Drainfield Rehabilitation

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The septic system, once thought of as a temporary solution for the treatment of domestic wastewater, is still the best choice for homes or residences and small communities where it would be cost-prohibitive to access public sewer systems. In the U.S., these onsite systems collect, treat, and release about four billion gallons of wastewater per day from an estimated 26 million homes.

Current interest in the impact of these systems on groundwater and surface water quality has increased interest in optimizing the systems' performance. It is now accepted that these onsite systems are not just temporary installations that will eventually be replaced by centralized sewers, but are a permanent part of the wastewater infrastructure.

Septic systems are typically simple in design, which makes them generally less expensive to install and maintain. And by using natural processes to treat the wastewater onsite, usually in a homeowner's backyard, septic systems don't require the installation of miles of sewer lines, making them less expensive and less disruptive to the environment. In addition, there are many innovative designs for septic systems that allow them to be placed in areas with shallow soils or other site-related conditions previously considered to be unsuitable for onsite treatment and dispersal.

Although the septic tank settles out most of the heavier solids and breaks down almost half of the suspended solids from household wastewater, the effluent still has a high amount of biodegradable organic materials, along with a high bacterial content that may include pathogens. Therefore, septic tank effluent is not suitable for direct discharge into surface waters or onto land surfaces. Further treatment is needed to remove these harmful pathogens. The most common way to do this and dispose of the partially treated wastewater is through subsurface soil absorption through the drainfield.

Septic systems were never intended for lifetime use without maintenance. Neglecting maintenance of system components only leads to failures. When properly designed, installed, and maintained, septic systems have a minimum life expectancy of 20 to 30 years.

The U.S. Environmental Protection Agency (EPA) *Onsite Wastewater Treatment Systems Manual* (2002) defines system failure as "a condition where performance requirements are not met." Typically, failures are declared when wastewater is observed on the surface of the ground or is backing up into the household plumbing.

When a septic system fails, it can pollute nearby water resources and endanger public health. Children are most susceptible to these health problems because they very often come into contact with the contaminated areas. There's really not all that much that is going to go wrong with the septic tank itself as long as it is watertight and pumped on a regular basis. However, what usually fails is the soil absorption system.

The soil absorption system, or drainfield, is an arrangement of perforated pipes or chambers buried underground that channel the pretreated wastewater—the liquid discharge (effluent) from the septic tank—out over a large area of the soil. The effluent then moves slowly down through the soil to become naturally purified before returning to the aquifer. The drainfield acts as a natural filter for effluent by absorbing the organic materials, reducing or removing bacteria and viruses, and removing some nutrients.

The most obvious sign of drainfield failure is surfacing effluent. If the soils can no longer accept the effluent being delivered, the effluent will either

Below and above right: Repairing a failed septic system may require constructing a new drainfield.

DESIGN BY JULIE BLACK

rise to the ground surface, or "blow out" at the end of the last trench. Either of these two events should alert the homeowner that there is a problem.

The reason the soil can no longer accept the pre-treated effluent is most often because of the biomat. As the effluent or pre-treated wastewater enters the drainfield, bacteria in the soil begin to thrive on the new food source. As these bacteria grow, they form a thick, slimy colony called the biomat that restricts the flow of effluent to the surrounding soil. (**See sidebar on page 21**.)

Causes for failure are many and varied—ranging from improper siting, design, or construction, to the simple overuse of water-generating appliances. It is vital that the exact cause for the failure is determined before attempting any remediation to the system. The suggested process for correcting system failure is to gather information about the system, determine the cause of failure, and design the corrective action.

Causes of Failure

Drainfield failure can be caused by many things, including excessive rainfall, tree roots interfering with the drainlines, or vehicles driving over the system and cracking pipes. But the two most common causes are hydraulic and organic overloading. Hydraulic overloading occurs when too much water is sent to an under-designed system. Organic overloading is the result of too much organic matter in the effluent.

The initial design of a system is based on soil and site characteristics, including depth to groundwater or bedrock. Part of the design includes the system's capacity, which takes into account the number of people living in the home.

Capacity is usually based on the number of bedrooms in the home, but this may not be an accurate way to determine flow generation. Extra people or the addition of a hot tub, for instance, can quickly create more wastewater than the system and drainfield can handle.

The addition of appliances, such as garbage disposals and dishwashers, can greatly change the quality of the wastewater sent to the system. These appliances send increased amount of solids to the system, possibly causing organic overloading. Use these appliances in moderation, keeping in mind that a garbage disposal is not a waste receptacle.

Many local and state regulatory authorities require onsite systems to be sized larger to handle the additional load from such appliances as garbage disposals. Check with your local health department or permitting authority to see if this is the case in your area. Telephone numbers of such agencies are normally listed in the government or blue pages of the local telephone directory.

Septic system failure can also result from:

- Overloading with water. Homeowners should avoid putting too much water into the system at one time. It is better to stagger laundry loads throughout the week rather than having a "wash day" where you might do all the laundry within a 24- to 48-hour period. Divert your hot tub away from your onsite system when draining it.
- Discarding decay-resistant materials into the system, such as grease, sanitary napkins, and other solids.
- Allowing tree roots to clog or destroy the absorption system.
- Compacting soil over the drainfield. Avoid driving or parking vehicles over the drainfield.
- Age of the system. Septic systems are designed for an operational life of 20 to 30 years. If you have an aging system, it may be time to inspect and replace it.

The Correction Procedure

When an onsite system fails, it is important to gather specific information about the system in order to diagnose the problem and determine the appropriate corrective action.

Initial Data Gathering

- Visual observation of the failure should be made to confirm the problem. All system components should be inspected, and any mechanical components (such as float switches and flow diverters) should be tested by a qualified/certified system inspector.
- A complete history of operation and maintenance of the system should be reviewed. Frequently, a study of the past three to five years of operation and maintenance will reveal a possible problem. The correction may be as simple as pumping the tank or cleaning a tank filter.
- Obtain a copy of the original permit and any updates. This permit will contain a layout of the system from a site survey or drawings of the original design.
- Determine approximate loading rates from the original design and permit.

Alternating drainfields provide relief for a failing system. Here, a second drainfield is installed.

- Soil test results should be reviewed. If soil test results are not included in the permit, soil samples should be taken to determine the soil profile and to locate any soil boundaries that may be present. The age of system should also be determined.
- Obtain a complete report of the symptoms of failure. For example, surfacing effluent above the drainfield suggests that the soil may be overloaded, either with too much total water or that the water has inappropriate amounts of organic matter that has clogged the soil pores. Additionally, if the failure is seasonal, wet weather conditions are likely to be the cause.
- Determine the amount of wastewater entering the system. Using data from the dwelling's water meters, actual flow (even if estimated) is then compared to the design loadings. This will yield a good approximation of how much wastewater is entering the wastewater system. Leaking plumbing fixtures will skew this number, causing more water to enter the system. Thus, all leaking fixtures must be repaired.

Determining the Cause

From the information gathered through the above steps, ideas about the potential causes of failure should come to light. It might be necessary to do some additional steps to test the idea before any corrective actions are taken. Wastewater metering or testing, equipment testing and monitoring, or additional soil testing might help more clearly define the cause of the system failure.

Repair permits may be required before any corrective action begins. Contact your local health department or permitting agency to find out what is required to obtain such a permit.

Remediation Techniques

There are various repair or remediation techniques that may be considered, depending on the investigation into the causes of failure as described above, economic considerations, and the flexibility of the local permitting entities. State and local statutes vary as to what technologies are permitted. Homeowners must work closely with their local health departments or permitting authorities to make the best choice for their individual situation.

Short-Term Solutions

If the neighborhood is soon to receive public sewerage, it might be practical to use a short-term technique such as water conservation. But conservation and other management techniques are only part of most solutions. Drainfield failure must be considered a serious health hazard and as such, should be taken care of with long-term goals in mind.

Sometimes the overloaded drainfield can recover if a strict policy of water conservation is observed by the homeowner. After pumping the septic tank, this would involve replacing water-guzzling appliances with more efficient ones, repairing leaking fixtures, and staggering showers and clothes washing times to reduce the output of effluent.

If the soil around the piping is allowed to dry out, it may be able to function properly once again. This method obviously requires a good deal of homeowner commitment. It usually takes a 30 percent reduction in water use to allow the drainfield to recover.

In cases of physical damage, system restoration may only require the leveling of the distribution box or repairing crushed or broken pipe. If tree roots are interfering with the operation of the soil absorption field, they can be removed. Broken or deteriorated baffles in the septic tank can allow solids to go to the drainfield; these should be replaced or repaired.

There are now some new technologies that may provide temporary relief to drainfield failure. The first is "jetting," a procedure that utilizes special pumps to inject high-pressure water into the drainlines to break up silt deposits and other solids, coupled with powerful vacuum lines that suck the broken-up solids out of the lines before they can settle again.

If the problem stems from poor or compacted soil, hope may come

Effluent from a failed drainfield has surfaced in this backyard.

Biomat Formation

As the effluent is discharged into the soil absorption system, bacterial growth develops beneath the distribution lines where they meet the gravel or soil.

As the effluent is discharged into the soil absorption system, bacterial growth develops beneath the distribution lines where they meet the gravel or soil.This layer is known as the clogging mat, clogging zone, biocrust, and biomat. This biomat (biological mat) is a black, jelly-like layer that forms along the bottom and sidewalls of the drainfield trench. This clogging zone reduces infiltration of the wastewater into the soils.

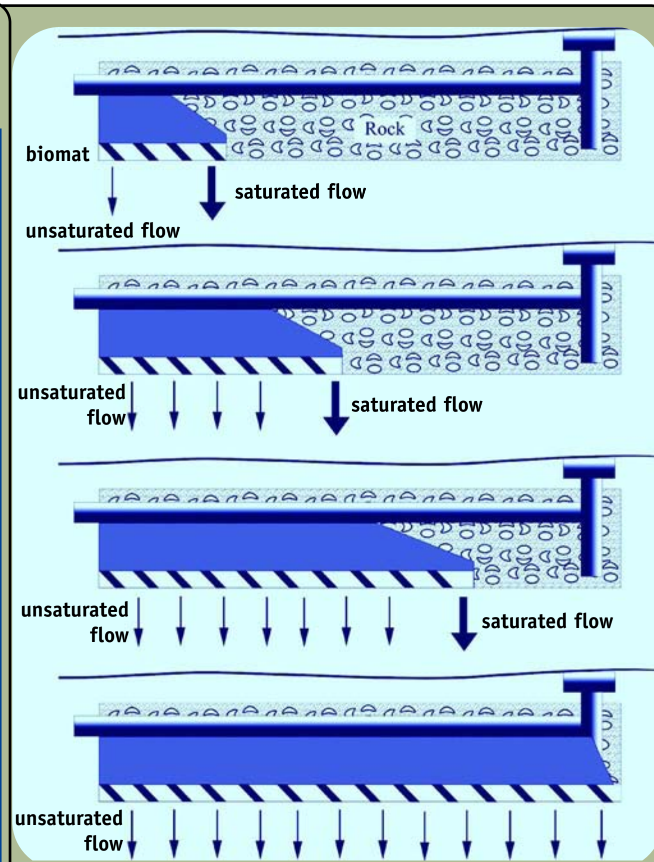
The biomat is composed of anaerobic microorganisms (and their byproducts) that anchor themselves to soil and rock particles. Their food is the organic matter in the septic tank effluent. Less than one centimeter to several centimeters thick, the biomat acts as the actual site for effluent treatment.

The biomat forms first along the trench bottom near the perforations where the effluent is discharged, and then up along trench walls. It is less permeable than fresh soil, so incoming effluent will move across the biomat and trickle along the trench bottom to an area where there is little or no biomat growth. (See growth pattern diagram at right.)

Biomats tend to restrict the flow of effluent through the drainfield, but are crucial because they filter out viruses and pathogens. As the biomat develops, the soil infiltration rate decreases. Once the hydraulic loading rate exceeds the soil infiltration rate, ponding starts. At some point, wastewater will either back up into the home or break out onto the soil surface.

Biomat formation cannot, and should not, be prevented, but septic tank filters, proper organic loading, and proper maintenance of the septic tank can slow the rate at which it forms. Septic tank filters prevent excess suspended solids from flowing into the drainfield and can be retrofitted to existing systems.

Other maintenance that should be performed on the septic system includes having the system inspected and the tank pumped at regular intervals. Pumping the tank allows it to better settle out solids, also reducing the organic load to the drainfield.



in the form of another new-technology solution known as "soil fracturing." Highly specialized equipment uses a pneumatic hammer to drive narrow probes down into the soil of the drainfield, typically to a depth of between three and six feet.

Air is then forced into the soil at a controlled rate, which fractures the hard soil and creates tiny open channels through it. Next, polystyrene pellets are injected into the newly aerated soil, which keeps the passages open so the soil will not simply compact again. This technology has met with mixed results and is only approved by certain states. It is very important to check with your local health officials to find out what similar process (if any) is approved for your situation.

Some of these more extreme procedures may provide some temporary relief for a failing system that is soon to be replaced or connected to a municipal system. In many states, the process falls between the regulatory cracks whether or not it is a repair and requires a repair permit.

Long-Term Solutions

In some cases, corrective measures are not enough; a new soil absorption system must be constructed. New soil absorption systems can be placed either in an isolated area so the old system is not disturbed in the process or in between the existing trenches if there is adequate room. These additional lines are considered part of an alternating drainfield system.

A diversion valve is installed so that in the future it will be possible

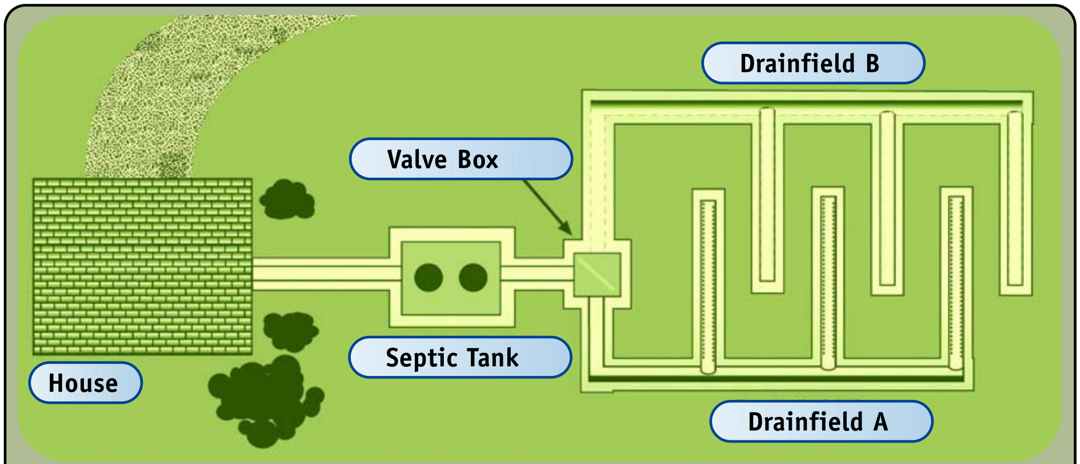


Figure 1 - Interlacing Drainfield System

to direct the flow from the septic tank to either of the soil absorption systems. After the new drainfield is in place, the flow is diverted from the old field, which will slowly rejuvenate itself and be available for use in the future.

The rejuvenation process takes about two years and involves naturally occurring organisms that decompose the clogging mat that has formed and return the absorptive system to near original capacity. (The old drainfield can recover faster if a septic tank pumper can open the field and remove as much of the ponded wastewater as possible.)

After a replacement system has been installed, a homeowner should switch back to the old drainfield after two years, and then switch back and forth between the two systems annually. This will result in a continuous use and rejuvenation cycle for both drainfields and should prevent future failures. An observation tube in each drainfield may be used to monitor the condition of the drainfields and can help the homeowner determine the frequency of alternating between the two fields.

If an adequate area for a new system does not exist, and the old system is a trench system with at least six feet of undisturbed soil between the trenches, it is possible to install new replacement trenches interlaced between the old ones. However, the plumbing for the new and old system must be entirely separate so that when one is in operation, the other has the opportunity to completely dry out. (**See Figure 1 above**.)

Another option to reduce the organic load on the drainfield is by adding an advanced treatment system such as an aerobic treatment unit or a sand filter. Sand filters and aerobic treatment units (ATUs) are systems that use natural processes to treat wastewater and are frequently used to renovate organically clogged, failing septic tank-soil absorption units. Typically, sand filters are used as the second step in wastewater treatment after the septic tank where solids in raw wastewater have been separated out. Constructed of a bed of sand about two or three feet deep and often contained in a liner, sand filters receive the partially treated effluent in intermittent doses. The effluent slowly trickles through the media and is collected in an underdrain and flows to further treatment and/or disposal.

Sand filters are very effective at reduction of organic matter and are capable of handling heavy hydraulic loads. These two qualities make them particularly useful in cases of drainfields that have been overloaded either hydraulically or organically.

Aerobic treatment units are similar to septic tanks in that they use natural processes to treat wastewater, but unlike septic treatment, the ATU process requires oxygen. ATUs use a mechanism to inject and circulate air inside the treatment tank. Bacteria that thrive in oxygen-rich environments work to break down and digest the wastewater inside the aerobic treatment unit.

Aerobically treated effluent is defined as effluent exiting a properly operating ATU or sand filter. This additional step reduces the amount of total suspended solids (suspended solids value of less than 10 to 15 mg/L, compared to typical septic tank effluent with suspended solids in the range of 100 to 250mg/L).

In situations where the soil absorption units have failed due to an excessive biomat formation, aerobic effluent reduces the symptoms. (Several states allow systems that are failing due to clogging biomat to be renovated using aerobically treated effluent, provided the site meets separation requirements between the aggregate/ soil interfaces and limiting conditions of high water table or bedrock.)

This article was first printed in the Winter 2005 issue of the NESC newsletter Pipeline.

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Items referenced above with # codes are available from the NESC at (800) 624-8301.

Small Flows Quarterly
JURIED ARTICLE

The Regulation of Alternative Onsite Wastewater Treatment Systems in the Great Lakes Region

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ABSTRACT: In the Great Lakes region, increasing numbers of homeowners are using alternative onsite wastewater treatment systems (OWTS) to compensate for conditions that preclude the use of conventional gravity-fed septic systems. Many OWTS regulatory programs, already burdened with aging conventional systems, are now faced with the additional challenge of ensuring that alternative systems are properly designed, installed, and maintained. The U.S. Environmental Protection Agency (EPA), concerned about overall OWTS failure rates, recently issued a set of recommended guidelines for the management of OWTS regulatory programs. To determine the challenges associated with implementing the EPA's recommendations, the authors conducted a survey of OWTS program administrators with jurisdictions bordering a Great Lake. This paper presents and evaluates the survey results, which suggest a general trend in the region toward accommodating the permitting of alternative systems by making OWTS codes less prescriptive and more performance-based. In addition to this change, the results also suggest that, in many locales, a parallel focus should be on strengthening program elements related to: (a) post-permit inspections, especially when home ownership changes; (b) maintenance contract requirements; and (c) the use of "responsible management entities" to maintain and manage clusters of OWTS.

In the Great Lakes region, where many new homes are being constructed in sensitive shoreline areas, effective programs for regulating onsite wastewater treatment systems (OWTS) are more important than ever. One problem is that the most attractive sites for new homes, such as those along inlets and inland lakes, often have sandy soils and high water tables, making them unsuitable for conventional, gravity-fed septic systems. Therefore, homeowners desiring to build on these sites often compensate for the limiting conditions by using alternative OWTS technologies and techniques.

These alternative OWTS use components such as pumps, aerators, filters, and controls, a fact which raises the importance of periodically verifying that everything is operating properly (Sexstone, 2000). Not only can these components fail, their failure tends to have more significant consequences due to their proximity to recreational water bodies and environmentally sensitive areas.

The use of alternative technologies also places greater burden on the permitting process, especially in locales operating under older OWTS codes. Older codes tend to be fairly prescriptive, specifying a conventional gravity-fed system whose size is determined by the amount of wastewater being treated and, in some cases, by the characteristics of the site. In general, older OWTS codes do not accommodate homeowners who desire to build on sites not particularly suitable for gravity-fed conventional systems. However, given that property taxes are a major source of revenue for rural townships, such as those surrounding the Great Lakes, local regulators often face political pressure to allow variances. Although homeowners compensate for a site's limiting conditions by using "alternative" or "experimental" technologies, assessing such designs is a major challenge.

To help communities ensure that all OWTS—alternative or conventional—are designed, installed, and maintained properly, the U.S. Environmental Protection Agency (EPA) issued guidelines that describe the main elements of an effective OWTS program (EPA, 2003). The guidelines describe five management models, with the more complex models associated with the use of alternative OWTS in environmentally sensitive areas. In 2003 and 2004, we conducted a survey of officials responsible for OWTS regulatory programs in the Great Lakes region, with the main goal being to assess the challenges they faced, both in general and in implementing the EPA guidelines.

This paper summarizes our findings for program elements related to the permitting and maintenance of alternative systems. A previous paper reported on program capacities associated with the EPA's basic management model, which assumes that sites are suitable for the use of conventional gravity-fed systems (Halvorsen and Gorman, 2006). Before describing our survey methodology and summarizing our findings, we first place the EPA management guidelines in a broader context and briefly describe the management models.

Background

General OWTS Trends

Many OWTS regulatory programs evolved under assumptions that few people would view as valid today. Based on the structure of early codes, these assumptions appear to be as follows:

- that a particular type of technology (i.e., conventional septic tanks using gravity to discharge liquids into a drainage field) would be used;
- that a prescriptive design, if installed properly, would continually perform as expected; and
- that onsite systems would either last forever or be replaced by sewers before their performance deteriorated significantly.

These assumptions have their roots in the period following World War II, when the use of onsite wastewater systems grew dramatically with the rapid development of automobile suburbs. Most of these areas were not served by urban sewers, so developers turned to a technology long used on farms: a short sewer line to an underground tank that drained into a soil absorption field. This technology allowed postwar developers to dispose of residential wastewater without constructing sewers (Rome, 2001).

With little, if any, regulatory oversight, problems occurred. Most residents, having no experience with septic systems, paid little attention to their systems until after they backed up. Problems related to contaminated well water and foul-smelling wastes from inoperable systems became commonplace. Many communities that initially relied on septic systems eventually turned to centralized sewers, with billions of dollars in state and federal funds going toward the construction of these sewer and centralized wastewater treatment systems (Melosi, 2001). Over time, many people came to see the use of septic systems as an interim solution, providing new residences with some wastewater treatment until enough people moved into an area to justify sewers (Eddy, 2001). The first wave of OWTS codes, which depended primarily on the use of construction permits, generally reflected the view that onsite systems were temporary solutions that would eventually be replaced by sewers (Kreissl and Suhrer, 2005).

However, this pattern of sewers replacing OWTS has become less of a norm. First, state and federal subsidies for the construction of sewers and wastewater treatment plants have decreased, making it more difficult for communities to pay for centralized systems. Second, land use patterns in newly developed areas tend to be less amenable to sewers. While 25 percent of all U.S. homes depend upon onsite systems for wastewater treatment, the percentage of new homes being constructed with onsite systems is even higher (EPA, 2003, p. 3). In many of these areas, decentralized solutions involving OWTS are a permanent alternative to sewers.

Experience has also shown that the performance of all systems degrades over time. Through a combination of many factors—overloading, material deterioration, homeowners neglecting to pump, disposal of inappropriate materials, changes in soil properties due to compacting and matting—the effectiveness of most systems gradually declines. Due to factors such as these, conventional systems generally have an expected lifetime of 20 to 30 years. Furthermore, the EPA (2003, p. 4) cites census data that indicates over half of all OWTS in the U.S. are over 30 years old, suggesting that those systems are too old to be working properly. Indeed, in that same report, the agency estimates that ten to twenty percent of all OWTS are operating at a degraded level of performance.

The increasing use of alternative technologies has further undermined any assumption that OWTS, once constructed and permitted, could be forgotten. To ensure that these onsite systems continue to operate as designed requires that they be maintained in a manner consistent with what they are: miniature wastewater treatment facilities. Together with the challenges posed by aging conventional systems, the challenges associated with permitting alternative systems have encouraged many states and locales to revise their codes and strengthen their programs.

Onsite Sewage-Related Surveys

In the years before the EPA published its guidelines, a number of state or multi-county surveys were performed (most querying homeowners), but few have been published in the peer-reviewed literature. The National Environmental Service Center (NESC) periodically surveys program administrators across the U.S., collecting data on topics including the types, costs, and numbers of systems permitted and the types of inspections and maintenance required (Angoli, 2001). They most recently sent their survey to 3,192 administrators in 1999, with 1,046 responding. The organization makes its raw data available at the state and national level, with the currently available data being for 1998.

The NESC (2001) survey indicates that the average number of new permits reported by individual agencies across the U.S. was, for 1998, 325. An average of 62 percent of these systems were conventional, suggesting that alternative systems represented a significant percentage of systems being permitted. The survey also indicated that relatively few agencies required inspections of alternative OWTS (the highest percentage of areas requiring them are for aerobic treatment units at 35 percent).

A number of surveys have been administered at the state or multi-county level. Caudill (2002) surveyed administrators in health departments across Ohio, with the results indicating that about half of the departments required operations inspections for some types of systems, presumably alternative systems, as part of their program. In Northeast Ohio, CT Consultants (2001) performed a field survey of OWTS in seven counties, finding system failure rates between 13 and 20 percent. Mancl (1990 and 1999) surveyed all local OWTS regulatory program administrators in Ohio in 1987 and 1997. She found a number of problems, including a 1987 average OWTS failure rate of 27 percent, a great deal of variation in program quality around the state, and the allowance of unproven OWTS technologies.

In another part of the Great Lakes region, Schwartz et al. (1998) performed a field survey of homeowners with OWTS and drinking water wells in three upstate New York counties. They found that one-third had never pumped their septic tanks, a factor that may contribute to one-third of homeowners' wells testing positive for fecal coliform. In 2000, McNulty and Lindbo (2005) surveyed homeowners with OWTS in nine rural North Carolina counties. They found that about 43 percent erroneously believed that OWTS tanks didn't need to be pumped out until they failed. Olson and Gustafson (2001) conducted a survey of Minnesota homeowners participating in OWTS education classes and found that they were much more likely to perform appropriate OWTS management behaviors after attending the class, suggesting that motivated homeowners can change behavior after learning more about their systems.

Noah and Lake (2000) describe the results of 1997 focus groups with a broad set of OWTS stakeholders in 12 western Washington counties. Interested in understanding barriers to the adoption of alternative systems, they identified the cost of permitting and difficulty of regulating as two of the main barriers. Johnson et al. (2001) report on a survey of OWTS within one Michigan watershed that found individual system failure rates of between 20 to 52 percent depending upon the county.

In the period since these studies have been published, the EPA has released guidelines for the effective management of OWTS programs (Hoyge et al., 2001, and EPA, 2003). Our study examines the degree to which locales along the Great Lakes operate OWTS regulatory programs consistent with these guidelines, with this article focusing on management models that assume alternative OWTS are being permitted in environmentally sensitive areas.

EPA's Management Models

The management guidelines published by the EPA are designed to help local officials ensure that all systems (conventional and alternative) are, first, designed and installed properly and, second, continue to operate properly. These guidelines describe five management models (see **Table 1**), each matching a level of regulation to both the technology being used and the environment in which it is sited. For example, in areas suitable for conventional septic systems, the EPA sees a basic "Homeowner Awareness" management model as sufficient. This model relies primarily on traditional construction permits and on reminding homeowners of their responsibilities. At the other extreme are cases in which the desired level of environmental protection is enough to recommend that OWTS permitting be integrated into a community's larger planning efforts. In such cases, the EPA recommends that regulators permit the use of OWTS only if the operation and maintenance of these systems are managed by "responsible management entities (RMEs)." Otis et al. (2001) and Walsh et al. (2001) describe some of the preliminary work that was done to develop these models.

In this article we assess the capacity of Great Lakes programs to permit and monitor OWTS in situations where the EPA recommends a management model beyond the basic "Homeowner Awareness" model. We focus on cases in which alternative systems are used to compensate for difficult site conditions, with the "Maintenance Contract" model being the minimum recommended. We also briefly examine program capacities associated with the EPA's "Operating Permit" model, which requires homeowners to periodically verify that their system is performing as designed, and "Responsible Management Entity" models, in which an RME is created to manage a group of OWTS.

Table 1—Management Models Proposed by the USEPA

	USEPA Management Model	Description
1	Homeowner Awareness Model	Represents the minimal level of management. Appropriate for cases in which sites without sewer access are suitable for conventional septic systems. Relies on construction permits and public awareness.
2	Maintenance Contract Model	Represents the level of management desirable when alternative technologies are used and for areas of moderate environmental sensitivity in which sites are marginally suitable for conventional septic systems. Includes service contracts as a management tool.
3	Operating Permit Model	Represents the minimum level of management necessary to protect areas that are environmentally sensitive, such as wellhead protection zones, shellfish waters, and water-contact recreational areas. Includes performance monitoring.
4	Responsible Management Entity O&M Model	Represents a level of management appropriate for environmentally sensitive areas in which onsite and clustered systems are the main form of sewage treatment. Establishes an entity to manage the maintenance of all systems.
5	Responsible Management Entity Ownership Model	Represents a level of management appropriate for environmentally sensitive areas in which onsite and clustered systems are the main form of sewage treatment. Establishes an entity that owns and manages all systems.

Methodology

To assess the capacity of locales along the Great Lakes shoreline to implement the EPA guidelines, we first identified program elements that, based upon preliminary interviews and information gathering, appeared to vary widely. (Each of the five management models consists of many program elements.) We then designed survey questions to assess the capacity of locales to implement these program elements. We also incorporated questions that assessed the specific types of problems regulators faced, regardless of their program capacity.

We determined which program elements to focus on after interviewing a subset of regulators in the region responsible for OWTS regulatory programs. In these preliminary interviews, we asked individuals to describe the regulatory structure in their state, their general permitting process, and any challenges or problems they could identify. Based on the interviews, we determined that the most significant challenges included issues related to the permitting of alternative systems and the operation and maintenance of all OWTS systems. These interviews, in combination with the EPA's recommended guidelines, formed the basis for a set of survey questions concerning agency permit processes, homeowner information databases, maintenance contract requirements, and communication with homeowners. We included both closed- (quantitative) and open-ended questions in the survey, which allowed us to standardize responses to some questions across survey respondents while still giving them the opportunity to discuss at length the strengths, weaknesses, and unique characteristics of their local regulatory programs. A copy of the survey is available online at **http://www.nesc.wvu.edu/survey_SFQW06.pdf** as an appendix to this article.

Our population consisted of OWTS regulatory agencies bordering the Great Lakes in the U.S. and Canada (see **Figure 1**). Eight states have counties that border the Great Lakes: New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, and Minnesota. In most of these states, administration of OWTS regulations is performed by environmental health offices within larger health departments that also have responsibility for administering regulations governing food services and other programs. Except for Michigan, each state has a statewide regulatory code that local agencies enforce, mostly at the county level. In Michigan, codes are created mostly at county level but also at the regional (multi-county) level. Legislation empowering Michigan's Department of Environmental Quality, which currently has loose oversight over local programs, to create a statewide code is under consideration (Senate Bill No. 0071, Michigan Legislature, 2005).

For the U.S. portion of our study area, we surveyed 100 percent of the 67 county or regional (multi-county) agencies that border a Great Lake and that regulate OWTS. All of the regulatory administrators received a paper copy of the survey along with a cover letter explaining our research goals. Unless they indicated that they were unwilling to participate, each administrator was contacted at least three times via the phone to arrange an appointment before we designated them a nonrespondent. In the end, 91 percent of the U.S. administrators responded to our phone survey with only six refusals out of 67 regulatory agencies. One individual did not respond from each of the following states: Illinois, Minnesota, New York, and Ohio. Two did not respond from Wisconsin.

In Canada, Ontario is the only province bordering the Great Lakes. Its governmental structure for regulating septic systems is different than in the U.S. In some places, regulation occurs at the municipal level. Elsewhere it occurs at the regional (multi-county) level. In addition, in incorporated areas, building departments oversee OWTS permit programs; outside of these areas, OWTS are permitted and regulated by local or regional departments, including health units and conservation authorities. In total, there are 33 local Ontario offices governing OWTS management that border a Great Lake. While it was important to survey Ontario regulators, our focus on the capacity of local agencies to implement EPA management models is less relevant there. Therefore, to maximize our coverage of the different regions and governmental levels within Ontario, we surveyed one office at each level within a region. Depending upon the region, we surveyed a regional (unincorporated area), township or county level, and/or municipal level (building department) office.

When U.S. and Canadian regulatory entities are combined, we attempted to survey 80 offices. Of those, 74 (93 percent) responded. This excellent response rate makes us confident that our results accurately reflect the situation for regulators with jurisdictions bordering the Great Lakes in both the U.S. and Canada. Furthermore, the survey is particularly comprehensive for Michigan, because most of that state's counties border a Great Lake or are regulated by a regional health department that has a Great Lakes shoreline within its jurisdiction. Hence, in Michigan, regulators with responsibility for 58 (69 percent) of the state's 84 counties were surveyed. **Table 2** lists the number of respondents per state

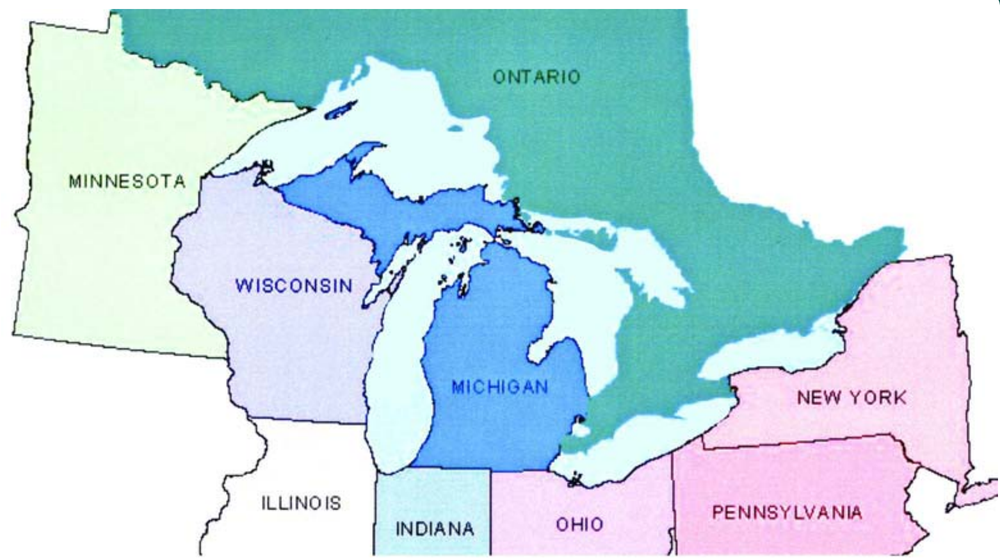


Figure 1 — The Great Lakes Region
Source: Kristine Bradof, Michigan Technological University

or province and the percentage of total respondents they represent.

Table 2 — Great Lake States and Province, Shoreline Lengths, and Number of Offices Surveyed

State/Province	Number of offices surveyed	Percentage of total surveyed	Miles of Great Lakes shoreline[1]	Number of OWTS in surveyed area[2]
Illinois	2	3	63	50,000
Indiana	3	4	45	50,000
Michigan	25	32	2,963	455,000
Minnesota	2	3	189	35,000
New York	8	11	408	200,000
Ohio	7	10	310	110,000
Pennsylvania	1	1	51	25,000
Wisconsin	13	18	820	110,000
Ontario	13	17	4,331	Not Available
TOTAL	**74**	**100**	**9,182**	**1,035,000**

1. Shorelines of the Great Lakes (www.michigan.gov.deq)
2. Number of OWTS rounded to the nearest 5,000; based on 1990 census data. (OWTS data not collected in 2000.)

Results

This section summarizes the capacity of the responding locales to permit and monitor the use of alternative OWTS technologies. First, we examine the extent to which agencies permit alternative technologies. Then, we summarize their capacity to implement program elements related to the EPA's "Maintenance Contract" model, which is the one most relevant to alternative technologies. Next, we briefly examine the capacity of locales to implement program elements related to the EPA's "Operating Permit" and "Responsible Management Entity" management models. Finally, we summarize state patterns, with the focus on the relationship between state codes, the flexibility locales have in permitting alternative technologies, and the capacity of those locales to manage the appropriate program elements.

Experience with Alternative Systems

In general, we consider any system more complicated than a septic tank with a gravity-fed drainfield to be an alternative system. However, in the course of this project, we learned that regulators do not always use the same criteria to categorize OWTS as conventional and alternative. The term *conventional* tends to mean systems with which regulators are familiar and that are, to some extent, integrated into their regulatory code. *Alternative* seems to mean systems that are newer to agencies, require some kind of variance from code, or are only rarely permitted. In addition, some regulators use different words, such as *nonconventional* and *experimental*, to describe what we have been referring to as alternative, with designations such as experimental sometimes carrying specific code requirements.

Precise definitions aside, all but one locale in our study permitted what we would consider to be alternative OWTS. In most locales (58 percent), respondents reported that alternative systems account for less than one-fifth of the systems being permitted (see **Table 3**). However, 37 percent of respondents indicated that more than 40 percent of all permits were for alternative OWTS. Of those, 10 respondents (13 percent) indicated that over 80 percent of their permits were for OWTS.

We also learned very quickly that different regulators use different terms to describe specific types of alternative technologies, making it difficult to compile a list of systems with which different locales have experience. When we asked regulators what types of alternative systems they permitted, 55 identified a wide variety of types, referring to both generic technologies and systems marketed by specific manufacturers. In addition, 18 of those surveyed simply answered that they allow what their code allows. Only one indicated that alternative systems were not permitted. **Table 4** lists the types of systems and the frequency those systems are mentioned as allowed within the surveyed jurisdictions. As much as possible, we have preserved the phrases and language used by respondents to provide some sense of the difficulty encountered in tabulating the different types of alternative systems. If nothing else, the variety suggests why it is difficult to ensure that homeowners—and, for that matter, service contractors—fully understand the differences between systems. It also gives some indication as to why determining the requirements of different systems during the permitting process can be difficult.

When we asked which type of alternative system regulators thought worked best within their jurisdiction, about a third indicated mound systems. It is important to keep in mind that some regulators do not view mounds as alternative systems, because they are so frequently used within their districts. For example, one respondent told us that 95 percent of the new systems they permit are mounds, so that they do not consider them as truly alternative. On the other hand, others consider them to be alternative technologies because they

Table 3 — Percentage of OWTS Permits in Locales

Percentage of 2002 OWTS Permits Given for Alternative Systems	Percentage Respondents Selecting This Level
20% or less	58
Between 20 and 40%	6
Between 40 and 60%	14
Between 60 and 80%	10
Between 80 and 100%	13

are more complex than conventional gravity-fed systems, often requiring pumps to lift the effluent and usually being more subject to freezing and leakage. Another one percent identified recirculating sand filters, which probably included jurisdictions that do not consider mounds to be alternative. About ten other types of systems were also identified, each by one or two respondents. Fourteen percent did not identify specific types of systems but indicated that site conditions would determine which system would perform best. About 15 percent said they couldn't answer the question because they don't have enough experience with alternative systems.

Table 4 — Permitted Systems Defined by Respondents as Alternative

System Type	Number Reporting
Mound systems	33
Aerobic Treatment Units (ATU's), general aeration systems	27
Sand filters (also used as pre-treatment units)	24
Peat filters (Ecoflow), textile filters, or drip irrigation systems	15
Pressure Distributed Systems and pump systems	13
The Infiltrator, recirculation and media filtering systems	10
Alternative Treatment Systems (ATS's)	9
Constructed wetlands	9
Enviro-chambered systems	8
Raised filter bed systems	8
Trench systems	7
Biofilters	6
Stabilization ponds or oxidation lagoons	6
Holding tanks for failing OWTS	5
Subsurface materials-easy flow gravel-less	5
Drain fields	3
Nibbler Systems	2
Advantex	1
Allow no alternative systems.	1

Alternative Systems and Permitting

The permitting process forms the foundation for all of the EPA management models regardless of whether conventional gravity-fed systems or alternative technologies are involved. It is a critical time when a site's suitability for OWTS is determined. At this point, site evaluators decide whether a parcel's characteristics (including its size, soil type and depth, distance to bedrock and groundwater, and location of features such as wells) warrant permitting the construction of a conventional system, an alternative system, or no system at all. Here, we summarize how alternative systems complicate the permitting process and assess the challenges that Great Lakes OWTS programs face in handling those complications.

One issue for permitting agencies is the degree to which OWTS codes are flexible enough to accommodate alternative technologies. Prescriptive codes that assume the use of conventional, gravity-fed systems tend not to facilitate the systematic evaluation of alternative systems. To what extent is the permitting of alternative systems integrated into septic system codes for locales bordering the Great Lakes? Sixty-eight percent reported that it is. However, 53 percent of the regulators agreed with the statement, "In order to protect human and environmental health, our current local and/or state code needs to be updated to more effectively regulate alternative OWTS." Thus, nearly all jurisdictions allow the use of alternative systems, but a significantly smaller percentage have codes that include what regulators see to be adequate standards and procedures for permitting alternative systems.

The use of alternative technologies also complicates the permitting process, because a greater amount of effort must go into evaluating designs. In locales where codes assume the use of conventional gravity-fed OWTS, homeowners must request a variance to use something different, with the request accompanied by the submission of design plans. Then, regulators must assess the ability of the system specified in the variance to adequately treat wastewater.

Indeed, when asked what challenges they experienced with regard to alternative systems, some of the most frequently described difficulties had to do with the cost and challenge of keeping up with the changing technologies (22 out of 74 or 30 percent). When asked, "Does your agency fully recover the costs of permitting alternative systems through permit fees?" Forty-three percent said no. Of those, 53 percent said they were having trouble funding this work (23 percent overall). These responses suggest that a significant number of agencies are struggling to deal with costs related to permitting these systems, which makes it more likely that they will have to cut programmatic corners to make up the shortfall. Assuming that these cuts come from OWTS-related regulatory programming, it could mean putting costs off into the future, at which point failures resulting in direct risks to human and environmental health could force agencies and municipalities to spend even more. As the demand for alternative systems rises, as many of our respondents told us it is currently doing, and many of their state appropriations continue to decrease, as many also told us was happening, the potential for future problems with alternative systems increases. Addressing the problem, however, may involve not only securing more funds, but also developing an organization with a different skill mix.

We also asked an open-ended question regarding the steps in the permit process required within each jurisdiction. These responses establish that locales are meeting minimum site evaluation standards for making determinations about the suitability of sites for OWTS. However, important variations exist relevant to the permitting of alternative technologies. In Wisconsin, homeowners are expected to hire certified professionals to inspect the site and design an appropriate OWTS, whether conventional or otherwise. In Indiana, homeowners also hire certified soil scientists to determine site conditions, but agency personnel get more involved in the interpretation of the results. In Lake County, Illinois, agencies employ certified soil scientists who perform the site evaluations, and homeowners must hire a certified system designer. In many Michigan counties (or multi-county regions), agency personnel perform the site evaluations and work more directly with contractors and homeowners than agency personnel in states such as Wisconsin. Given that codes are developed at the local level in Michigan, significant intrastate variation is also seen there.

We also asked regulators who determined the types of systems allowed within their jurisdictions. In response, 53 percent said their agency had complete authority to determine the type of system appropriate. Sixteen percent said they are limited by local regulations, which specify the types of systems allowable, and 37 percent said they are limited by state regulations, which specify what types of systems are allowable. Nineteen percent said they make decisions at the local level when a conventional system is being permitted, with the state (or province) issuing alternative system permits. (Responses to this question were not mutually exclusive, and some respondents selected more than one answer.)

These variations in requirements from jurisdiction to jurisdiction—codes and regulatory models that vary in their degree of flexibility, a greater or lesser reliance on private OWTS professionals for site evaluations and system design, and the different roles that the state and local agencies play—suggest that an important change is still underway in OWTS regulation. Although the EPA management guidelines do not explicitly endorse one pattern of organization or execution over another, they do assume that agencies have the flexibility to permit alternative systems and have good access to the services of skilled private-sector OWTS professionals. Therefore, the EPA guidelines reinforce a general change toward codes that are less prescriptive and more accommodating to alternative technologies.

Maintenance Contracts

A key expectation in the EPA's "Maintenance Contract" model, which is the minimum level of management recommended if an agency permits alternative OWTS, is that the agency require homeowners to purchase and renew yearly maintenance contracts for service (EPA, 2003). EPA also recommends that the local agency require proof of a maintenance contract prior to issuing a permit, that the homeowner be required to demonstrate periodic renewal of this contract, that the agency follow through on violations of this requirement, and that a database including this information be regularly updated.

We asked respondents if they (or the state) require an operation and maintenance contract as a condition of permitting alternative systems. Sixty-two percent said "yes" for at least one type of system, including one agency that has taken over responsibility for performing this service. Thirty percent of respondents require proof of contract renewal for every year of the system's life. Forty-two percent of those that require a maintenance contract also require that the service provider report to them on the performance of the system.

Even if agencies require homeowners to secure maintenance contracts, problems may still arise if there are not enough trained professionals to service them. Therefore, the EPA guidelines recommend that agencies work to ensure that their jurisdictions have sufficient numbers of well-trained, competent, and reliable service providers to maintain these types of systems. Sixty percent of respondents said that their jurisdiction had sufficient numbers of reliable maintenance contractors to adequately service alternative OWTS.

These responses show that the majority of agencies are issuing alternative system permits but are not requiring yearly service provider reports or proof of a continuing maintenance contract. As described above, this is a potential problem because homeowners who are unaware of the need for regular maintenance or are unwilling or unable to pay for regular maintenance may have systems that are failing and not operating as designed. Given that these systems are typically used to compensate for difficult site conditions or to provide additional protection to a sensitive environment, their failure is particularly likely to result in negative consequences. In addition, while a majority of regulators do feel that sufficient numbers of reliable service providers are operating within their jurisdiction, a fair number do not. This potential lack, coupled with the fact that most jurisdictions do not require proof of contract renewal, mean that most agencies are not meeting the EPA's recommendations for a maintenance contract management model, even though nearly all of them are permitting higher maintenance alternative systems.

Respondents also explicitly identified concerns with their ability to ensure that alternative systems continue to operate as designed. When asked what alternative system-related challenges they face, 43 out of the 74 respondents (58 percent) volunteered some issue related to ensuring that these systems were working properly over the long run. One of the most frequently mentioned issues was their agency's inability to follow up on the renewal of maintenance contracts. Reasons why this was a problem included the lack of a legal mechanism for enforcing renewal requirements, the lack of a computerized database for tracking actions, and the lack of staff time to effectively check or re-inspect the systems. Another frequently mentioned problem had to do with ensuring that new homeowners were aware of, and compliant with, the proper maintenance of their systems.

Alternative Systems, Record Keeping, and Communication with Homeowners

All of the EPA management models recommend that regulatory agencies be able to track the names, addresses, and system types of all OWTS homeowners within their jurisdiction. This information is especially necessary if an agency is to monitor maintenance obligations associated with alternative systems. Along these lines, 85 percent of respondents said they had a computerized database of OWTS permits, and an additional four percent said they did not have one but it was in development. Therefore, nearly all agencies have, or are in the process of developing, a computerized database of homeowners and are moving in the direction of the EPA's recommendations for computerized databases.

However, significant gaps in information exist. Some of those gaps involve information about systems installed before permits were required or before an agency's database was developed, resulting in missing information for older conventional systems. This lack of information about aging septic systems is a significant concern. However, in terms of an agency's ability to track alternative systems, a more significant gap in information arises when agencies have no mechanism to update their records when transfers of ownership occur. Given the rapidity of homeownership turnover in the average North American community, this means that agencies without a mechanism for updating their records are losing the names of homeowners who currently own OWTS within their jurisdiction. Without the ability to personalize contacts with homeowners, such as mailed maintenance reminders, it is difficult to ensure that mailings reach the desired homeowner.

To ensure that records are kept current, the EPA recommends that OWTS be inspected whenever a house changes ownership. Our results indicate that most (86 percent) of surveyed jurisdictions are not meeting the EPA's recommendations for inspections when properties change ownership. These agencies are missing a critical opportunity to become aware of, and make contact with, new owners. They are also missing a critical opportunity to partner with financial institutions that already commonly require OWTS inspections. Agencies could, of course, contact owners without requiring an inspection, but responses to another survey question show that this is not happening. In answers to a related question regarding when regulators update their computerized permit databases, only 20 percent of respondents told us that they update their database every time properties change hands.

When homes serviced by OWTS are transferred to new owners in areas where there is no required contact with a regulatory agency, the agency is also missing an opportunity to inform homeowners who may not be aware of the type of OWTS they have acquired. If it is an alternative OWTS, they may not be aware of the complexities of the system or what they need to do to keep it in proper working order. They might not realize that they are supposed to secure a maintenance contract for their onsite system. This is particularly likely to occur when the regulatory agency either does not require homeowners to submit yearly proof of their maintenance contract or takes no action when that proof is not provided. This means that most agencies are losing track of the names of homeowners with OWTS, making it more difficult to communicate with them.

Operating Permit Management Model

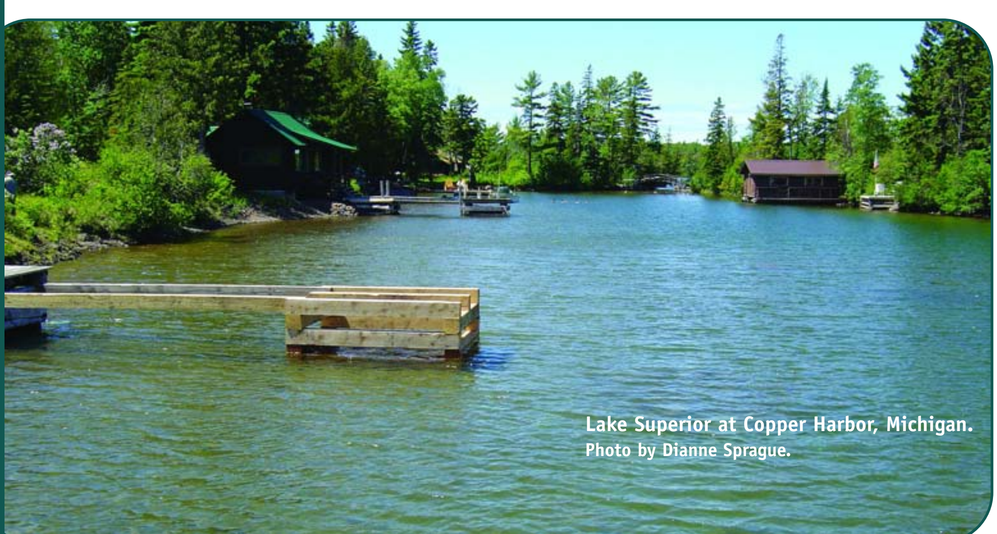
According to the EPA guidelines, agencies should have the ability to administer operating permits in environmentally sensitive areas. For example, in a wellhead protection zone, any water that flows out of a drainfield recharges an aquifer supplying public drinking water, and special attention is warranted. Unlike construction permits, operating permits require performance monitoring and must be periodically renewed. They are a step more stringent than requiring homeowners to purchase maintenance contracts.

Any gap in an agency's capacity to implement a "Maintenance Contract" management model translates into an inability to implement a successful "Operating Permit" management model as well. In addition, gaps in information related to all types of OWTS (conventional as well as alternative systems) are more relevant here, because the justification for stringent monitoring stems more from the need for greater protection than from the type of technology involved. Hence, insufficient knowledge about older systems installed before permits were required becomes a critical issue here. Given the gaps that already exist in the capacities of most agencies to use maintenance contracts as a management tool, we did not specifically evaluate the ability of agencies to manage operating permits. However, given those gaps, it appears that most locales along the Great Lakes do not have the capacity to implement all the program elements associated with the "Operating Permit Management Model."

A mitigating factor is that the protection of critical aquifers is often driven by additional policies and regulatory requirements. In such cases, there may be more support for implementing program elements for which agencies otherwise do not have the backing. In cases where agencies are understaffed and underfunded, even this support may not be enough. In such cases, other arrangements, such as those described in the following section, may be more effective.

Responsible Management Entity (RME) Models

RMEs are public or private organizations responsible for the operation, performance, and management of onsite systems within specific service areas. RMEs make the most sense to use when it is possible and desirable to manage a cluster of OWTS as a group. Such a scenario may occur when individual homeowners surrounding an inlet or small inland lake desire to protect that body of water. An RME could also be established when an agency desires to protect an environmentally sensi-



Lake Superior at Copper Harbor, Michigan.
Photo by Dianne Sprague.

Lake Superior at Hunter's Point, Michigan.
Photo by Dianne Sprague.

J U R I E D A R T I C L E

tive area, such as wellhead protection zone. In the "RME Operation and Maintenance" model, a homeowners' association could choose to hire an RME to take over the management of onsite systems owned by their members. In the "R&M Ownership" model, the RME would own the onsite systems and serve as a type of utility.

RMEs provide a mechanism for agencies to interact with a few key entities in ways not possible for the entire population of OWTS owners. Ownership RMEs also make other configurations of OWTS more possible, such as cluster systems in which several homes share a treatment and dispersal system. However, in many states, the regulatory authority responsible for managing OWTS depends on the level of discharge, with health departments responsible for smaller flows associated with residences and environmental agencies responsible for the larger flows associated with cluster systems. In some states, a reevaluation of both that dividing line and the rules governing cluster systems would make sense if existing policies are discouraging what could be a useful regulatory tool.

We asked all regulators if they had any private RMEs within their jurisdictions, and 16 percent said they did (six of the 12 people who said yes were in Michigan). Five percent reported having a public RME. This limited experience with RMEs in the Great Lakes area suggests that more research on the effectiveness and efficiency of using RMEs should be performed, along with an analysis of the regulatory structures that encourage or discourage their use. Given the number of inlets and inland lakes in this region, which is the type of area in which RMEs make the most sense, the potential for the RME management models being useful is high. They may also be useful in situations where the nutrient output of numerous septic systems need to be managed to prevent the eutrophication of a water body.

Desired Improvements in Regulatory Programs

What improvements do regulators desire to see in their programs? We asked two questions on this topic. One focused specifically on improvements in the code that they administer and the other on improvements in noncode or general areas. Twenty percent of respondents felt that their code was solid and could not suggest any major or minor changes. Of those who desired changes, there were few patterns among the answers. Some of the responses conflicted, with two jurisdictions grappling with the same problem being critical of the solutions suggested by the other. In some cases, respondents were critical of changes that they had already implemented, while other regulators suggested that same type of change as the solution to their own problems.

For instance, one regulator wanted to require more regular pumping, while a regulator in a district that had this requirement wanted to lengthen required intervals for seasonal homes. A few wanted more design flexibility, while another wanted more standardization. Some regulators wanted operation and maintenance requirements for alternative systems, while one wanted a reduction in these requirements. A few wanted more local control over OWTS decision making, while another wanted to give control and responsibility back to the state. One respondent wanted to require that everyone connect to a sewer, while another in a jurisdiction that currently requires such connections desired to mandate this only for failing systems.

In general, we can group the responses into six categories: general changes; alternative systems; operation and maintenance; service providers; permitting, including design and siting specifications; and post-installation inspections. Of the desired changes that were of a general nature, the most frequently cited concerned enforcement. These mostly had to do with eliminating loopholes and increasing their department's enforcement authority.

Eight individuals specifically wanted changes that addressed issues with alternative systems. These included creating operation and maintenance requirements, shifting authority from the state to the local level regarding approval of systems, addressing alternative systems within their code, and standardizing alternative system design requirements to reduce the need for engineers and to make the permitting process less expensive. Another wanted to adopt a requirement that licensed engineers create all plans. One regulator wanted to take over monthly maintenance and inspection of alternative systems from private contractors to identify failing systems more quickly; they currently inspect them yearly, as do at least two other surveyed departments. One of the locales had already taken over operation and maintenance of alternative systems, and the regulator from that locale mentioned that finding the time to keep up with this work was difficult.

A number of individuals wanted changes regarding operation and maintenance requirements for all systems. Another suggested creating a collective special assessment district, what the EPA might refer to as a public RME, with homeowners charged for maintenance on a monthly basis as if they were connected to a sewer. Similarly, another regulator wanted the health department to have the authority to require management districts rather than have that decision controlled by homeowner associations. There were only two comments regarding changes to regulations aimed at service providers: one wanted increased requirements for certified soil testers, and another wanted to introduce contractor liability for system performance.

Many of the desired changes had to do with specific components of the permit process. Two regulators wanted to increase minimum required lot sizes to two acres, and two wanted to require the enlargement of dispersal systems. Another individual simply wanted size requirements to better fit site conditions. One regulator wanted to ensure that the capacity of adjacent sites to develop was protected when OWTS site locations were authorized, and another wanted a minimum standard for isolation of OWTS from the water tables. One regulator wanted minimum required distances from structures, including wells and docks. Some comments had to do with specific OWTS design elements, such as requiring effluent filters; requiring larger, heavier pipes to the drainfield; and changing loading requirements for mounds to mandate longer, narrower systems. Finally, several individuals wanted changes in the appeals process. One wanted it "updated;" another wanted to get the "politics" out of it. Still another wanted to get some technically trained professionals on an appeals board currently composed entirely of health professionals.

Eleven respondents desired mandatory post-permit inspections of all or some systems. Most of those respondents also wanted a point-of-sale or transfer inspection requirement. A few had a point-of-sale/transfer requirement and found it insufficient; they desired regular inspections, such as once every few years. Another wanted random inspections, explaining that some homeowners turn off aerator pumps to save on electricity charges. One individual wanted to require a mandatory inspection of every system when it was 25 years old.

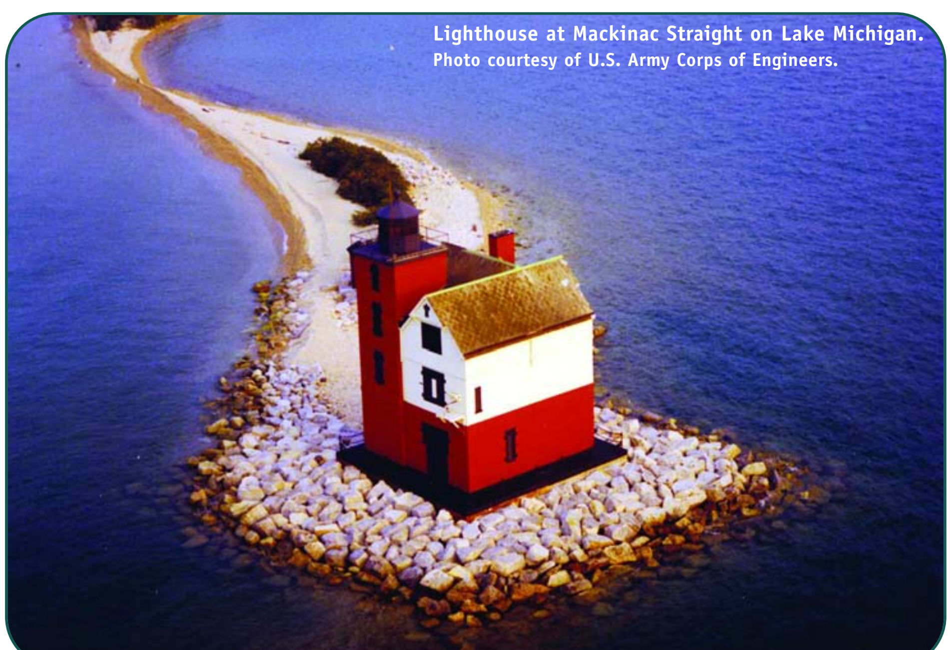
This range of responses suggests that there are no specific changes that will serve as a "silver bullet" capable of satisfying all regulators. At the same time, these responses do indicate that the increasing use of alternative systems is placing additional challenges on regulators, and that many of the improvements they desire are related to the permitting and maintenance of these systems.

State and Province Level Patterns

Given that most locales follow a state- or province-wide sanitary code, it makes sense to look for patterns within states and Ontario. For example, if all regulators in a given state indicate that they enforce maintenance contracts, it suggests that their state code is effective in requiring or encouraging this particular program element. On the other hand, if all regulators in a given state have indicated that they do not enforce maintenance contracts, it suggests that the state code may be ineffective in dealing with this program element. This section summarizes the extent to which general patterns can be identified for Ontario and states in which four or more regulators were interviewed: Ohio, New York, Michigan, and Wisconsin. Too few regulators were interviewed in the remaining states (Indiana, Minnesota, Illinois, and Pennsylvania) to establish any meaningful pattern.

Wisconsin

We surveyed 13 regulators within Wisconsin, with two nonresponding agencies. In Wisconsin, OWTS are usually regulated by of-



Lighthouse at Mackinac Straight on Lake Michigan.
Photo courtesy of U.S. Army Corps of Engineers.