County Health Department Improves Sewage Treatment System Management Using GIS

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Abstract:
Sewage treatment systems are utilized extensively in rural areas of Muskingum County, Ohio to manage wastewater from households that do not have the option of connecting to a municipal system. Muskingum County has over 10,500 existing systems and over 300 new systems are installed each year. To better manage alterations to existing systems and construction of new ones, a GIS was implemented.

Utilizing an existing Mircosoft Access data set of sewage treatment system information, and spatial data generated by the Muskingum County GIS department, all sewage treatment system locations were geocoded using ArcGIS 9.0. Now, utilizing parcel information, soil composition, and land contours, sanitarians are able to perform preliminary sewage treatment system reviews in minutes and eliminate the need to review printed parcel maps located in another building, and usually at least one site visit. The resulting map was made accessible to all sanitarians on the computer network using ArcPublisher.

Background:
As the population in southeast Ohio continues a steady movement from cities to rural areas, the extension of public sewers has not kept pace. In many cases extending public sewer to remote or sparsely populated areas is not economically feasible. As a result, the individual sewage treatment system has taken a prominent place in the overall practice of sewage treatment, and is utilized extensively throughout Muskingum County, Ohio.

The first step in the design of a home sewage treatment system is to determine the suitability of soils. Most home treatment systems depend on soils to both treat and absorb wastewater. Factors such as soil permeability, depth to seasonal ground water, bedrock or other limiting layers, surface topography, and the flow of runoff water all must be evaluated in determining the suitability for an on lot sewage treatment system.

The most common, and economical, type of system consists of a septic tank followed by a series of leaching lines. The tank serves as primary treatment. It allows for the settling and storing of most of the solids and starts the anaerobic breakdown of the wastewater. The leaching lines disperse the wastewater over a large area allowing further treatment and absorption by the soil. Other types of systems have been developed to overcome limitations of the soil, or to operate on smaller home sites. These systems include aeration, filtering water through sand, peat or other material, and chemical disinfection.

Muskingum County, Ohio has over 10,000 existing systems of record and over 300 new systems are installed each year. To better manage alterations to existing systems and new installations, a GIS was implemented which enables ZMCHD sanitarians to quickly assess a property's suitability for a sewage treatment system.

Methods:
Since the health department does not generate and maintain base geographic files of the county, the Zanesville/Muskingum County Health Department (ZMCHD) has worked closely with the Muskingum County GIS department to obtain current geographic files to be used in GIS projects. An accurate centerline file with address ranges provides the most use since most health department data sets contain an address. In the past, ZMCHD relied on TIGER road files for most GIS projects. Recently, Muskingum County was one of the first counties in Ohio to take advantage of the Location Based Response System (LBRS) initiative. LBRS is a state effort to share the county's cost (determined by the road miles and addressable structures in the county) of obtaining accurate, field verified, road centerline data with address ranges. Additionally, every residence's road access (i.e. driveway) was also collected so the data includes a field verified address point for every residence in the county. Now the health department is able to accurately geocode its data using these point and centerline files. Other local geographic data such as land parcels, contours, spot elevations, orthophotography, flood planes, and soil composition were used to implement the sewage treatment system GIS.

Utilizing a Mircosoft Access data set of sewage treatment system information, existing system locations were geocoded using ArcGIS 9.0. Geocoding services (address locaters) were created for both the centerline and address point files obtained from the LBRS project. The first attempt at geocoding was made to the address point file in order to place a point as close as possible to the system's actual location. Those unable to be matched to the point file were then geocoded to the centerline file to approximate the system location. Unmatched records were reviewed to determine why geocoding was unsuccessful.

Included in the sewage treatment database is a scanned sketch of the system layout, as documented by the licensing sanitarian. ArcView's hyperlink feature was utilized to link (Figure 1) to the file location of the sketch. NOTE: The scanned image was included in the Access data set as an embedded OLE object. Extracting the path location of the sketch required the use of a Visual Basic program in order for the hyperlink feature to be utilized.

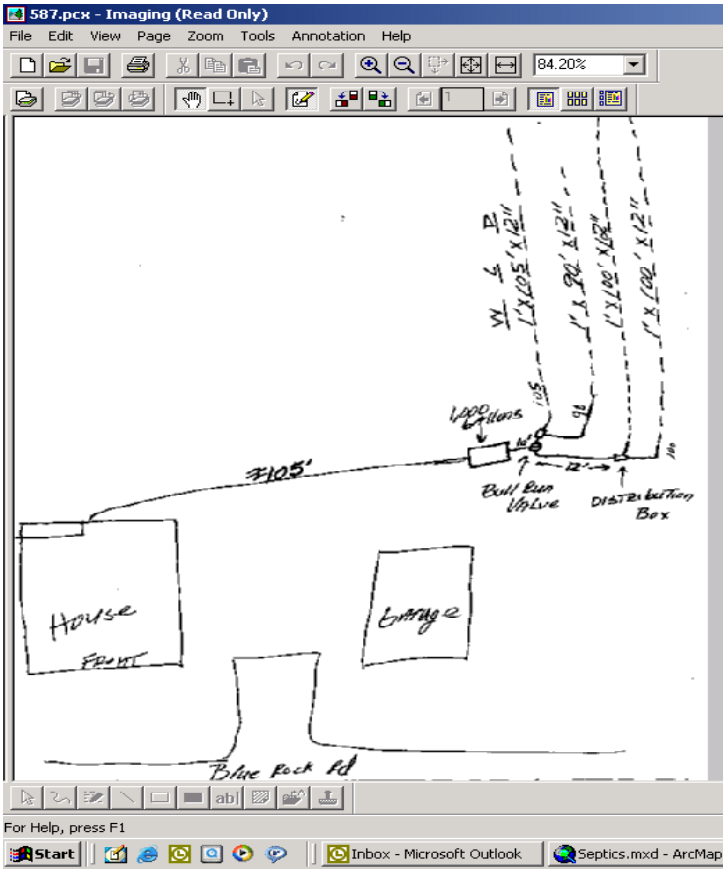


Figure 1: Image of scanned sketch of sewage system accessed from the map using a hyperlink.

Once the geocoding and path locations were complete, a map was created utilizing the necessary geographic files. The files included in the final map were: address points, road centerline, sewage treatment system locations, soil types, land contours, land parcels, flood plains, and orthophotography. The final map was made accessible to all environmental health staff on the computer network using ArcPublisher. Sanitarians search for an address using the ArcView find tool and zoom to its location. Once the location is found, the sanitarian is then able to utilize all of the geographic information to do an initial assessment of the lot for sewage treatment system placement or modification.

Results:
Of the 10,426 existing sewage treatment systems records, 8,386 (80.4%) were successfully geocoded to the address point file. Manual geocode matching was performed to place as many as possible to the address point. This was done to compensate for typographical inconsistencies between the LBRS centerline file and address information in the health department's sewage treatment system database. The remaining 2,040 records were geocoded to the address verified centerline file to approximate the system location. 1,801 (17.3%) systems were successfully geocoded to the centerline file leaving only 239 (2.3%) that were unable to be geocoded. Upon review of the unmatched records, most were older records that lacked an address, or only designated by a lot number or street name.

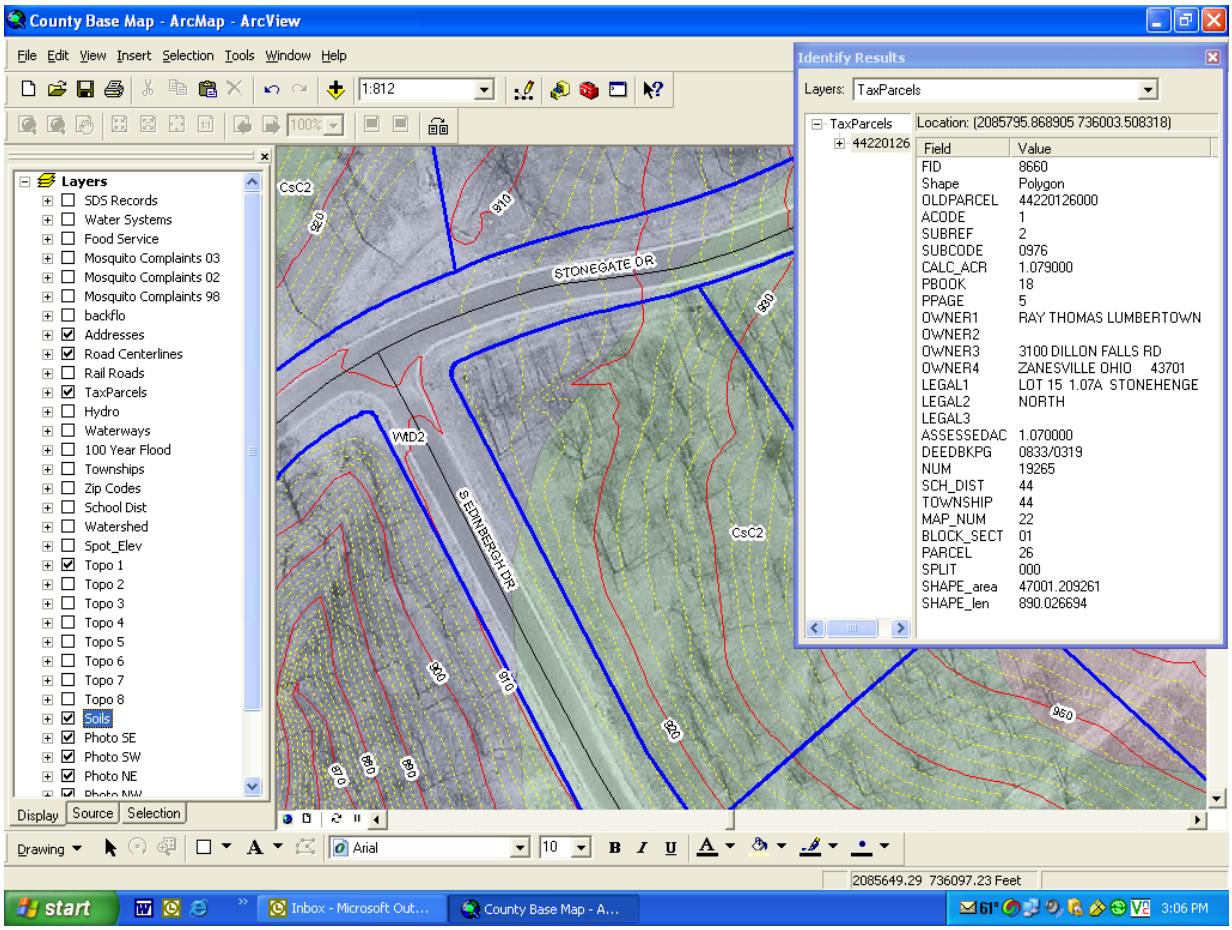
While detailed timesaving data is not available, the sewage treatment system GIS has reduced the number of man-hours needed to manage the program. Using the GIS has eliminated the sanitarian's requirement to review printed parcel maps only available in the auditor's office located in another building. It has reduced time needed to leaf through paper files to review system configuration. Some site visits have been eliminated due to the ability to assess the property using GIS.

Discussion:
The GIS allows sanitarians to perform sewage treatment system reviews of existing systems in minutes. These reviews are necessary if there is a complaint or if a homeowner wishes to modify the system or request a variance. Some homeowners request a variance for special circumstances, which must be approved by the health board. The GIS allows for a detailed visual presentation to be made to the board improving their decision-making ability.

The GIS is especially useful as new sewage treatment systems are installed. Since current land parcel information is available, initial evaluations as to the size of the lot, and location relative to flood plains can be made quickly. With soil composition, orthophotography, land contour, and spot elevation information, initial assessments as to system location can be also be made (Figure 2). By having the GIS as a visual tool, sanitarians can now have detailed phone consultations with property owners and contractors regarding the placement of homes and sewage treatment systems. These preliminary conversations would be difficult without visiting the site first. Additionally, many of the property owners do not reside in the county and are building retirement or weekend homes, so being able to discuss issues with them and not having to arrange a

meeting at the site saves time and improves customer service. Additionally, the GIS will allow the sanitarian to quickly reference systems in close proximity, which can aid in the design of the system.

Figure 2: Parcel information with land contours, roads, and soil types displayed.



Conclusions:

GIS is a valuable tool for sewage treatment system management. It allows sanitarians to quickly utilize geographic information critical to decision making, and eliminates the need to refer to cumbersome printed maps. While it does not eliminate all field visits, it does make field visits more productive since the sanitarian already has a feel for the property (size, contours, soil) prior to visiting the site.

Making the map accessible using ArcPublisher allows for more staff to be exposed to GIS. As staff members become more familiar with GIS, it is anticipated that future GIS projects will be undertaken. Ideas will be generated on what programs might benefit from GIS analysis, and since most public health data contains an address, geographic references are available.

Acknowledgements:
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