The following article was published in the Fall 2005 issue of CLEARWATERS magazine,
the official publication of the New York Water Environment Association, Inc., http://www.nywea.org

How Well Are Your Onsite Systems Treating Wastewater? Using a GIS-Based Needs Assessment

by Carl Etnier

The Board of Selectmen in the Town of Holliston, Massachusetts, wondered whether the town had outgrown its onsite wastewater treatment systems. Wastewater from the entire town—over 4,400 developed parcels—was treated in onsite systems. In 1995, Massachusetts had adopted new regulations for onsite systems that mandated system inspections at the time of property transfer. "Anyone with an onsite system suddenly had more steps in the already complicated process of selling a home," commented Bruce Douglas, a former Stone Environmental employee who spoke with Town of Holliston officials as they were assessing their alternatives. "The town was also looking at future growth and wondering whether continued reliance on onsite systems would be consistent with protecting the town's drinking water wells and other environmental, public health, and community objectives." The town had made substantial progress toward a design for a centralized wastewater collection and treatment system, but the high cost estimates led the Board of Selectmen to return to the drawing board and re-examine the question of whether and where the town *needed* a centralized system.

Stone Environmental was asked to perform a needs assessment for Holliston. A needs assessment gives local authorities a thorough evaluation of current and (if desired) projected wastewater-related needs. Needs could arise from conditions that violate state or local regulations, from risks to public health or the environment, or even (as we will see in Holliston) from aesthetic considerations.

The basic approach to a needs assessment is to understand what wastewater infrastructure the community has and how well it is performing. Projected growth is also considered, if the community wishes, along with new needs that would arise in a more populous community.

Communities like Holliston have made large investments in onsite wastewater treatment systems. As the U.S. Environmental Protection Agency has noted, well-managed onsite systems can be a permanent part of the nation's wastewater infrastructure. In performing a needs assessment, Stone Environmental looks for ways to meet all wastewater needs while preserving the investment in onsite systems, since continued use of the infrastructure already in place is generally the low-cost alternative. Continuing to use onsite systems does not mean doing nothing—some systems may need to be repaired or replaced, and all systems require regular management to function well permanently.

One of the main questions that a needs assessment addresses is on which lots site conditions and regulations make it more problematic to continue using onsite systems. Some sort of off-site solution—either a cluster system with subsurface discharge or a sewer to a treatment plant with surface discharge—may be the best alternative for those lots. Since off-site solutions require more extensive piping, and the cost per user is less when there are more hookups per foot of piping, then off-site solutions are most cost effective when they can service clusters of lots.

Stone uses geographic information systems (GIS) as the central tool in performing needs assessments because of the power and flexibility offered by this technology. It can be used simply to present the results of analysis or as a potent tool to examine details for every lot individually while using planning-level data. That is, specific data about each lot are combined with planning-level data, such as soils and water table data from Natural Resources Conservation Service (NRCS) and locations of streams, wetlands, and roads. The lot-specific data generally include size of the lot, size of the building footprint, predicted wastewater flow (for example, based on the number of bedrooms), and design of the current wastewater treatment system. Often permits for onsite systems include soil profiles and water table data from one or more test pits on the

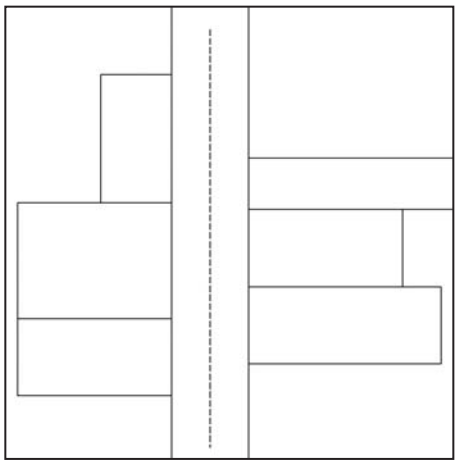

Figure 1. Start with the parcels and roads.

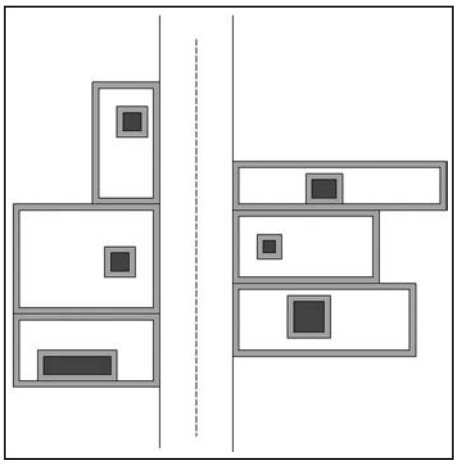

Figure 2. Add the buildings and setbacks.

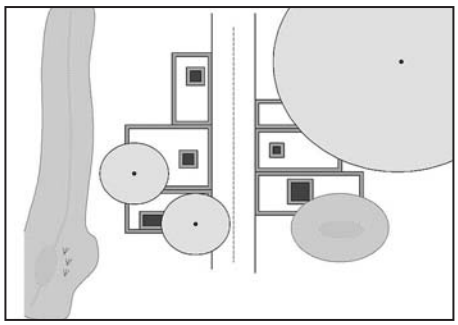

Figure 3. Add ponds, streams, and wetlands with setbacks.

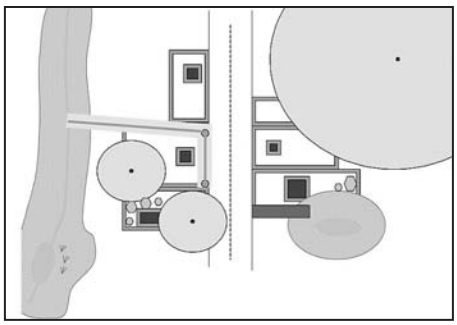

Figure 4. Add rights of way, drainages, and bedrock.

"For the assessment to be useful, the public needs to understand and accept the assumptions going into the analysis."

lot. Where available, such information can be used to supplement and calibrate the NRCS data.

In Holliston, GIS was used to create maps of the town, using the following:

- Parcel information digitized from town tax maps
- Building footprints, road edges, streams, wetlands, and topography taken from aerial photographs
- Floodplains and wellhead protection areas delineated by the Massachusetts GIS office
- The assessor property owner database, Massachusetts Board of Health permit data, and zoning districts from the Holliston town hall

With GIS, each type of data is stored in a separate mapping layer. This allows different types of maps to be produced using different combinations of data. Figure 1 shows a basic layer, the parcel boundaries, and the roads. Figure 2 shows where the buildings are on the parcels and the setbacks from property lines and buildings for onsite systems' absorption fields required by Massachusetts regulations. The regulations also require setbacks from ponds, streams, and wetlands, so a layer with those features and setbacks is added (figure 3). Finally, rights of way, drainages, and exposed bedrock are unsuitable for absorption systems, so a layer with those features is added (figure 4). All this information combined shows how much area is available for the absorption system.

Whether the area available on each lot is sufficient for an onsite system depends on the wastewater flows from the building and the soil characteristics. A building with low flows on a lot with sandy soils, for example, requires a smaller absorption field than a building with higher flows and/or one on a lot with heavier soils. For each lot, a determination was made of how much area an onsite system compliant with regulations would require, based on the design flow (number of bedrooms for homes) and the soil characteristics. This information was added to the GIS map to determine how limited the lots were for continued use of onsite systems (figure 5).

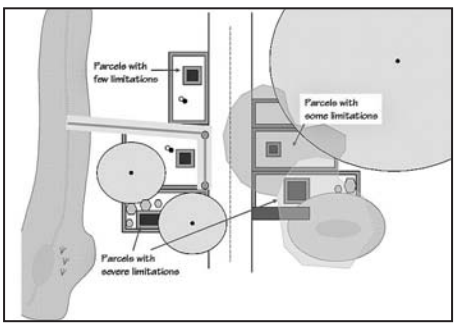

Figure 5. Add wastewater flows and soils characteristics to determine which lots have limitations for using onsite systems.

Figure 6. The suitability of lots for fully compliant onsite systems in a portion of Holliston, Massachusetts. The darker lots have more unbuffered area than is required for an onsite system; the lighter gray lots have less unbuffered area than required. (The unshaded lots are undeveloped.)

Figures 1–5 are schematics to illustrate the principles of a GIS-based needs assessment. Figure 6 shows this stage of the needs assessment in a small area of Holliston. The darker lots in figure 6 have more unbuffered area than is required for onsite systems; the lighter gray lots have less unbuffered area than required.

Besides this basic assessment of the suitability of lots for onsite systems, a GIS-based needs assessment can be built around additional needs of the community. The needs may arise from its historical development, its geographical situation, and the desires of its citizens. For Holliston, a number of additional factors were considered important:

1. Older systems are likely to perform less well, either because they were designed to older, less stringent specifications or because of the effects of age.
2. Systems on lots with high groundwater are likely to have lower performance than where there is greater depth to groundwater.
3. A mound system, which can overcome limitations from shallow groundwater, is less desired where the topography is flatter and it is more difficult to blend the mound aesthetically into the landscaping.

When each of these factors was mapped by itself, the affected lots were scattered through a lot of the town. When all three layers were put together, however, the map identified some clusters of lots that have older systems, high seasonal groundwater, and a flatter topography. Where these lots are clustered together, it is more feasible to use off-site solutions, connecting them to a sewer or cluster system.

Figures 1–6 show different ways that GIS can be used in a needs assessment of the current situation. In Holliston, the assessments were also made of wastewater needs in the future, when the town will be fully built out, and of the potential for impact on the drinking water in the municipal wells under current or future scenarios. A few neighborhoods most likely to need off-site solutions were identified, and the village district was shown to have marginal capacity for build-out using onsite systems. Onsite systems do not pose a significant threat to drinking water quality, it was also concluded.

Stone's needs assessment for Holliston found a significantly greater possibility to keep using onsite systems than a previous study that recommended larger use of sewers. The previous study recommended a sewer for one neighborhood of 442 lots, for example, where the Stone study found only 16 lots limited by area and 17 lots limited by a combination of system age, groundwater depth, and slope. Another neighborhood with 116 lots had been designated for sewer, but the Stone study found only 4 lots limited by area and 5 limited by system age, groundwater, and slope. These two neighborhoods alone represent a significant potential for cost savings if the onsite systems continue to be used.

Sometimes continued use of onsite systems is not compatible with current regulations and/or a town's goals or current sit-

uation. While Stone Environmental looks for ways to preserve investment in onsite systems, it has advised installing a sewer where the assessment results dictated. A transparent, fact-based, outcome-neutral approach is open to whatever results emerge.

Needs assessments can be performed at various levels of detail. A basic needs assessment takes a first cut at which parcels are compatible with continued use of onsite systems using planning level data and perhaps the results of a citizen survey. A more sophisticated analysis considers more scenarios, tests the results of varying initial assumptions, and uses more parcel-specific data.

Whatever the level of detail for needs assessment, it is important that there be a substantial level of public involvement. For the assessment to be useful, the public needs to understand and accept the assumptions going into the analysis. Public meetings can also help generate ideas for different types of analysis to perform. The local board of health or a wastewater advisory committee can master the details of the needs assessment's approach and results. Later, when it comes time to approve funding for whatever infrastructure or management system that is recommended, the local committee that understands how the recommendation was developed can be very helpful in mobilizing support.

In many states, a needs assessment is a requirement to be eligible for state revolving fund loans. In New York, a needs assessment is "not a *mandatory* requirement," according to Jim Stearns, the head of the community assistance unit in the Environmental Facilities Corporation. "We always suggest that people do things like that, but it's not a requirement."

Nonetheless, a lot-by-lot, GIS-based needs assessment using planning-level data can help a community

- save money by helping to avoid unnecessary centralized hookups,
- understand where to concentrate wastewater management resources, and
- see wastewater implications of growth proposals.

A needs assessment like this can be customized to the needs of the community. Bill Heigis, Stone's project manager for the Holliston study, said, "The town's Wastewater Advisory Committee really wanted facts that would hold up scientifically—a detailed, factual understanding of the situation on the ground." Accordingly, much effort was put into making preliminary results available to citizens, including on a web page, and revising the data where their comments showed it was warranted. Another community wanted to complement the factual understanding with the citizens' values about which water resources were most important to protect, so that potential solutions would protect the most valuable resources. Other, smaller communities are looking for a quick overview of their situation, using less detailed analysis. Whatever the community wants to know about its wastewater needs, a GIS-based needs assessment can be tailored to give them an answer at an appropriate level of detail.

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