental agencies. NEIWPCC has adopted an interstate process for reviewing proposed wastewater treatment technologies. A technical review committee composed of representatives from New England state onsite wastewater programs and other experts evaluates innovative or alternative technologies or system components that replace part of a conventional system, modify conventional operation or performance, or provide a higher level of treatment than conventional onsite systems.

Three sets of evaluation criteria have been developed to assess proposed replacement, modification, or advanced treatment units. Review teams from NEIWPCC assess the information provided and make determinations that are referred to the full committee. The criteria are tailored for each category, but in general include:

- Treatment system or treatment unit size, function, and applicability or placement in the treatment train.
- Structural integrity, composition, durability, strength, and corresponding independent test results.
- Cost and life expectancy, including comparisons to conventional systems/units.
- Availability of parts, service, and technical assistance and costs thereof.
- Test data on prior installations or uses, test conditions, failure analysis, and tester identity.

(Source: NEIWPCC, 2000).

2.4.6 Construction

Poor installation can be devastating to the performance of both conventional and advanced systems that rely on soil dispersion and treatment. Installation can start after issuance of a construction permit, which occurs after the design and site evaluation reports have been reviewed and approved. Installation should conform to existing protocols to ensure proper system performance.

There are numerous sources of information on proper installation in a variety of soil types, including the problems associated with certain climatological conditions, soil moisture conditions, precautions on the use of certain types of construction equipment, construction procedures required to avoid structural damage, and appropriate overall construction practices (Tyler, et al., 1985). The impacts of improper installation of soil-based systems generally occur within the first year of operation in the form of wastewater backups. Some improper practices, however, may not exhibit this relatively quick and obvious form of failure. These problems are often related to poor treatment performance, and may take years to manifest themselves in the form of degraded ground water or nearby surface water.

Table 2-9. Construction/installation approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Construction/installation	Construction permit granted based on site evaluation, system design and installation by licensed/certified site evaluators, designers ,and installers. Inspect system prior to backfilling to confirm that installation or complies with design.	Use more proactive inspection program during the construction phase Maintain and disseminate list of locally approved installers based on performance.	Create protocols for installation procedures and contingencies with proactive inspection. Provide extensive construction oversight for all critical steps. Develop supplemental training and licensing programs for installers that deal with local conditions and requirements.

Construction/installation should conform to the approved plan and use appropriate methods, materials, and equipment. Typical program element provisions are presented in Table 2-11. Mechanisms to verify compliance with performance requirements should be established to ensure that practices meet expectations. The typical regulatory mechanisms presently employed to ensure proper installation include precovering inspections of systems near the end of the construction/installation phase and submission of as-built drawings. A more thorough inspection would include:

- Pre-construction meeting with owner and contractor (described in the preceding section).
- Field verification and staking of each component (to prevent damage from equipment).
- Inspections at random times during construction.
- Verification and database entry of as-built drawings.
- A permit to operate the system as designed and built.

Inspections should be conducted at several stages during the system installation process to ensure compliance with regulatory requirements. During the construction process, inspections before and after backfilling can help verify compliance with approved construction procedures. If there are insufficient management program resources to conduct these inspections, an approved, independent design professional could be required to oversee installation and certify that it has been conducted and recorded properly. The construction process for soil-based systems must be flexible to accommodate weather events, since construction during wet weather may compact soils at the infiltrative surface or otherwise alter soil structure. Arbitrary changes in trench depth or location and other improper construction techniques can have serious consequences on performance (University of Wisconsin, 1978). Similar problems occur from the travel of heavy equipment over infiltrative surfaces and down-gradient areas or by silt and clay residues on unwashed trench aggregate (Tyler, et al., 1985). If uniform distribution and dosing are incorporated in the design, improper installation can negate the added performance benefits that the designer would have claimed in the approval process.

Installation of soil-based conventional systems has received inadequate attention under the present system of prescriptive codes. Commonly, the local health department will provide a field inspection prior to backfilling the soil absorption system after which an occupancy permit is issued. Compaction of certain soils or damage to the infiltrative surface during excavation and installation tasks is not obvious during this type of spot inspection and can go unnoticed until system hydraulic failure occurs. In many places (26 percent of the agencies responding to the NSFC survey), training and certification/licensing of installers is not required. Some licensing/certification programs exempt veteran installers through grandfather clauses in the regulation. All management programs should ensure that installers are licensed/certified, but they should also monitor system performance records to further screen recommended practitioners within their jurisdictions. All installer/contractors should receive some type of training on an ongoing basis to prevent or minimize problems associated with inappropriate installation, but enforcement of this requirement is more difficult with lower-level management programs. Even the lowest level management entity should review the qualifications of installers and require submission of final as-built drawings. This recorded documentation should include the names of the site evaluators, designers, and installers and the dates of each event for each onsite system.

2.4.7 Operation and maintenance

The homeowner is the lynchpin of most O/M efforts, particularly in the lower level management programs. There are very useful guides available to conventional system owners in most states through their extension services and through national organizations such as the NSFC. In all management programs the homeowner must be cognizant of the damage that can be caused to soil-based systems by driving heavy vehicles over the ground surface or by paving those areas which results in cutting off the free-flow of oxygen to those systems. The homeowner must also be aware of the effects of adding strong acids or alkalis, toxic compounds, oils, and greases on the performance of these systems and on the receiving waters. The system owners and service providers should also know the effects of water conservation, illegal stormwater connections, garbage grinders, and water softeners.

Operation and maintenance needs of different onsite technologies vary considerably. The conventional septic tank and SWIS usually require only a tank pump-out once every few years with an accompanying inspection of structural appurtenances. Mechanical systems such as activated sludge-based units require servicing three to four times per year to assure that aeration tank solids concentrations do not increase to the point that they are “belched” out with the effluent and cause infiltrative surface clogging or receiving water quality problems, depending on the unit’s discharge designation. Other mechanical/electrical systems also require more frequent (usually annual) inspection to assure proper operation of electro-mechanical components. Newer, modem or internet-based packages can monitor and control many of these mechanical components, thus reducing the frequency of inspection and keeping labor costs affordable for larger and more sophisticated management programs.

Complaints generally provide the only formal notification to the oversight agency that problems exist with unmanaged onsite wastewater systems. Inspection programs that monitor system performance, as employed in Management Programs 3 ! 5, can help reduce the risk of premature system failure, thus decreasing long-term costs and the risk of ground water or surface water contamination (Washington DEQ/PSWQA, 1996). Also, better managed O/M programs can eliminate unnecessary expenses such as purchasing unproven and sometimes dangerous compounds under the guise of improving septic tank and soil absorption system performance. Well-conceived O/M programs are facilitated by better design (e.g., risers that are easily accessible from the surface), real-time accessibility to system records by field personnel, and automated monitoring that can warn or even adjust operational sequences to avoid imminent problems in pretreatment systems. Many states do not allow alternative onsite treatment technologies because they cannot require the increased O/M required to keep them performing as designed. Examples of how this program element can be implemented are shown in Table 2-12.

Table 2-10. Operation and maintenance approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Operation and maintenance	O/M educational materials circulated to system owners; complaint response protocols published; O/M reminders sent to system owners; and use of only certified/licensed O/M providers.	Maintenance contracts and reporting required for mechanical systems; operating permits renewable upon reported completion of required O/M tasks and inspections; disseminate list of acceptable licensed/certified O/M providers based on complaint investigations.	Trained, certified service providers handle O/M tasks for all systems in accordance with established protocols; supplemental training and certification programs provided or supported by RME through training centers or other means; O/M provider performance reviews frequently-updated and approval list dissemination.

Most, if not all, management programs are likely to use private service providers to implement this management element. Therefore, there is a universal need for trained and certified/licensed O/M service providers. Fewer than 40 percent of the responding jurisdictions to the NSFC survey required training and licensing/certification of O/M service providers. Therefore, until these requirements become more common, the low- to mid-level management programs in areas where they do not exist will have to rely on performance records based on complaints. They should also work with their state oversight agencies to rectify this need. There are established training centers and existing training/certification programs available from the NAWT, NSF International, and the National Environmental Training Center for Small Communities that may be able to assist in solving this problem.

Management Program 3 and higher-level management programs feature renewable/revocable operating permits. Permits are reissued at specified intervals (e.g., 1!5 years) after documentation is submitted that all required operation, maintenance, and monitoring tasks have been completed. Lower level management entities should require verification that licensed/certified service providers are retained by system owners. Service providers should be encouraged to report to the management program if contracts are allowed to lapse.

Requiring pump-outs to ensure proper maintenance

Periodic pumping of septic tanks is now required by law in some jurisdictions and is becoming established practice for many public and private management entities. In 1991 Fairfax County, Virginia amended its onsite systems management code to require pumping at least every 5 years. This action, based upon provisions of the Chesapeake Bay Preservation Act, was accompanied by public outreach notices and news articles. System owners must provide the county health department with a written notification within 10 days of the pump-out. A receipt from the pump-out contractor, who must be licensed to handle septic tank residuals, must accompany the notification.

(Source: Fairfax County Health Department, 1995).

Wisconsin's Private Onsite Wastewater Treatment System Rule (Wisconsin Administrative Code, 2001) requires management plans for all onsite treatment systems. The plans must include information and procedures for maintaining the systems in accordance with the standards of the code as designed and approved. Any new or existing system that is not maintained in accordance with the approved management plan is considered a human health hazard and subject to enforcement actions. Individual management plans for conventional residential septic tank/subsurface infiltration systems are not required. The maintenance requirements specified in the code include the following: 1) all septic tanks are to be pumped when the combined sludge and scum volume equals one-third of the tank volume; 2) existing systems have the added requirement of visual inspections every 3 years for wastewater ponding on the ground surface; 3) only persons certified by the department may perform the inspections or maintenance; and 4) the system owner or designated agent of the owner must report to the department each inspection or maintenance action specified in the management plan at its completion. A data management system is used to allow certified inspectors/operators direct telephone access to the system records for reporting and facilitating compliance tracking by the department. This, in effect, creates a statewide program similar to Levels 2 and 3 for Wisconsin.

2.4.8 Residuals management

Private O/M service providers periodically pump residual material under an oversight program established by the regulatory authority. Management entities (i.e., private or public RMEs) often contract with private service providers to handle this task for a number of systems in the managed area. Transport and disposal/reuse of residuals are governed by federal, state, and local codes. Many governmental units have addressed the challenge of residuals management by designating approved sites for disposal. Detailed guidance for identifying, selecting, developing, and operating reuse or disposal sites for residuals can be found in *Process Design Manual: Land Application of Sewage Sludge and Domestic Septage* (EPA, 1995), which is posted on the Internet at http://www.epa.gov/ORD/WebPubs/sludge.pdf. Additional information on septage (residuals pumped from septic tanks) can be found in *Guide to Septage Treatment and Disposal (EPA, 1994*) and *Domestic Septage Regulatory Guidance* (EPA, 1993), which are posted at http://www.epa.gov/oia/tips/scws.htm. The Water Environment Federation is also an excellent source of information on residuals (http://www.wef.org).

In general, regulations strive to minimize exposure of humans, animals, groundwater, and ecological resources to potentially toxic or hazardous chemicals and pathogenic organisms found in these residuals. The primary objective of a residuals management program is to establish procedures and rules for handling and dispersing accumulated materials removed from treatment processes in an affordable manner that protects public health and ecological resources. Residuals management programs include tracking or manifest systems that identify sources, pumpers, transport equipment, final destination, and treatment/reuse techniques employed at that site, as well as procedures for controlling human exposure to residuals, including vector control, wet weather runoff, and controlled access to disposal sites. Examples of this program element are depicted in Table 2-13.

Table 2-11. Residuals management approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Residuals management	Assure that residuals are being reused or managed in compliance with applicable rules; educate and remind owners of the need to inspect and/or pump treatment tanks at regular intervals; and require only state-certified/licensed O/M residuals handlers and approved sites.	Require homeowners and licensed/certified service providers to report when residuals are removed and tanks inspected in order to renew operating permit; maintain and disseminate list of acceptable O/M service providers based on investigated complaints.	Create and administer tracking, inspection and monitoring plan for all aspects of residuals removal, hauling and reuse/disposal; provide any necessary supplemental training and registration/licensing programs for local O/M providers or arrange it with training centers and universities; and employ only approved providers.

At present, almost all onsite system residuals are in the form of septage. Most septage is dispersed onto the land, but a significant percentage is received and processed in sewage treatment plants. In addition to regulations, practical limitations such as land availability, site conditions, buffer zone requirements, treatment plant loading versus capacity, hauling distances, fuel costs, and labor costs play a major role in evaluating septage or other residuals reuse/disposal options. The above options generally account for nearly 90 percent of the septage generated. However, there are some special septage treatment facilities. Initial steps in the residuals reuse/disposal decision-making process include characterizing the quality of the septage and determining potential adverse impacts associated with various reuse/disposal scenarios. Protocols for crafting an environmental management system (EMS) are useful in developing and implementing a residuals management program. Even though residuals management is almost always performed by private O/M service providers, the management entity must assure the regulatory authority (i.e., at some level of government) of compliance with all regulations.

Typically the amount of septage produced per person served in the management entity is 50 to 70 gallons per year (EPA,1994b; WEF,1997). Therefore, if there were 1,000 people in a management zone a rough estimate would be 50,000 to 70,000 gallons per year to be pumped, transported, and treated for dispersal back into the environment. Certain alternative onsite systems like ATUs should produce significantly greater quantities of residuals if properly serviced, but the characteristics of the additional residuals are less onerous. An important task for the management entity is to identify approved sites with sufficient capacity to properly treat, reuse, or dispose of the residuals that the O/M service providers remove and transport. Concerns about odors and pathogens associated with septage increase the need for public education on the management options chosen and how they will be monitored and compliance enforced.

Working with stakeholders early in the management program planning stage to develop the optimal residuals management program is recommended. Capacity needs should be extrapolated from the types of technologies to be employed and the estimated numbers of each type, rather than from present septage generation rates, which will likely yield a lower estimate of capacity needed.

2.4.9 Training and certification/licensing

States and tribes are responsible for developing programs that elevate the quality of service provided by the onsite industry, just as they do for central sewer systems by conducting certification/licensing programs for treatment plant operators or for the drinking water treatment plant operators. State regulatory authorities often set minimum criteria for certifying and/or licensing various service providers (e.g., septic tank pumpers/haulers, site evaluators, system designers, installers, inspectors). In the absence of a rigorous state, tribal, or territorial program, local management entities should consider developing one. The level of development of such a program will vary according to the comprehensiveness and capabilities of the management program partners. Even at the most minimum level, a form of such a program can be implemented by requiring trained and state or tribal licensed/certified service providers to perform these tasks.

Angoli (2001) reported that most onsite regulatory agencies surveyed do have some form of licensing/certification for installers (74 percent), soil/site evaluators (50!68 percent), inspectors (67 percent), and designers (64 percent). Operations and maintenance training/certification is significantly lower (19!37 percent). Even if the management entity is located in a state that does not have or has a less-rigorous certification/licensing program, the entity can still alert other owners of verified complaints against service providers.

Even in states that do have licensing/certification programs, the management program can pass on such information to the state department responsible for the program. Higher-level management programs with comprehensive inspection programs can either warn or decertify service providers who consistently evoke complaints from homeowners. Since the O/M tasks, particularly the pumping task, are the most frequent and personal contacts with homeowners, a swift response on the part of the management entity to such complaints is vital in retaining public confidence. Some examples of management program approaches to certification/licensing are provided in Table 2-14.

There are several entities working to address the need for better trained and qualified service providers, including the waste transport industry, states, training centers, and national organizations. Washington State is attempting to institute a homeowner insurance program (NSFC, 2001) wherein the entire onsite industry is attempting to rid itself of inadequately performing service providers by identifying reasons for system failure and the responsible parties. This concept is being considered for wider application by the National Onsite Wastewater Recycling Association. NAWT also offers a form of conventional onsite system warranty that could have a positive effect in eliminating poor performers.

Table 2-12. Certification and licensing approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Certification/licensing of service providers	Require homeowners to use only state or tribal registered/licensed service providers.	Support more comprehensive state/tribal requirements for certificate or license.	Develop inspections and performance reviews for approval of service providers in district.
		Create and disseminate lists of acceptable service providers contingent on their accuracy of reporting and service complaint investigations.	Implement supplemental programs specific to district for service providers seeking to perform services based on local protocols.

For those states that do not have training centers there are programs offered by NSF International, the National Environmental Training Center for Small Communities at West Virginia University, and NAWT that certify service providers. Always check with state and tribal authorities to determine whether they recognize or accept these training and accreditation programs. Onsite wastewater system training centers exist or are being developed in several states, and are cooperating with the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT) and the National Decentralized Water Resources Capacity Development Project (NCDP) in creating new and improved training programs that can be provided at the centers.

The State of Maine requires that site evaluators be permitted and that designers of systems treating more than 2,000 gallons per day or systems with nondomestic wastewater characteristics be registered professional engineers. Prerequisites for applying for a permit and taking the certification examination are either a degree in engineering, soils, geology, or similar field, plus one year of experience, or a high school diploma or equivalent and four years of experience (Maine Department of Human Services, 1996). After the state implemented the program in 1974, OWTS failure rates dropped significantly (Kreissl, 1982). At present, requirements for site evaluators, system designers, installers, inspectors, and maintenance service providers presently vary widely among the states. For example, some states issue permits or grant exemptions that allow homeowners to design and install onsite treatment systems at their primary residence.

These code provisions, which are linked to farmstead or homestead exemptions, should be eliminated or revised to require some demonstration of competency on the part of the prospective homeowner designer/installer. For example, Alaska allows homeowners to design and install systems at their residence if they complete an approved training course and comply with state design, construction, and siting requirements. Approval is granted after the homeowner submits an infiltration field size estimate based on a professional analysis (i.e., by an engineer or laboratory) of soils at the proposed site (Alaska Administrative Code, 1999).

NSF Onsite Wastewater Inspector Accreditation Program

NSF International has developed an accreditation program to verify the proficiency of persons performing inspections on existing OWTSs. The accreditation program includes written and field tests and provides credit for continuing education. Inspectors who pass the tests and receive accreditation are listed on the NSF International Web site and in the NSF Listing Book, which is circulated among industry, government, and other groups.

The accreditation process includes four components. A written examination, conducted at designated locations around the country, covers a broad range of topics relating to system inspections, including equipment, evaluation procedures, trouble-shooting, and the NSF International Certification Policies. The field examination includes an evaluation of an existing OWTS. An ethics statement, required as part of the accreditation, includes a pledge by the applicant to maintain a high level of honesty and integrity in the performance of evaluation activities. Finally, the continuing education component requires requalification every 5 years through retesting or earning requalification credits through training or other activities.

To pass the written examination, applicants must answer correctly at least 75 of the 100 multiple-choice questions and score at least 70 percent on the field evaluation. A 30-day wait is required for retesting if the applicant fails either the written or field examinations.

(Source: NSF International, 2000).

Professional standards programs include either licensing or certification, both of which are usually based on required course work or training; an assessment of knowledge, skills, and professional judgment; past experience; and demonstrated competency. Some certification and licensing programs require at least some college-level course work. For example, Kentucky requires a 4-year college degree with 24 hours of science course work, completion of a week-long soils characterization class, and another week of in-service training for all site evaluators and permit writers (Kentucky Revised Statutes, 1992). Regular training sessions are also important in keeping site evaluators, permit writers, designers, and other service personnel effective. The Minnesota Cooperative Extension Service administers 2-day workshops on basic and advanced inspection and maintenance practices, which are now required for certification in 35 counties and most cities in the state (Shephard, 1996).

Comprehensive training programs have been developed in other states, including North Carolina, West Virginia, and Rhode Island. Most licensing programs require continuing education through recommended or required workshops at specified intervals. For example, the Minnesota program requires 3 additional days of training every 3 years.

Certification programs for inspectors, installers, and septage haulers provide assurance that systems are installed and maintained properly. States are beginning to require training, certification, and/or licensing for all service providers to ensure that activities conducted by providers comply with program requirements. Violation of program requirements or poor performance can lead to revocation of certification and prohibitions on installing or servicing onsite systems. This approach, which links professional performance with economic incentives, is highly effective in maintaining compliance with onsite program requirements. Programs that simply register service providers or fail to take disciplinary action against poor performers cannot provide such assurances.

Installer and designer permitting in New Hampshire

Onsite system designers and installers in New Hampshire have required state-issued permits since 1979. The New Hampshire Department of Environmental Services Subsurface Systems Bureau issues the permits, which must be renewed annually. Permits are issued after successful completion of written examinations. The designer's test consists of three written sections and a field test for soil analysis and interpretation. The installer's test consists of a written examination only.

The tests are broadly comprehensive and assess candidate knowledge of system design, regulatory setbacks, methods of construction, types of effluent disposal systems, and new technology. Designers must take three tests that take about 5 hours to complete. The passing grade is 80 percent. The field test measures competency in soil science through an analysis of a backhoe pit, determination of hydric soils, and recognition of wetland conditions. Installers must pass a 2-hour written exam that measures understanding of topography, regulatory setbacks, seasonal high water table determination, and acceptable methods of system construction.

(Source: New Hampshire Department of Environmental Services, 1991).

More information on training programs for onsite wastewater professionals, including a calendar of planned training events and links to training providers nationwide, can be found on web sites maintained by the NESC and EPA-OWM (see Appendix).

NAWT onsite inspector training and certification program

The National Association of Waste Transporters (NAWT) has developed and implemented a training and certification program for inspectors of OWTSs. The program consists of two days of classroom training followed by a certification examination. NAWT-certified inspectors are required to participate in continuing education offerings to maintain their certification. The goal for this program is to develop a capacity to evaluate the functionality of wastewater treatment system components. The inspection process consists of documenting the existence of critical components of conventional septic tank and soil absorption systems, inspect them for their operability, and document deficiencies where they exist. The inspection process does not include any warranty for the system or guarantee for its service life.

(Source: NAWT)

3.4.10 Inspections and monitoring

Onsite wastewater system performance should be periodically monitored and inspected by system owners, private service providers, and/or management program staff to ensure proper performance. Inspections are a basic form of monitoring the performance of individual systems. The impact of a group or cluster of systems (e.g., for a subdivision or portion of a town) can be ascertained via aquifer or watershed monitoring and assessment of trends.

Inspections can take several forms. Typically, there is a qualitative evaluation based on appearance, odor, or noise attributes, followed by some means of below ground system inspection through passage or observation ports that extend to the surface. Based on the outcome of the inspection, a problem may be identified that calls for scheduling repairs or servicing, (e.g., pumping). The management entity should develop a compliance schedule that clearly outlines the sequence of events and their time limits to correct (and certify the correction) identified problems. Many higher-level programs will, after a specified period, perform the required tasks to attain compliance and bill the homeowner. If the owner fails to pay within some designated time period, a lien is placed against the property. Example inspection/monitoring program elements are shown in Table 2-15.

Table 2-13. Inspection and monitoring approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Inspection/ monitoring	Educate and request homeowners on how to conduct basic inspections, (e.g., monitor sludge/ scum buildup in septic tank). Require inspections by licensed/certified persons at time of property transfer, change in use, and complaint investigation.	Specify regular inspection of all systems as part of operating permits; develop inspection reporting program via O/M provider/homeowner inputs; and permit only licensed/certified inspectors to perform them.	Conduct aquifer or watershed monitoring in addition to pretreatment system inspections. Regularly evaluate monitoring data and permit requirements to determine if any program adjustments are needed. Develop supplemental training programs specific to local needs for approved inspectors.

NSFC offers a compilation of regulations regarding inspections from the states that have them and some other public education products that describe what the homeowner can expect from an inspection of their system. Some states have developed handbooks for inspection that deal with most aspects of a possible inspection protocol. Basic onsite system operation and performance inspections should be documented on standardized forms that include checks for:

- Evidence of vehicles being driven over the septic tank or reserve field.
- Installation of pavement, driveways, or structures over the septic tank or reserve field.
- Wet areas or poor drainage in or around the infiltration field.
- Slow flushing or gurgling of water in plumbing fixtures.
- Leaking toilets or addition of significant wastewater-generating fixtures such as water softeners.
- Additions to the house or building since the system was installed.
- Surface drainage patterns in the area of the tank and infiltration field.
- Broken or open tank access covers or doors.
- Sludge/scum buildup in septic tank; clogging of tank outlet screens.
- Effluent quality to confirm compliance with design assumptions.
- Physical condition of all treatment components.

Inspections of onsite systems are normally performed by a trained homeowner, an independent licensed/certified inspector, or staff member of the management entity. Lower level management program inspections are generally limited to a pre-cover inspection during construction and prior to property sale or change in use. Comprehensive management programs feature inspections that can be conducted randomly or at preset times during system construction or operation. Onsite system inspections can be one of the most effective tools of management to monitor the performance of service providers and to assure that required O/M is properly performed.

Some management entities and states require mandatory inspections or disclosure of system operating condition upon property transfer (e.g., Minnesota, Wisconsin, Massachusetts), and/or periodic monitoring by licensed inspectors. Renewable operating permits might require system owners to have a contract with a certified inspection/maintenance contractor or otherwise demonstrate that periodic inspection and required operation and maintenance procedures have been performed for permit renewal (Wisconsin Department of Commerce, 2001). Minnesota, Wisconsin, Massachusetts, and some counties (e.g., Cayuga and other counties in New York; Washtenaw County in Michigan) require that sellers of property disclose or verify system performance (e.g., disclosure statement, inspection by the local oversight entity or other approved inspector) prior to property transfer.

Financial incentives usually aid compliance and can vary from small fines for poor system maintenance to preventing the sale of a house if the OWTS is not functioning properly. Inspection fees might be one way to cover or defray these program costs. Lending institutions nationwide have influenced the adoption of a more aggressive approach toward requiring system inspections before home or property loans are approved. In some areas, inspections at the time of property transfer are common despite the absence of regulatory requirements. This practice is incorporated into the loan and asset protection policies of local banks and other lending institutions.

If regional aquifer or watershed monitoring/assessment detects some degradation of receiving waters, an RME, in concert with the regulatory authority, may need to readjust certain system design requirements to assure compliance with their permit. Monitoring of downstream ground water has been attempted in research studies, but this type of monitoring is both expensive and difficult (Pask, 2000) because of uncertainties in predicting effluent plume migration pathways in nonuniform geology. Sandison, et al. (1992), Burnell (1992), Nelson and Ward (1980) and Eliasson, et al. (2001) discuss monitoring program issues that may be useful in developing monitoring programs for decentralized management program use. Gunnison County, CO, requires periodic monitoring of septic tank effluent and shallow unconfined aquifers downgradient of the discharge to determine impacts on the latter's nitrogen, BOD, and phosphorus concentrations. An axiom for cost-effectiveness is to maximize use of existing wells and existing monitoring activities by various other agencies. Usual characteristics monitored include nitrates, fecal coliforms, and phosphorus, but local conditions will dictate the exact type and frequency of measurements required.

2.4.11 Corrective actions and enforcement

Various types of legal instruments are available (see Table 2-16) to ensure compliance with onsite system regulations. Regulatory programs can be enacted as ordinances, system management agreements, local or state codes, or simply as guidelines. State code requirements can often be modified or strengthened by local health boards or other units of government in concert with state authorities to better address local conditions through the passage of local ordinances.

Table 2-14. Approaches to ensuring compliance and their implications

Collection method	Description	Advantages	Disadvantages
Liens on property	Local governing entity (with taxing powers) may add the costs of performing a service or past unpaid bills as a tax on the property.	Has serious enforcement ramifications and is enforceable.	Local government may be reluctant to apply this approach unless the amount owed is substantial.
Recording violations on property deed	Copies of violations can, through administrative or legislature requirement, be attached to the property title (via registrar of deed).	Relatively simple procedure. Effectively limits the transfer of property ownership.	Can be applied to enforce sanitary code violations; may be ineffective in collecting unpaid bills.
Presale inspections	Inspections of onsite wastewater systems are conducted prior to transfer of property, or when property use changes significantly.	Notice of violation may be given to potential buyer at the time of system inspection; seller may be liable for repairs.	Can be difficult to implement due to additional resources needed. Inspection fees can help cover cost.
Termination of public services	A customer's water, electric, or gas service may be terminated (as applicable).	Effective procedure, especially if management entity is responsible for water supply.	Termination of public services is potential health risk and requires political will; does not apply if property owner has well.
Fines	Monetary penalties for each day of violation, or as a surcharge on unpaid bills.	Fines can be levied through judicial system as a result of enforcement of violations.	Effectiveness will depend on willingness of the authority vested to issue the fine.

(Source: Ciotoli and Wiswall, 1982.)

Local ordinances that promote performance-based approaches can reference technical manuals for more detailed criteria on system design and operation. Approaches for enforcing requirements and enabling corrective actions by a management program include

- Responding promptly to complaints.
- Providing meaningful performance inspections.
- Reviewing required documentation and reporting.
- Issuing notices of violation (NOVs).
- Implementing consent orders and court orders.
- Holding formal and informal hearings.
- Issuing civil and criminal actions or injunctions.
- Condemning systems and/or property.

- Correcting system failures.
- Restricting real estate transactions
- Issuance of fines and penalties

Even the most basic management program should have the ability to adopt rules and assure compliance with them by levying fines, fees, assessments, or by engaging service providers to respond to failed/failing systems. Enforcement programs need not be based solely on fines to be effective. Information stressing public health protection and the monetary benefits of clean water can provide additional incentives to homeowners for program compliance. Active and effective outreach programs that focus on awareness, education, and training can reduce noncompliance. There are, however, some requirements that must be enforceable to ensure program effectiveness. They include both construction and operating permits, licensing and certification requirements to demonstrate the necessary skills to perform services, the right to require or carry out repairs or replacement, and, if necessary, levy monetary penalties. Examples of the variety of approaches to enable corrective actions are provided in Table 2-17.

Table 2-15. Corrective action approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Corrective actions/ Enforcement	Issue NOV and negotiate compliance schedules for documented problems; administer enforcement program with fines and/or penalties for failure to comply with requirements in a timely manner.	Develop revocable operating permit program to assure corrective actions through required inspections and enforce it. Create electronic reporting system to track corrective measures with real-time input from staff and service providers.	Develop clear and concise protocols with citizen input and review to provide step-by-step definition of enforcement action sequence. Enable corrective actions to be implemented by RME or third-party service providers with payment ensured by power to impose property liens or other enforceable instruments.

All of the tools in Table 2-17 can be time-consuming and generate negative publicity. Any attempt to force compliance on a reticent homeowner will not produce a positive outcome if not supported by the public. Involvement of stakeholders in development of this program element is vital to the viability of the management program. This public involvement, with input from the oversight agencies, can ensure that the corrective actions/enforcement provisions are appropriate for the management area and effectively protect human health and water resources. It is important that program expectations by the serviced population are clear, consistent, and specific. It is also important to involve the public in corrective actions/enforcement activities, possibly through an appeals board or some form of program performance review committee, to minimize any misinformation or other negative feedback from this sensitive activity. Most states establish regulatory programs and leave enforcement up to the local agencies, subject to periodic oversight reviews.

To have validity, all enforcement approaches seeking to implement corrective actions must have the necessary force of law. Therefore, the legal basis and enabling language for the existence of the district or other enforcing agency must have that power. In most states that power is vested in the local governments through certain “home rule” provisions, but there are numerous variations when dealing with onsite wastewater systems. In some states the power to enforce these rules is granted by the states, but real power to impose user fees and fines may still be limited to the local government. Therefore, the necessary legal power must be ensured before the management entity can be formed. The two key roles in effective management entity enforcement are the citizen’s willingness to be part of the entity and the local or state government’s cooperation in the enforcement of rules to assure compliance.

The RME cannot exist without these policing powers, which may be granted by state and/or local government or by state enabling legislation that facilitates its formation. However, Otis, et al. (2001) stress that the focus of a successful program must be to maintain compliance, rather than to be punitive, in order to gain public support. In most cases, the RME will be able to enforce its agreements with customers through standard contract law, in the case of a Model Program 4 approach, or through termination of wastewater treatment services under Model Program 5, which features RME ownership of the treatment system.

2.4.12 Record keeping, inventory, and reporting

Record keeping and reporting programs are among the most important activities of all management programs. Record keeping includes every aspect of management and at a minimum should include information on ownership, type, and location of the system on the property (often referred to as a lot plan), as-built drawings, site evaluation results and when and by whom it was performed; permit approver and date; name of the designer; date of installation, name of the installer and the inspector of the installation; dates and details of each inspection, any maintenance contracts, pumping and/or repair; monitoring data; and all other information such as dates of complaints and enforcement responses to them that pertain to each system. It includes all information originally gathered during the inventory of existing systems in creating the management entity and should be kept in a readily accessible database or filing system. Examples of these program element contents are given in Table 2-18.

As the management program increases in sophistication these databases can be used for automatic tracking of maintenance contracts, dates of upcoming inspections or operating permit expiration, and other time-dependent activities. In Texas alternative systems with required O/M tasks are recorded on the property deed in order to make subsequent owners aware of these requirements. With an RME, such tracking systems can virtually drive a large portion of the day-to-day activities, and they should allow real-time entry of field information and protected access to data by field personnel. Hantzsche, et al. (1991) described objectives for the data management system at Sea Ranch, CA, that could be used as guidance for any RME. Heigis, et al., (2001) and Mayer (2001) have also described advanced onsite management record-keeping tools for creating and maintaining databases for possible application by an RME.

Table 2-16. Record keeping, inventory, and reporting approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Record keeping, inventory, and reporting	Maintain system inventory, site evaluation, construction permit and inspection files.	Develop reporting approaches to collect O/M information from all service providers and inspections in addition to system inventory.	Provide system inventory and tracking system as in intermediate approach with watershed characterization information and data to assist planning staff.
	Administer maintenance reminder and public education programs.	Institute electronic reporting and database system for operating permit program actions.	Develop interactive, real-time information tracking programs to maximize field productivity, track watershed and ground water trends, facilitate reporting to oversight agencies, and to maximize public education/involvement.

The basic foundation for all record keeping systems in all management entities is the initial inventory of onsite wastewater systems within the boundaries of the program (Burnell 1992; Clemans, et al., 1992). Clermont County, Ohio, developed an OWTS owner database by cross-referencing water line and sewer service customers. Contact information from the database was used for a mass mailing of information on system operation and maintenance and the county's new inspection program to 70 percent of the target audience (Caudill, 1998). Where operating permits are employed or even where they are not, a system of information sharing with the homeowner is an excellent approach. Homeowners can be valuable in identifying inaccurate entries to assure that the records are accurate.

Cuyahoga County Board of Health, Ohio, computer database management

To improve their sewage program filing system, Cuyahoga County Board of Health developed a Microsoft Access-based format to access and track drawings, evaluation results, permits, and other correspondence pertaining to the sewage system serving for a specific address. This database enables the Board of Health to respond to homeowners and service provider's questions and send out septic tank pumping reminders as needed.

(Source: Novickis, 2001).

Where point-of-sale inspections are dictated, such information must be regularly recorded and added to the inventory to ensure an up-to-date inventory of systems. These inspection reports are part of the deed recording system, but unless the inspection is funded by the management entity or legally required, it may not be made public for inventory entry. Problems have occurred in the past where the management program did not automatically receive a copy of the inspection report, thus precluding it from being entered into the database. Some Management Program 2 systems have used property transfer and change-in-use inspections to identify lapses in maintenance contracts, but most request maintenance contractors to report those lapses.

Washtenaw County, Michigan, time-of-sale program

Washtenaw County has a time of sale program with the following features:

- Inspectors must be approved (licensed through training/exam) by the RME.
- RME staff must verify needs identified within 5 days of submission.
- Corrective actions identified by the inspection must be submitted to RME in 30 days.
- Repairs must be completed or contract entered into (with 150 percent of estimate in escrow) before sale.

(Source: Johnson, et al., 2001).

All program reviews and regulatory oversight procedures are dependent upon the records maintained as part of the management program. Therefore, all record-keeping programs must accommodate these functions. As the size and level of the management program increase, electronic, interactive record keeping becomes not only attractive, but also necessary. In all management programs at all levels, the information on any specific system must be accessible to the system owner upon request. The types of information that should be maintained in the program records (databases) include:

- System owner and contact numbers.
- System location and components from as-built drawings on lot plans (installer and dates).
- Site evaluation information and provider.
- System designer, inspector & permitting official (capacity, design basis, and caveats).
- O/M activities (dates, performing individuals, and reports).
- Complaints (dates, responding personnel, and reports).
- System rehabilitations (dates, as-builts, contractors, and approving official).
- Monitoring data (dates, reports, and sampling, and analytical performers).

A number of private and public software packages are available for application to the management program needs. Interested parties are directed to the EPA-OWM and the NSFC Web sites for an up-to-date listing.

2.4.13 Financial assistance and funding

In the context of an operational onsite wastewater management entity, this program element is a catch-all for a variety of financial and legal support requirements, as well as community assistance programs to assist homeowners in financing required repairs to achieve compliance. Lower-level management programs require homeowners to take much greater responsibility for compliance than more comprehensive programs. The need to develop financing opportunities for system upgrades and repairs, however, can be significant for all levels, except for Management Program 5. Public-private partnerships are considered to be one of the most often cited forms of such assistance. In some cases the management entity makes arrangements with local lending institutions to offer special terms ! such as lower interest or longer payback periods ! to their service population who are unable to pay the cost for required repairs or upgrading in order to come into compliance in a timely manner. In effect, the entity is a co-signer of such loans and guarantees them against default. In areas where there are major commercial wastewater sources, the potential of using private financing through a partnership arrangement should be investigated since these contributors may have the most to gain from participating in a successful decentralized management program. Typical program element contents are shown in Table 2-19.

Table 2-17. Financial assistance and funding approaches

Program element	Basic approach	Intermediate approach	Advanced approach
Financial assistance and funding	Program revenues must suffice to provide necessary legal and administrative support to conduct all aspects of the management program. Seek grants or other funding to help owners upgrade or replace systems.	Program revenues must suffice to provide necessary legal and administrative support to conduct all aspects of the management program. Work with state, tribal, or local governments and local lending institutions to develop low interest loan programs. Seek grants or other funding to help owners upgrade or replace systems.	Program revenues must suffice to provide necessary legal and administrative support to conduct all aspects of the management program. Create cost-share program to help low income owners pay for system repairs or replacement as part of the user fee structure. Implement management fees that cover inspections, repair, replacement, O/M costs, and a sinking fund to cover future infrastructure needs. Seek grants or other funding to help owners upgrade or replace systems.

A public or privately owned/operated decentralized RME is eligible to receive EPA Clean Water State Revolving Fund (SRF) loans , but not all states have implemented the rules needed to implement these loans. Numerous other federal and state loan and grant programs exist, and one of the primary roles of the RME is to actively seek out such funding sources for their constituents.

A possible approach for a RME is to create an equitable program of user fees that provides a financial assistance program for eligible homeowners to regain compliance with applicable performance requirements. Although there are excellent guides available for developing rate structures by management entities in small communities (University of Tennessee,1991; Ciotoli and Wiswall,1982; Shephard,1996; RCAP,1995), creating a management program financed by user fees is particularly difficult without strong public involvement.

The RME can work with local lending institutions to provide low interest loans to owners needing to upgrade their systems or work with local businesses within the onsite management district to develop a public/private partnership to assist those individuals. Such opportunities are maximized with use of citizen advisory boards and citizen membership in the management entity's board of directors. Mancl (2001) reports that five long-term successful management entities have charged homeowners between $100 and $365 per year. Pickney and Pickney (2001) report that the Tennessee Public Utilities Commission established fees for their privately owned and operated Model 5 RME at $35.11/month, which covers costs associated with managing and financing future infrastructure repairs, primarily for cluster systems. These systems are built according to the specifications provided by the firm and are then deeded over to the firm upon completion of construction. The revenue streams created to sustain the RME are generally from property assessments, user fees, taxes, fees for specific services, fines, and developer-paid fees such as connection fees and impact fees. The advantages and disadvantages of each of these revenue sources are presented in Table 2-18

Development company sponsors management district in Colorado

The Crystal Lakes Development Company has been building a residential community 40 miles northwest of Fort Collins, Colorado, since 1969. In 1972, the company sponsored the creation of the Crystal Lakes Water and Sewer Association to provide drinking water and sewage treatment services. Membership in the association is required of all lot owners, who must also obtain a permit for onsite systems from the Larimer County Health Department. The association enforces county health covenants, aids property owners in the development of onsite water and wastewater treatment systems, monitors surface and ground waters, and has developed guidelines for inspection of onsite water and wastewater systems. System inspections are conducted at the time of property transfer. The association conducts preliminary site evaluations for proposed onsite systems, including inspection of a 7-foot deep backhoe pit excavated by association staff with equipment owned by the association. The county health department has also authorized the association to design proposed systems. The association currently manages systems for more than 100 permanent dwellings and 600 seasonal residences. Management services are provided for all onsite systems in the development including 300 holding tanks, seven community vault toilets, recreational vehicle dump stations, and a cluster system that serves 25 homes on small lots and the development's lodge, restaurant, and office buildings. The association is financed by annual property owner dues of $90 !$180 and a $25 property transfer fee, which covers inspections.

(Source: Mancl, 1999).

PENNVEST: Financing onsite wastewater systems in the Keystone State

The Pennsylvania Infrastructure Investment Authority (PENNVEST) provides low-cost financing for systems on individual lots or within entire communities. Teaming with the Pennsylvania Housing Finance Agency and the Department of Environmental Protection, PENNVEST created a low-interest onsite system loan program for low- to moderate-income (i.e., 150 percent of the statewide median household income) homeowners. The $65 application fee is refundable if the project is approved. The program can save system owners $3,000 to $6,000 in interest payments on a 15-year loan of $10,000. As of 1999, PENNVEST has approved 230 loans totaling $3.5 million. Funds for the program come from state revenue bonds, special statewide referenda, the state general fund, and the State Revolving Fund.

(Source: Pennsylvania Department of Environmental Protection, 1998.)

Table 2-18. Advantages and disadvantages of various funding sources

Funding source	Description	Advantages	Disadvantages
Loans	Money lent with interest; can be obtained from federal, state, and commercial lending institution sources.	State and federal agencies can often issue low-interest loans with a long repayment period. Loans can be used for short-term financing while waiting for grants or bonds.	Loans must be repaid with interest. Lending agency might require certain provisions (e.g., power to levy taxes) to assure managing agency of ability to repay the debt. Commercial loans generally are available at higher interest rates and might be difficult to obtain without adequate collateral.
Grants	Funds awarded to pay for some or all of a community project.	Funds need not be repaid. Small communities might be eligible for many different grants to build or upgrade their environmental facilities.	Applying for grants and managing grant money require time and money. Sometimes grant-imposed wage standards apply to an entire project even if the grant is only partially funding the project; this increases project expense. Some grants require use of material and design requirements that exceed local standards and might result in higher costs. Grant funds are quite scarce in comparison with loan funds.
General obligation bonds	Bonds backed by the full faith and credit of the issuing entity. Secured by the taxing powers of the issuing entity. Commonly used by local governments.	Interest rates are usually lower than those of other bonds. Offers considerable flexibility to local governments.	Community debt limitations might restrict use. Voters often must approve of using these bonds. Usually used for facilities that do not generate revenues.
Revenue bonds	Bonds repaid by the revenue of the facility.	Can be used to circumvent local debt limitation.	Do not have full faith and credit of the local government. Interest rates are typically higher than those of general obligation bonds.
Special assessment bonds	Bonds payable only from collection of special assessments. Property taxes cannot be used to pay for these.	Removes financial burden from local government. Useful when direct benefits can be readily identified.	Can be costly to individual landowners. Might be inappropriate in areas with nonuniform lot sizes. Interest rate might be relatively high.
Bond bank monies	States use taxing power to secure a large bond issue that can be divided among communities.	States can get the large issue bond at a lower interest rate. The state can issue the bond in anticipation of community need.	Many communities compete for limited amount of bond bank funds.

Certificates of participation (COPs)	COPs can be issued by a community instead of bonds. COPs are issued to several lenders that participate in the same loan.	Costs and risks of loan spread out over several lenders. When allowed by state law, COPs can be issued when bonds would exceed debt limitations.	Requires complicated agreements among participating lenders.
Note	A written promise to pay a debt. Can include grant and bond anticipation notes.	Method of short-term financing while a community is waiting for a grant or bond.	Community must be certain of receipt of the grant money. Bond notes are risky because voters must approve general obligation bonds before they are issued. Voter support must be overwhelming if bond notes are used.
Property assessment	Direct fees or taxes on property. Sometimes referred to as an improvement fee.	Useful where benefits from capital improvements are identifiable. Can be used to reduce local share debt requirements for financing. Can be used to establish a fund for future capital investments.	Initial lump sum payment of assessment might be a significant burden on individual property owners. Some states and localities restrict the allowable burden on individuals.
User fee	Fee charged for using the wastewater system.	Generates steady flow of revenue. Graduated fees encourage water conservation.	Flat fees discourage water conservation. Graduated fee could discourage high-volume water using industries or businesses from locating in an area.
Service fee	Fee charged for a specific service, such as pumping the septic tank.	Generates funds to pay for O&M. Fees not imposed on people not connected to the system.	Revenue flow not always continuous.
Punitive fees	Charges assessed for releasing pollutants into the system.	Generates revenue while discouraging pollution.	Generation of funds not always reliable. Could encourage business to change location or participate in illegal activities to avoid fees. Could generate opposition to O&M scheme.
Connection fees	Charges assessed for connection to existing system.	Connection funded by beneficiary. All connection costs might be paid.	Might discourage development. Can be restricted by state and local laws.
Impact fees	Fees charged to developers.	Paid for only by those who profit. Funds can be used to offset costs.	Might reduce potential for development. Can be restricted by state/local laws.

(Source: EPA, 1982, 1994).

Funding systems and management in Massachusetts

The Commonwealth of Massachusetts has developed three programs that help finance onsite systems and management programs. The loan program provides loans at below-market rates. A tax credit program provides a tax credit of up to $4,500 over 3 years to defray the cost of system repairs for a primary residence. Finally, the Comprehensive Community Septic Management Program provides funding for long term community, regional, or watershed-based solutions to system failures in sensitive environmental areas. Low interest management program loans of up to $100,000 are available.

(Source: Massachusetts Department of Environmental Protection, 2000).

A regular review of the management program requires public involvement to review financial and staffing records, rules, complaints, fee structures, regulatory agency inputs, and staff reports as part of the continuing process of optimizing the value of the management program to the people it serves and the watershed it protects. This review should be performed annually, with a means for interim changes as necessitated by unforeseen problems. Any suggested changes recommended by this reviewing body need to be approved by the appropriate regulatory oversight agency. A good reference to be studied prior to undertaking these reviews is the NOWRA Model Framework for Unsewered Wastewater Infrastructure that appears on their Web site (http://www.nowra.org).

2.5 Model programs for system management

Chapter 4 provides a more detailed description of each of the five model management programs (see Table 2-19) with each of the program elements described for each level. The tables in Chapter 4 incorporate the program elements discussion from this section, and serve to further define the model management levels in terms of their program elements.

The program elements must be specifically tailored to the objectives of the specific model management program to provide a complete example of what that program might look like when applied to a real community. Finally, the reader must not lose sight of the fact that each real management program that may be developed can and almost certainly will be a mixture of the program elements developed for these model programs so that it will be a hybrid of these models that are designed to deal with specific situations.

Table 2-19: Overview of management model objectives and basic features

Management Model	Objectives	Basic features
Management Model 1 Inventories and maintenance reminders	▪ Owner awareness of permitting program, installation, and O/M needs. ▪ Compliance with codes, regulations.	▪ Only conventional onsite systems. ▪ Prescriptive design/site requirements. ▪ Owner education to improve O/M. ▪ Inspections only during construction and complaint evaluations. ▪ Create and maintain system inventory.
Management Model 2 Maintenance contracts	▪ Maintain prescriptive program for sites that meet code criteria (MP 1). ▪ Permit only approved alternative systems on sites not quite meeting criteria.	▪ Prescriptive design/site requirements. ▪ Allowances for specified alternatives where code not met. ▪ O/M contracts and reporting required for alternative systems. ▪ Inspections & owner education as in MP 1. ▪ Create & maintain inventory.
Management Model 3 Operating permits	▪ Onsite system designs based on site conditions and performance requirements. ▪ System performance assumed by O/M task completion and verified through permit renewal inspections.	▪ Wider variety of designs allowed. ▪ Performance of required O/M tasks governs operating permit renewal. ▪ OWTS monitoring/inspections required. ▪ Property sale and change-of-use compliance-assurance inspections. ▪ Create and maintain inventory.

Management Model	Objectives	Basic features
Management Model 4 Responsible management entity operation and maintenance	▪ Responsible public or private entity assumes O/M and inspection/monitoring responsibilities for all systems in management area.	Performance governs acceptability. Operating permits ensure compliance. All systems are inspected regularly. Monthly/yearly fees support program. Owner responsible for all costs. Create and maintain inventory.
Management Model 5 Responsible management entity ownership	▪ Public or private RME owns and operates all systems in management area. ▪ Similar to centralized sewer system service approach.	▪ Performance governs acceptability. ▪ All systems are inspected regularly. ▪ Monthly/yearly fees support program. ▪ Users relieved of all O&M responsibilities. ▪ RME funds installation & repairs. ▪ Create and maintain inventory.