Texas On-Site Insights
Information about On-Site Wastewater Treatment Systems in Texas
Volume 5, Number 3, October 1996

USBR Leads Team Efforts to Study Impact of On-Site Wastewater Systems on Caddo Lake, Recommend On-Site Solutions

Caddo Lake is one of Texas' most unique natural resources. The lake covers more than 30,000 acres in Northeast Texas and Northwest Louisiana, and includes many scenic and valuable bald cypress swamps. It was formed by a massive log jam in the late 1700s and scientists believe it may be the largest "natural" lake in the Southern United States. The lake provides habitat for 216 bird species, 47 species of mammals, 90 reptile and amphibian species, and many varieties of fish. The lake is one of only 15 sites in the U.S. classified as a "wetland of international importance."

Recently, a team of federal and state agencies and policy makers joined forces to produce a study of water supply and water quality needs surrounding the lake. The work was done by the U.S. Bureau of Reclamation (USBR) under the umbrella of the Caddo Lake Initiative. Participants included staff from U.S. Representative Jim Chapman's office, the U.S. National Biological Survey, the U.S. Army Corps of Engineers, and the Texas Parks and Wildlife Department. Goals of the effort were to identify water quality concerns, including the impact of on-site wastewater treatment and disposal systems, on water quality, and to identify options for wastewater treatment in the area.

The U.S. Bureau of Reclamation and other agencies investigated how on-site wastewater systems may adversely impact Caddo Lake (above).

Part of the study involved assessing whether soils in the region are suitable for conventional on-site wastewater systems. The report concludes that nearly all the soils surrounding the lake are severely limited in their ability to support conventional septic tanks and absorption fields. Many soils are prone to flooding, percolation rates are slow,

surfacing of wastewater is likely, little filtration occurs, and high water tables are prevalent.

The study inventoried the number of on-site wastewater systems in the watershed. For example, 20 permitted conventional systems and 14 aerobic units were documented in the two most heavily populated areas -- Karnack and Uncertain. The report characterizes on-site systems used in rural areas and suburbs including the waterfront restaurant area, Cypress Village, Mossey Acres, and Pine Island Point. In general, the report notes that many homes with on-site wastewater systems in the region are located on undersized lots and along seasonal floodplains. As a result, health officials in the region feel that many sites may be discharging raw or poorly treated wastewater into the lake. In many cases, no on-site wastewater system exists. Often, the design and operational capacities of these systems has not been recorded.

Another excellent perspective on how water quality in the lake is affected by on-site wastewater systems was provided by research conducted by East Texas Baptist University (ETBU) in Marshall. From September to November of 1994, Roy Darville and student Greg Brock of the ETBU Caddo Lake Institute sampled 11 sites in the lake and surrounding waters and measured populations of fecal coliform bacteria. Samples were collected near the water surface and along the shoreline at each site. Results reveal that there are many sites where on-site wastewater treatment systems are used that also exhibit high levels of bacteria. At some sites, fecal bacteria populations in the lake ranged from 75 colony forming units per 100 milliliters (cfu/ 100 ml) to more than 15,500 cfu/ 100 ml . The highest average levels were 2,748/ cfu/ 100 ml.

Many options were recommended to treat wastewater in the region to protect water quality. These included upgrading the Longhorn wastewater treatment plant and converting it into a regional facility, developing a regional wastewater treatment plant at Uncertain and discharging highly treated wastewater into Caddo Lake, conveying wastewater from the region to the Marshall wastewater treatment plant, developing individual wastewater plants in small communities, and converting many existing on-site wastewater units into mound disposal systems.

According to the report, roughly 80 residences in the study area now discharge raw or poorly treated sewage into Cypress Bayou or Caddo Lake. The study recommended that mounds be used to replace failing or non-existent drainfields. Technical specifications for how the mounds could be constructed and operated were described. For example, a system that serves a 3-bedroom home with a designed flow of 450 gallons per day would need a 600-foot mound. If the mounds followed conventional systems, septic tanks would have to be leakproof and watertight, and a pressure dosing system and pump chamber would have to be used to apply effluents to the mound. Advantages of the mound system are that they can overcome problems caused by frequent flooding, high groundwater tables, and shallow, impermeable soils. The report suggests that 80 on-site units could be converted to mound systems for roughly $2.2 million. The cost to construct a mound system for a typical 3-bedroom home would be $27,900 and system operation and maintenance is expected to cost about $1,000 annually.

As a result of this effort, recommendations were made as to how wastewater treatment and water supplies can be improved. No funding sources have yet been identified to make these improvements.

NOTE: A detailed study that summaries this work was published in 1995 by Jeff Lucero of the USBR Great Plains Region office in Billings, MT. The report is titled *Water and Wastewater Engineering Report for the Communities of Karnack, Uncertain, Pine Island Point, Mossey Acres, Cypress Village, and Longpoint in Harrison County, TX*. For details, contact Lucero at (406) 247-7751 or Mike Irlbeck of the USBR Austin Office at (512) 916-5641. Darville's phone number is (903) 935-7963, extension 318.

TWRI Puts Research Council on WWW

A new World Wide Web (WWW) site that will eventually contain detailed information about the Texas On-Site Wastewater Treatment Research Council is now on-line. The WWW site, which can be accessed at http://towtrc.tamu.edu, is being produced by Ric Jensen, Sergio Acosta, and Jonathan Jones of the Texas Water Resources Institute (TWRI) at Texas A&M University. This effort was funded by the council.

"Our goal is to expand the ways in which information is provided about the council, its programs, and on-site wastewater issues in general," Jensen says. "We hope that this WWW site will allow more people to access, search and download information about on-site wastewater that will be valuable for them. As technologies increase, many more people will be able to access and use this resource."

The WWW site is structured to inform the public about many aspects of the council, including the legislation that created the council, how the council operates, and broad types of projects the council can fund. Specific information will be included about such council activities as research projects, conferences, and technology transfer activities the council has sponsored. Information will also be included on many research projects and activities that were not funded by the council. All issues of this newsletter will also be linked to the site.

The WWW site will also contain information about on-site wastewater issues obtained from other sources. Links will be posted to other WWW pages that focus on similar issues. A search tool will be installed on the site to let users find the specific information they seek. This effort will provide a forum for feedback and comments about on-site wastewater issues. Individuals and organizations that wish to have their WWW sites linked to the Council home page or who have specific information requests should send an e-mail message to twri@tamu.edu or call TWRI at (409) 845-8571.

SWT Graduate Student to Conduct Survey of Performance of Low Pressure Dosing Systems in Travis County

A graduate student at Southwest Texas State University (SWTSU) is now developing a survey to gain information about the performance of innovative on-site wastewater systems in Central Texas.

Suraiya "Sue" Murray of SWTSU is a graduate student working on a degree in environmental studies. She is working under the supervision of Jim Kimmel of the Geography and Planning Department. Her graduate work consists of a study she is conducting in coordination with Ervin Coonrod and Ray Kenmotsu of the Travis County Health and Human Services Department.

"We're confident these systems will work," Coonrod said, "although non-engineered LPD systems may have a higher potential failure risk than those that were professionally designed. We also want to find out if localized site conditions like clay soils may be limiting the effectiveness of these technologies."

In the study, Murray is developing a telephone survey that she will conduct among roughly 400 eastern Travis County residents who rely on non-engineered LPD systems to treat wastewater on-site. These systems have been promoted by the County health department as a viable and economic way for rural residents to treat wastewater because they are easy to install and they work in many terrains.

The focus of the survey is to determine how residents feel their systems are performing. "We're trying to find out if the systems are performing as intended, if there are problems, and if so what are the nature of those problems," Murray says. "Specifically, we want to ascertain if they were given information on how to care for their systems, whether system malfunctions may be related to design, and homeowner perspectives about whether problems with surfacing effluent, backups, or odors often occur." Products will include survey results as well as geographic information showing which specific parts of the County may be experiencing performance problems.

For details about the survey, contact Murray at (512) 505-7354 or Murray@Electric.Austin.tx.us.

TEEX WWW Site Contains Information about On-Site Classes

The Texas Engineering Extension Service (TEEX) has created a World Wide Web site that includes information about its on-site wastewater training programs. Information at this site includes descriptions of TEEX courses and schedules and locations of where classes will be offered. For example, there is currently information on the site about the on-site sewerage facilities--installer class and the on-site sewerage facilities--designated representative (inspector) class. Individuals can also use the site to register for classes via electronic mail. The address for the main TEEX site is www.tamu.edu/teex. Specific information about the on-site wastewater courses is available at www.tamu.edu/teex/div/wwtr. You can call (409) 845-7225 or e-mail them at islovan@teexnet.tamu.edu for more details.

Austin On-Site Program Protects Water Quality, Encourages Use of Alternative Systems

Protecting water quality in environmentally sensitive areas, encouraging the use of alternative systems, and keeping pace with rapid growth are some of the challenges facing the on-site wastewater staff of the Travis County Health and Human Services Department.

Sarah Calvert of the Austin Travis County Health Department inspects this innovative system.

Ervin Coonrod manages the on-site wastewater program for the department. There are more than 30,000 on-site wastewater systems in the county and more than 900 applications for new systems were filed with the department in 1995. The on-site wastewater staff includes two supervisors (Coonrod and Ray Kenmotsu), two engineers, and 13 field sanitarians. The department maintains a computerized database of individual records and has implemented a telephone "hot line" customers can dial into to schedule system inspections or to report complaints.

Lake Austin provides drinking water for the city. There are roughly 450 on-site wastewater systems that face the lakefront. The department conducts an annual permitting and inspection walk-over of all systems where staff look for foul odors, excess vegetation growth, and surfacing of effluents. "If we observe there are problems, we can come back later and perform a more thorough examination," Coonrod says.

Every other year or so, the level of Lake Austin is drawn down as much as 15 feet for about 6 weeks during the winter. The purpose is to kill aquatic weeds and allow volunteers an opportunity to remove debris. "We take advantage of the drawdown and, with the Lower Colorado River Authority, go out on Lake Austin in small boats to conduct a detailed field survey. We look for signs of failing systems and evidence of illegal systems," Kenmotsu said. "A wet spot near a drainfield or soil erosion might indicate that a system may be overloaded or that a septic tank is leaking. We're also looking for evidence of illegal systems where pipes may be discharging effluent directly into the lake and where cesspools are used. Personnel in the boats are in constant contact by radio with a ground crew. If they see a potential problem, they can request that the ground crew take a closer look."

In the Austin area, most of the growth is to the Southwest and the West. This area includes the Barton Creek watershed and other sites where maintaining a high level of water quality is a top priority. Coonrod says 80 to 90% of the systems being installed here are professionally engineered and designed. Most of the growth in the area is in the form of expensive homes. The department requires that systems in these areas must be designed by professional engineers.

The types of systems that are required at a site depend to a large extent on when a subdivision was developed and the regulations that were in place at that time. A few years ago, Austin enacted the Save Our Springs ordinance and other rules for newly platted subdivisions. These regulations specify the lot sizes that are required. County rules stipulate that lots be at least a half-acre per living dwelling. City ordinances require that individual lots be at least 1-acre and that the average lot size in a platted subdivision over the recharge zone must be at least 2-acres. There are stricter requirements for people with drinking water wells and for apartment complexes. Previously, some regulations were prescriptive and mandated the types of systems that had to be used in given situations. Evapotranspiration (ET) beds were specified for use near Williamson Creek.

As subdivisions fill in, often the only sites left pose great challenges for effective on-site wastewater treatment. "We're finding that as subdivisions mature the best lots for on-site wastewater systems are often picked over and taken. The lots that are left may have steep slopes, or rocky, shallow, soils that makes wastewater treatment difficult," Coonrod says.

Even though there are challenges that make it difficult to design and install appropriate on-site systems in this region, the use of alternative technologies provide solid answers for many homeowners. Low pressure dosing (LPD) systems are by far the most widely used alternative system in this region. These systems are popular because they are easy to install and require narrow trenches only 6" to 8" deep. They provide a great deal of flexibility because they can be designed to fit non-uniform slopes. Loading rates to specific parts of the drainfield can be customized by adjusting the size and number of orifices. The department has published a report on the proper design and installation of LPD systems.

Other systems that are being installed in the region include subsurface drip irrigation, aerobic units, sand filters, ET beds, and leaching chambers. An innovative pretreatment system being used in the area is an anaerobic spin filter that looks like a stack of poker chips. This system is backflushed by spinning solids back into the tanks. The county also requires that low flow fixtures be used in new construction and provides a 20% discount in the size of the drainfield when these devices are used. When leaching chambers are used, the size of the drainfield can also be reduced by as much as 20 to 40%.

NOTE: For details, contact Coonrod at (512) 469-2021.

Research Council, UT, City of Austin Work to Put On-Site Wastewater Database On-Line

By Susan M. Parten, Community Environmental Services, Inc., Austin, TX

A searchable database about on-site and small community wastewater issues is now on-line that can be accessed by computer users with modems and commercially available software. The project is the result of work between the University of Texas at Austin (UT) Department of Civil Engineering, Susan M. Parten of Community Environmental Services, Inc. (CES), of Austin, and the City of Austin Water and Wastewater Utility.

The database was developed by Parten, with assistance from Cheryl Malone of the UT General Library System, and Cindy Kehoe, a former graduate student at the University of Texas at Austin. The development and initial updates of the database at the University of Texas were funded by the Texas On-Site Wastewater Treatment Research Council. The University's most recent update of the database was funded by the City of Austin's Water and Wastewater Utility in l995, through the Alternative Management Project. The database is housed in the City of Austin's Center for Environmental Research.

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Software Needed to Access
the Database by Modem
     Norton's PC Anywhere (by Symantec)
     The host computer uses Version 5.0 for DOS

Telephone Number:                    (512) 926-7180
Name of host computer:               UT Database
Password needed to access host:      Onsite
```

Library Master is the software used to run the database. The database is set up in a read - only format (similar to an on-line catalog system). Citations and abstracts may not be downloaded or printed, due to copyright restrictions. A total of 30 minutes are allowed per on-line session. The database may be `"browsed" or "searched". Searching may be carried out using one of many fields. After being connected to the host computer, Ctrl Right Shift must be used for exiting. This will bring up the menu for PC Anywhere on the remote computer. Select "End Session." Remote users are not able to exit to DOS, or exit in any other manner.

For best search results, it is recommended that all fields be searched. If no field is selected, and key words or author(s) are typed in after selecting "Search" database, all fields will be searched. A message will appear to this effect. This may result in a more complete search than if the search is conducted for a specific field. Unless it is desirable to search only a portion of the database (such as when a search within a search is being conducted), be sure to select a "Search Full Database." The F1 key may be used for help in obtaining search or browse instructions. Cursor to the item for which help is needed, and hit the F1 key. Note that since the database and software are in a "read-only" form, some of the items displayed through the "help" function will not be applicable.

Main subject categories for the database include waste generation and conveyance, waste treatment and disposal, the economics of on-site and small community systems, regulatory aspects of on-site systems, community and individual systems planning and management, and patents and newspaper articles. Specific information is contained on wastewater characterization, water conservation, pretreatment of septic tank wastes, soil and site evaluation, wetlands, disinfection, and septage treatment and disposal. This information will be periodically updated.

If there are questions or problems, you may call Susan Parten at (512) 443-2733 between the hours of 9 AM and 5 PM on Tuesdays and Thursdays.

TNRCC Examines if On-Site Wastewater Systems May be Polluting South Texas Coast

Are on-site wastewater systems on small lots adversely impacting water quality on the South Texas Coast? That's the question professionals with the Texas Natural Resource Conservation Commission's (TNRCC) Corpus Christi field office tried to answer recently.

The work was led by Dave Reigel, Jim Bowman, and Chris Caudle. The study focused on a small community, Ingleside on the Bay, that is sited on a canal waterfront on the northern side of Corpus Christi Bay. The community doesn't have a centralized wastewater treatment system and each home uses its own on-site wastewater system. Because many of the lots are undersized and the Bay is nearby, there were concerns that fecal coliform bacteria from these systems may contaminate surface waters.

The project consisted of sampling six sites within the canal system and seven other locations in near-shore surface waters. Samples were taken for fecal coliform bacteria, temperature, pH, dissolved oxygen, and salinity. In the spring of 1994, samples were taken from all sites during normal conditions, after trace rainfall, and following heavy rains.

The results show that fecal coliform levels increased significantly to more than 653 colony forming units per 100 milliliters after heavy rains. This is probably attributed to the presence of the on-site wastewater systems. Sites near the canal showed the highest fecal coliform counts. Although fecal coliform levels were within Texas standards for contact recreation at most sites, they exceeded the allowable limit for shellfish harvesting at two locations near the canals.

For details, contact Reigel or Caudle at (512) 980-3100.

Educating the Public is Goal of TNRCC Tyler Office

In the Piney Woods of East Texas, the regional staff of the Texas Natural Resource Conservation Commission have begun efforts to educate the public about many aspects of on-site wastewater.

"We have found that increased communication about issues and opportunities is a great way to prevent many problems, work with those difficulties that exist, and to discover creative solutions," says TNRCC regional manager Leroy Biggers. "After we discovered that increased communication was needed, we organized and began hosting a series of workshops and inviting a wide variety of different groups, including representatives from agencies, industries, volunteer groups, and the general public to participate. These programs have been a resounding success."

This photo shows some of the problems that make proper on-site wastewater treatment difficult in East Texas, including steep soils and many forested areas.

Biggers explained that the regional office tries to sponsor these workshops every 60 days or so. The workshops have been held at Tyler Junior College and other sites and often attract more than 75 participants. One workshop featured hands-on soil identification training and was co-sponsored by the TNRCC, the Texas Department of Transportation, and the U.S. Department of Agriculture's Natural Resource Conservation Service. Another workshop focused on the use and maintenance of innovative technologies such as low pressure dosing, aerobic systems, drip irrigation and waterless toilets. Another seminar focused on the basic functions of the TNRCC on-site wastewater program and how to install proprietary aerobic systems.

"We've taken it upon ourselves to sponsor events to increase program awareness," Biggers says. "If we can catch potential problems before they develop, everybody wins." Biggers explains that the workshop featuring innovative systems provided system installers, inspectors, and the general public with detailed information on how to wire these systems, how to install pumps and alarms, and where to locate critical system components.

A special area of emphasis deals with making organizations and individuals aware of resources that may be available to finance on-site wastewater systems. "That's critical in

this region," Biggers says, "because we have so many people who are on low or fixed incomes and those who are indigent. They often can't afford a basic system. Many individuals have to choose between buying food, paying utility bills, or installing a proper on-site wastewater system. Unfortunately, we see many systems fail in areas where people cannot afford to buy and install a proper system or maintain the system they have."
As a result, the region has worked with many groups to provide information about the assistance that may be available to finance on-site wastewater systems. One workshop featured information on programs offered by various governmental entities and opportunities for volunteer involvement. Speakers described the Economically Distressed Area Program (EDAP) of the Texas Water Development Board, the Texas Small Towns Environment Program (TexSTEP) program that is being promoted and managed by the TNRCC, loans and grants offered by the Farmers Home Management Administration, and block grants that may be available from region councils of government. Other speakers described efforts of the Texas Comptroller's Office and how to write grants to fund such projects. Afterwards, the TNRCC Tyler office published a handout that summarizes many of these funding options. Copies of the handout are still available by contacting the TNRCC Tyler office.

Have the workshops made a difference? "Certainly we increased public awareness and got people talking about how we can work together to help people locate funding sources," Biggers says. He also noted that since the workshops began, TexSTEP is now helping to replace a sewer line in the East Texas town of Clarksville. Others in the region are discussing the opportunity to use TexSTEP to help remedy on-site wastewater challenges in the region. Another approach that is being explored is to create a supplemental environment program fund that could be used to help finance on-site wastewater improvements. This program could be funded through fines levied against those who violate environmental regulations and by contributions from businesses, civic groups, and individuals.

The TNRCC five person on-site wastewater technical support staff serves a region that covers 23 counties. The TNRCC administers the on-site program in nine counties and cooperates with authorized agents in 14 counties and five cities as well as five lake and river authorities. In 1995, TNRCC inspected 780 new systems and responded to 350 complaints. Another major task has been to computerize the agency's record keeping process. So far, information on roughly 4,000 permits issued since 1989 have been computerized.

A major issue facing the region centers around the use and maintenance of aerobic systems. "Most of these systems require active involvement by homeowners to supply chlorine to disinfect the wastewater," Biggers says, "but our spot checks show that many times this is not being done." Biggers cited a recent field survey by TNRCC staff in which they found that 12 of 13 aerobic systems were not properly chlorinated and raw sewage was being discharged. Another issue involving aerobic systems is making sure homeowners enter into agreements with vendors and service companies to maintain these systems. "We require homeowners to sign a two-year maintenance and operations

agreement for any aerobic system that's installed in the region and we ask that a continuous maintenance agreement be in effect," Biggers says. "A complaint we often receive is that homeowners feel they are forced into entering into maintenance contracts with the vendor who installed the system because many components are proprietary and must be obtained from that company."

Because East Texas contains so many scenic parks, forests, and lakes, the TNRCC staff also design and maintain on-site systems used in these areas. "We work with the various agencies and businesses that have these types of facilities and try to come up with solutions that work best for them," Biggers says. "A solution that's promising is to encourage the use of waterless toilets. The waste is reused and recycled on-site for irrigation. We work with parks departments to decide which systems are best for a particular site."

For details, call the TNRCC Tyler office at (903) 535-5100.

Meetings and Conferences

The **5th Annual National On-Site Wastewater Recycling Association Conference and Exhibit** will be Nov. 9-12 in Milwaukee, WI. For details, call 847-559-9235.

Evapotranspiration and Irrigation Scheduling for Agricultural Landscape and Turf will be offered in San Antonio Nov. 3-6. For details, call the American Society for Agricultural Engineering at (616) 429-0300.

Many on-site wastewater courses are offered by the **Texas Engineering Extension Service (TEEX)**, including **Operation and Maintenance of Surface Irrigation Systems with Aerobic Treatment and the Installer -- Basic Training Course.** For a full list of dates and locations, contact TEEX at (409)845-6246 or visit their WWW site on the Internet at http://www.tamu.edu/teex.

A symposium titled **Site Characterization and Design of On-Site Septic Systems** will be offered by the **American Society for Testing and Materials (ASTM)** in New Orleans, LA, January 16-17, 1997. The symposium focuses on the technology and practice of characterizing and designing on-site systems. For details, call ASTM at (610) 832-9585 or visit their WWW site at http://www.astm.org/.

LCRA Encourages Use of Alternative, Innovative On-Site Systems Near Highland Lakes

Many innovative programs to encourage the use of alternative and innovative on-site wastewater systems throughout Central Texas have been implemented by the Lower Colorado River Authority (LCRA). These efforts include technical brochures that describe how drip irrigation can be incorporated into on-site wastewater systems, and establishing a demonstration project near Matagorda Bay where constructed wetlands will be used for on-site wastewater treatment.

Chuck Van Cleave of LCRA stands between these two wetlands cells planted with horsetails (left) and canna lilies.

"A central theme of LCRA's on-site wastewater program," says Burt Carter, environmental coordinator for the agency, "is that we want to let homeowners know of the best ways to treat their wastewater and protect water quality. We want to encourage the use of systems that make sense for the total environment and incorporate efficient water use and conservation, while at the same time providing excellent wastewater treatment and reuse, whenever possible."

Chuck Van Cleave is an LCRA inspector who works with systems near Lake Travis. He says that there are many examples of alternative and innovative systems that work well in unique situations where traditional septic tanks and drainfields would likely fail.

There are now three constructed wetlands in the LCRA service area near Lake Travis. One system, which was designed by Robert Morris of Cedar Park, utilizes a septic tank and pump tank near the side of a house. Treated effluents are pumped into a cell of canna lilies and then flow to a wetland cell planted with horsetails. Each is these two wetlands cells measures 70' long, 4' wide and 2' deep. The cells are lined with 30 mil plastic to prevent leakage. Water is maintained at a constant level within each cell. After leaving the second cell, the effluent enters a pump tank. Effluents are disposed of in a low-pressure dosing field. The system is very attractive to look at, has not suffered from odor and insect problems, and provides excellent treatment. "The only drawback so far," Van Cleave says, "is that the railroad ties used to support the slightly elevated wetlands cells are deteriorating. Because of our experiences here, we now recommend that brickwork or concrete be used to support elevated cells. Otherwise, it's worked great." LCRA has monitored this system and measured the amount of water flowing into the first field and the amount that flows into the low-pressure dosing (LPD) area.

Even steep sites like this one near Lake Travis can still be fitted with proper on-site wastewater treatment.

This photo shows an evapotranspiration bed, which for many years was a recommended strategy for on-site wastewater treatment. These beds are not used often anymore, though, because of high costs and performance problems.

Another innovative system in the Austin area involves the use of drip irrigation to provide treatment on slopes as steep as 40%. At one home near the lake, the terrain drops so much that it's difficult to stand up straight without falling down. This system consists of primary treatment with a standard septic tank followed by a recirculating sand filter. Effluents are stored in a wet well that is designed to store the typical amount of effluent that will be generated each day. The disposal area consists of 0.5" drip lines that are buried 6" deep and laid on 2' centers. Wastewater is disposed of on two fields using drip irrigation. Effluents are pumped from the wet well into the drip field at low pressure (15 pounds per square inch). The drip irrigation system is designed to automatically alternate the fields that will receive the effluents so no one field is overloaded. Siphon-shaped breakers make sure the field is drained properly when the system is shut off. "Normally, it would be nearly impossible to achieve suitable on-site wastewater treatment for this site with a conventional system," Van Cleave says. "If you tried surface irrigation, the effluents would simply run down and off these slopes and flow rapidly downstream."

This photo shows on-site systems that were installed on small lots near the Texas coast.

In Buffalo Gap and other subdivisions near Lake Travis, the portion of household lots reserved for lawns and landscapes can be minuscule. Finding enough acreage to treat and dispose of wastewater is an extremely arduous task for the on-site system designer and homeowner. At one home, a unique system was designed by Morris and installed to compensate for a small waterfront lot with steep, rocky terrain. The backyard is small and, because it's ringed with trees, is difficult to get into. As a result, the concrete needed to construct the water-tight beds had to be hand-carried in buckets. Wastewater effluent flows from a septic tank to a series of three long and narrow evapotranspiration (ET) beds that are planted with turfgrasses and semi-aquatic plants. Each cell has a slight slope so effluents flow from one bed to another. Eventually, the effluents flow into a 5,000 gallon

holding tank. When the holding tank is relatively full, the effluents are pumped and recirculated back to the first of the beds. "If the grass is kept short and this site gets enough sun we think ET can be maximized and this site can treat wastewater extremely well," Van Cleave says.

Other LCRA efforts include providing information on such diverse topics as "green building" to incorporate environmentally sustainable on-site wastewater systems into home design, and fact sheets describing how utility customers can use cisterns to capture rainwater and reduce overall water use.

For details, contact Carter at (800) 776-5272 or (512) 473-3200.