Texas On-Site Insights
Information about On-Site Wastewater Treatment Systems in Texas
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From the Editor

In our last issue, we published a story titled "Use of Alternative Aerobic On-Site Systems Near Lake Livingston," that was written by Bobby Carlile and Mark Waters on page 4. Along with the article we included a photo of an innovative aerobic system that was installed near the Lake. The system shown in the photo was meant only to be an example of an innovative, effective technology that is being used near Lake Livingston. It was designed and installed by Terry Hoage of Sam Houston State University and Paulene Johnson of Septic HydroTech. We did not mean to imply that Hoage and Johnson are working with Carlile. They are not. Carlile and Johnson are selling and marketing different systems. Hoage is researching the effectiveness of aerobic treatment units. Finally, the system includes a sand filter and other components.

We regret any misunderstanding the placement of the photo may have caused.

Also, the mailing list for *On-Site Insights* has grown to 3728 readers. However, we are discovering that many of the issues that we print and mail are returned to us because we don't have the proper address. *On-Site Insights* reminds its readers to notify us when a change of address occurs. This will allow us to reduce our costs and to print and mail the newsletter more economically.

The primary audience for the newsletter is agency staff and professionals who are currently working in the field of on-site wastewater. If you are no longer working in the field of on-site wastewater or if you no longer have an interest in receiving the newsletter, please let us know.

As usual, we welcome any comments that you might have about the newsletter or its contents.

Thanks,
Ric Jensen
Editor, *On-Site Insights*

TNRCC Will Hold Hearing on Draft Rules Feb. 28 in Austin

This is a special issue of *On-Site Insights.* Most importantly, the issue features a summary of new draft regulations for on-site wastewater systems that have been proposed by the Texas Natural Resource Conservation Commission (TNRCC).

The proposed new regulations will, if adopted, have a significant impact on the on-site wastewater industry in Texas as well as on the consumers that rely on these systems. The draft rules address such topics as the training and licensing of installers, inspectors, site evaluators, and designated representatives who work with these systems. The draft rules also address the specific criteria in which different types of systems may be installed. Finally, a new schedule of fees has been proposed.

The regulations were published in the January 25 issue of the *Texas Register* (pages 404-426). A copy of the draft regulations can be obtained by calling the TNRCC on-site wastewater staff at (512) 463-8260.

A public hearing concerning the new regulations has been scheduled for February 28 at 9 AM in Room 201 S, TNRCC Building E, 12100 Park 35 Circle in Austin. The TRNCC building is roughly 8 miles north of Austin on I-35. The Parmer Road exit is the nearest to the building. The TNRCC staff can provide directions on how to get to the meeting. All interested parties are urged to attend and provide comments at this meeting.

TNRCC Proposes Sweeping Rule Changes for On-Site Wastewater Systems

By Sherman Hart,
On-Site Wastewater Team
Texas Natural Resource Conservation Commission
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New regulations have been drafted by the Texas Natural Resource Conservation Commission (TNRCC) concerning the regulation of on-site wastewater treatment and disposal systems.

Many of the changes involve a new method to classify systems as standard, non-standard or proprietary (see Table on page 8). Different levels of training will be required for the various types of systems. For example, only class II installers will be able to work with many non-standard or proprietary systems.

The following information summarizes some of the key points of the proposed rules.

- New requirements are proposed concerning the training and certification of installers, inspectors and site evaluators (see related story on page 7). Installers, inspectors and site evaluators will be required to attend classes and pass a test within a year after the rules are passed. A new category, Installer II, is being created, with accompanying training and testing requirements. Only those who are certified as an installer II will be allowed to install non-standard systems. Eight hours of continuing education are required annually for installers, site evaluators and designated representatives.
- The rules require professional designs on most systems, except single-family residences utilizing a conventional rock, leaching chamber, or gravel-less pipe.

- The TNRCC will review all non-standard designs, unless authorized agents request and are approved to perform the reviews.
- All variances must be approved by the TNRCC. Authorized agents may request and be approved to grant variances.
- All subdivisions plans must be reviewed by the TNRCC. Authorized agents may request and be approved to conduct the reviews. Only professional engineers (not registered sanitarians) can request that exceptions to minimum lot sizes be granted for new subdivision plan reviews. All subdivision site evaluation criteria must be published in county maps, deeds, and records.
- State-issued permits for standard designs will cost $200. Non-standard systems must be designed by a professional engineer or a registered sanitarian design and will cost $400.
- Reinspection fees for failed inspections will be $100 for standard systems and $200 for non-standard systems.
- The TNRCC can seek criminal, civil and/or administrative penalties against anyone who violates any provision of the rules.
- All septic tank designs must be approved by the TNRCC. Tank manufacturers must keep records of who buys the tanks and where they are installed. It is no longer required that inlet and outlet "Ts" are pre-cast into septic tanks.
- Proprietary treatment processes must be approved by the National Sanitation Foundation, if such approval is available. Persons using proprietary treatment processes and non-standard systems with mechanical components will be required to enter into on-going maintenance contracts.
- Setback distances from private wells to drainfields will be reduced from current levels of 150 feet to 100 feet, unless the wells are pressure-cemented. In those cases, the distance can be reduced to 25 feet. Setback distances to property lines will also be reduced.
- Soil analyses (not percolation tests) will be required to site and size systems.
- Homeowners can only install standard systems.
- The use of low pressure dosing is prohibited in shrink-swell clay soils.
- Sand filters are established as the standard method of treatment prior to surface irrigation.
- The use of conventional on-site systems is restricted in floodways.
- Areas served by commercial spray irrigation systems must be enclosed by a fence to isolate the area from public contact.
- Gravel-less pipe can only be used in sandy soils, unless substituted in bed systems.
- Pump tanks require check values. Pump tanks must be sized to accommodate average daily flows, if they are less than 750 gallons. If flows are greater than 750 gallons, the tank must be sized for half the average daily flow. Maximum and minimum pump runs are specified.
- Sizing criteria are established for grease traps.
- High water alarms are required for holding tanks and must be sized for one week's total flow.
- Standard trenches will be sized based on trench bottom and side-wall areas.

- "Realistic" greywater systems may be allowed. Requirements for these systems are contained in the rules. Modification to an existing plumbing system for greywater separation must be carried out in accordance with the uniform plumbing code of the State Board of Plumbing Examiners.

NOTE: Hart can be reached at the TNRCC at (512) 463-7972.

On-site Sewage System (OSSF) Designations

System Description	**Professional System Type**	**IDR Requirementsl**
Septic Tank & Absorptive Drainfield	Standard	No Class I or II
Septic Tank & ET Drainfield (Unlined)	Standard	No Class I or II
(Lined)	Standard	No Class II
Septic Tank & Pumped Drainfield	Standard	No Class I or II
Septic Tank & Leaching Chamber	Proprietary	No Class I or II
Septic Tank & Gravelless Pipe	Proprietary	No Class I or II
Septic Tank, Filter & Drip Emitter	Proprietary	Yes Class II
Septic Tank & Low Pressure Dosing	Non-standard	Yes Class II
Septic Tank & Absorptive Mounds	Non-standard	Yes Class II
Septic Tank, Filter & Surface Irrigation	Standard	Yes Class II
Aerobic Treatment & Absorptive Drainfields	Proprietary	Yes Class II
Aerobic Treatment & ET Drainfield	Proprietary	Yes Class II
Aerobic Treatment & Leaching Chamber	Proprietary	Yes Class II
Aerobic Treatment & Gravelless Pipe	Proprietary	Yes Class II
Aerobic Treatment Filter & Drip Emitter	Proprietary	Yes Class II
Aerobic Treatment & Low Pressure Dosing	Proprietary	Yes Class II
Aerobic Treatment & Absorptive Mounds	Proprietary	Yes Class II
Aerobic Treatment & Surface Irrigation	Proprietary	Yes Class II
Any Other Treatment System	Non-standard	* Class II
Any Other Subsurface Disposal System	Non-standard	Yes Class II

Any Other Surface Disposal System	Non-standard *	Class II

"IDR" stands for "Installer Design Required?".
* designates Engineer Only.

Developing a Computerized Bibliographic Database for On-Site and Small Community Wastewater Treatment Systems

By Susan Parten, Civil Engineering Department, University of Texas at Austin

Those who work in the field of on-site wastewater know there are a lot of problems in searching the technical literature. For example, articles about on-site wastewater are often found scattered in journals about many different technical fields. Professionals and scholars that regularly search the literature know that this process is time-consuming, difficult, and costly.

As a result, Howard Liljestrand and Susan Parten of the Civil Engineering Department at the University of Texas at Austin were awarded a grant to develop and update a searchable database and bibliography with information about on-site wastewater. Others involved in the project included Cynthia Kehoe (a graduate student in the UT Library Science Department) and Cheryl Malone of the UT General Libraries system. Grants were provided by the Texas On-Site Wastewater Treatment Research Council and the Water Hygiene Division of the Texas Department of Health (Now the Texas Natural Resource Conservation Commission).

Developing the Database

The database was developed by compiling citations and abstracts from more than 35 on-line sources in the fields of general and applied science, engineering, public health, government, and medicine. In addition, roughly 300 universities in North America and regulatory agencies throughout the U.S. were surveyed to determine if they also had suitable information for the database.

A number of steps were taken to develop the database, including:

1. A list of relevant keywords, authors, organizations, and associations were compiled;
2. Available on-line databases and other sources of information were searched to select those that were the likeliest to have the appropriate technical information;
3. The keywords, authors and other terms to be used in the searches were identified and on-line searches were performed;
4. Individual citations and abstracts were reviewed to determine if they were technically relevant; and
5. Raw data files were converted into a form where they could be used in the database;

Additional on-line searches were performed and redundant citations were removed. This step is repeated whenever the bibliography is updated.

The main broad subject categories for the database include:

- Waste generation and conveyance
- Waste treatment and disposal
- Economics of on-site and small community systems
- Regulatory aspects of on-site systems
- Community and individual systems planning and management
- Industrial and animal waste treatment
- Patents and newspaper articles

Specific information is contained on such subjects as wastewater characterization, water conservation, pretreatment of septic tank wastes, soil and site evaluation, wetlands, contaminant removal, disinfection, septage treatment and disposal and many others.

Basic Information About the Database

The database is IBM-compatible and PC-based. It can be run on 386 or 486 series computers with at least 20 megabytes of hard disk space. Pro-Cite software is used to search and update the database. Four different types of files are loaded into the software.

The database now contains roughly 9,200 citations, including references to books, journal articles, conference proceedings, patents and other information. This is the largest set of bibliographic references that have been compiled for issues relating to on-site wastewater and small community wastewater systems. Most of the journal citations contain abstracts.

Using the Database

The database is easily searchable. Searches can be performed using a variety of approaches. Users can select the time frame they wish to search (for example, articles printed between 1980 and 1990). These results can then be searched for keywords like wetlands or evapotranspiration beds.

Search results include information on the name, rank, affiliation, and address of the authors; the title of the article or book; the journal the article appeared in; the date it was published; the number of references that are cited in the article or book; a library call number, and the abstract, if it's available.

The University of Texas is now updating the bibliography semi-annually. A copy of the bibliography was also presented to the on-site wastewater staff TNRCC. The TNRCC hopes to set up a computerized bulletin board that users will be able to dial into, search, and download the results. That system is not yet in operation.

NOTE: Parten is a research associate at the Civil Engineering Department at UT Austin. She also owns and operates a small environmental engineering firm Community Environmental Services in Austin. If you want more information about the database, you can call her at (512) 443-2733.

Proceedings Highlights Texas On-Site Wastewater Issues

Copies of the proceedings of the 1993 Texas On-Site Wastewater Treatment and Research Council are still available.

The proceedings, titled *We're Breaking New Ground*, contains papers that were presented at the Council's annual meeting in Austin in October 1993. It was edited by Terri Chapman and Chris Guzman of the City of Austin Water and Wastewater Utilities.

Topics covered in the proceedings include the use of cluster systems, sand filters, shallow drainfields and constructed wetlands. Other talks in the proceedings focus on the remediation of failed systems, benefits of rainwater harvesting, how conservation can improve system performance, and communicating on-site wastewater issues. Case studies are included that assess how on-site systems performed near Lake Livingston and Galveston Island, and innovative technologies that are being utilized along the Texas-Mexico border.

The proceedings, which is now in its second printing, can be ordered by calling Guzman or Chapman at (512) 322-3656.

Report Describes On-Site Options for Small Towns

A new report that describes on-site systems and other wastewater treatment and disposal alternatives for rural areas is available from the Community Resource Group, Inc.

The report, *Wastewater Disposal Options for Small Communities*, includes information on septic tanks and drainfields, septic tank pumps, community soil absorption systems, pressure dosing, evapotranspiration beds, mounds, and sand filtration. The use of constructed wetlands and facultative and aerated lagoons to treat wastewater is also described. It also describes financing options for small communities, explains the regulatory framework, and provides guidelines for how to select and work with an engineer.

For more information on the report, call (512) 454-1033.

WTIE Computer Bulletin Board Provides On-Site Information

If you have a computer and a modem, you can rapidly access information about on-site wastewater through a bulletin board operated by the Small Flows Clearinghouse at West Virginia University.

The bulletin board system is titled the Wastewater Treatment Information Exchange or WTIE. Computer users with a modem that has a baud rate of 1200 or higher can connect to the BBS by calling 1 (800) 544-1936.

The bulletin board offers such services as electronic mail and conferences, technical bulletins, and databases searches. For example, electronic conferences are now available about such topics as constructed wetlands, wastewater systems for small communities, and infrastructure financing. Bulletins that can read and downloaded currently include information on aerobic units, composting, mound systems, lagoons, and other subjects. Searches of the Small Flows Clearinghouse's bibliographic database can also be conducted. Files can also be uploaded and downloaded from the system.

The system includes on-line help. Additional help and more information can be obtained by calling the Clearinghouse at 1 (800) 624-8301.

New Books Include Septic Systems Handbook, Onsite Wastewater Disposal

Two books that deal with on-site wastewater issues have recently been published by Lewis Publishing.

The Septic Systems Handbook was written by O. Benjamin Kaplan, who worked for many years with the San Bernadino County, CA, Health Department. Chapters of the book deal with why public agencies control the disposal of domestic sewage, basic components of the septic system, economics of drainfield size, proper sizing of leach lines, and factors that affect drain line failure. Other topics include basic soils information, how to conduct a percolation test, possible contamination of groundwater by fecal bacteria and nitrates, and water movement through soils. The book also contains information on innovative on-site technologies, mounds, land use considerations, plumbing codes, and ethics.

Onsite Wastewater Disposal was written by Richard J. Perkins of the New Mexico State Environmental Improvement Division. The book provides an overview of onsite wastewater disposal. Topics that are covered include system design, construction, and maintenance; codes and regulations, selecting a site and system and waste processes. Both conventional systems that utilize septic tanks and drainfields and innovative systems are discussed. Particular attention is paid to water conservation, "low impact" systems, and how to solve common problems such as surface ponding and excess infiltration.

To order either report, call CRC Press at (800) 272-7737.

Extensive Education, Training, Requirements Are Key Parts of New Draft Rules

Some of the TNRCC's proposed rules that will affect the most people involve the education and training requirements for installers, inspectors, and site evaluators. This

article reviews how the draft regulations may affect training and testing requirements and provides an overview of how they may impact professionals in the field.

The draft rules state that all those who work with on-site systems will be required to complete the educational training programs provided by or for the TNRCC. Only those who take the appropriate training courses and pass the required exams will be allowed to install, construct, alter, extend, or repair on-site sewage facilities (OSSF). Within a year after the rules are passed, all class I and II installers, designated representatives, and site evaluators will have to be TNRCC certified.

Examinations shall be administered and supervised by the TNRCC or any designated person or agency. Applicants must score at least 70% to pass the tests. Applicants are also required to attend at least 95% of the class hours to receive credit for the course.

Applicants will be informed of the results within 45 days. Those who fail an exam may repeat the test within 90 days after the date of the previous examination. The exam may be repeated up to three times over a 12-month period. If applicants don't pass the test within that 12-month period, the training as well as the exam will have to be repeated.

The draft rules do not specify where or when the training and examinations will be offered, or which agencies other than the TNRCC will be conducting them. Currently, the Texas Engineering Extension Service holds training sessions for installer I registration.

Installer I Classification

Under the proposed rules, installers do not need to have experience in installing, constructing, repairing, or operating on-site systems. They will have to successfully complete the Installer I training school.

The basic school required for the installer I certification will cover the basic treatment and disposal of wastewater, including an introduction of the role soils play in wastewater treatment. The school will also instruct applicants on rules, regulations, and permitting requirements. Installation and construction of standard or conventional on-site systems utilizing standard subsurface treatment and disposal methods will be taught. Upon completing the course, individuals will be familiar with distribution systems and should be able to make needed calculations, determine slopes, and be familiar with the use of a transit.

An installer I will be qualified to install, construct, repair, and operate standard on-site systems, including conventional trench drainfields and unlined evapotranspiration (ET) beds. Installers will also be able to work with proprietary systems that utilize gravel-less pipe drainfields, and leaching chambers.

Installer II Classification

To be certified as an Installer II, individuals must possess an Installer I certificate; have at least two years of experience in OSSF installation, alteration, extension, repair and operation; have completed the Installer II training school, and passed the Installer II examination.

The advanced Installer II school shall cover the subsurface treatment and disposal of wastewater, effluent characteristics, basic soil analyses, site evaluation and potential impacts on groundwater. The operation, installation, construction, and maintenance of alternative and innovative on-site systems using non-standard treatment and disposal methods will be taught. Upon completing the course, individuals will be know distribution mechanisms and will be able to make needed calculations and measure flow rates.

An Installer II is qualified to install, construct, alter, extend, or repair all types of on-site systems, including standard, proprietary and non-standard systems. A table that shows how the TNRCC has proposed classifying standard, non-standard, and proprietary systems is shown on page 8. Only an Installer II is qualified to maintain proprietary and non-standard systems.

Within roughly a year after the rules are implemented, no current registered installer will be allowed to operate as an Installer II without meeting all these requirements.

Designated Representatives and Site Evaluators

All applicants for designated representative or site evaluator certification will be required to take the site evaluator training and pass an examination covering the field of OSSF installation, construction, repair, operation, disposal, design, maintenance, soils analyses, site evaluation, and program administration.

The school required for the designated representatives or site evaluators will cover the subsurface treatment and disposal of wastewater; concepts and theory of system design; and operations, installation, construction, and maintenance of all types of on-site systems. The course will also include such topics as soil analyses and site evaluation, groundwater, regulatory operations, health laws, and the judicial system. After completing the course, individuals should be familiar with wastewater characteristics and distribution mechanisms. They will also be able to calculate and measure flow rates and to operate surveying equipment, and will be familiar with proper inspection and record-keeping procedures needed to administer an OSSF program. Designated representatives must be appointed, employed, or compensated by an authorized agent with the responsibility to regulate on-site systems; must have successfully completed the site evaluator training school; and passed the site evaluator examination. Designated representatives are qualified to administrate an OSSF program for an authorized agent.

Site evaluators must successfully complete the site evaluator training school, and pass the test for that school. Site evaluators are qualified to conduct pre-construction site

evaluations, which includes performing soil analyses, a site survey, and other tasks to determine the suitability of a site for a specific on-site system.

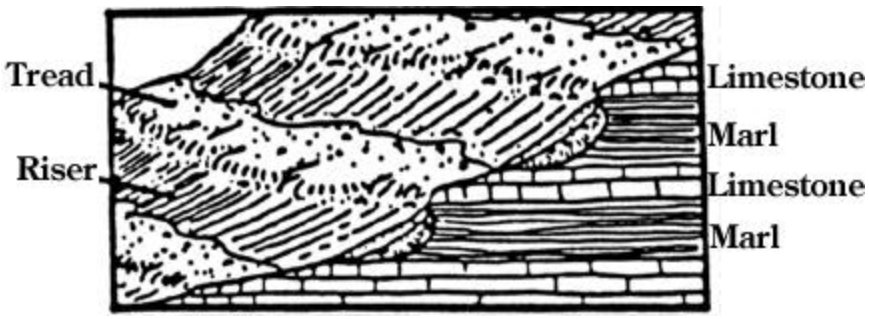
NOTE: You can call the TNRCC at (512) 463-8260 for more details.

Soils And Landforms Of The Central Texas Hill Country: Implications For Wastewater Application

By Larry P. Wilding, Soil & Crop Sciences Department, Texas A&M University, College Station, Texas 77843; and C. M. Woodruff, Jr., Consulting Geologist, 711 West 14th Street, Austin, Texas 78701

Much of the Central Texas Hill Country is comprised of dissected landscapes that were formed on Glen Rose limestone formations west of the Balcones Escarpment. A key attribute of the Hill Country is its "stair-step" topography, in which hard limestone and dolomite strata commonly crop out as flat treads and ledges. Marly beds form risers, which slope below the ledges. The risers function as local water retention and storage devices, although subsurface flows are impeded by stacked sequences of strata with varying permeability. This often forms a series of locally perched aquifers and aquitards.

Traditionally, this terrain has been used for rangeland. Recently, land-use patterns have changed. The Hill Country is now highly prized for homesites and development pressures are pronounced in urban-fringe areas near Austin and San Antonio. An environmental concern is the adequacy of on-site wastewater systems to treat wastes in this setting without causing ground or surface water pollution. Many people believe that soils are too thin and slopes are too steep across most of the Hill Country to allow adequate infiltration and remediation in on-site wastewater systems.



Much of the Hill Country contains "star step" slopes like this one (above). Limestone formations form flat treads, while marls shape sloping risers.

Since August, 1991, we have conducted soil, landform, vegetation and hydrology studies in two small watersheds that drain part of the Glen Rose limestone terrain west of Austin. The study area is part of a 3,346 acre-tract that has been proposed for mixed-use development and includes watersheds that drain into Barton Creek, which is recognized for its environmental sensitivity. The study area and the development are upstream of the recharge zone of the Barton Springs segment of the Edwards aquifer. Our research has focused on the how the hydrology, landforms and soil, chemical, physical and biological properties affect the quality and quantity of waters within the study areas.

Methods

We subdivided the study area into four watersheds for soil investigations. A total of 24 trenches were excavated perpendicular to treads and risers. Cross-sectional soil profiles were exposed and were described at 115 locations within the trenches. Topographic elevations were surveyed, allowing horizon thickness of soil sections to be reconstructed and visualized from step to riser. Horizons from 35 soil profiles were sampled and analyzed for key physical, chemical and biological attributes. Infiltration rates were determined with a small mobile rainfall simulator. Tensiometers and piezometers were placed in key soil and geologic zones to monitor the depth, duration and periodic variation of subsurface water movement. Microbial populations and respiration rates were measured on surface and subsurface soil materials to evaluate the presence and activity of microorganisms.

Results And Discussion

Most previous studies regarded these Hill Country soils as thin and stony with horizons that were typically only a few inches thick. The traditional view of Hill Country soils held that they possess only minor infiltration capacity, and that runoff is the dominant hydrologic process across most of the region. This suggests that these soils have only a minimal function as a medium for cycling water and associated organic and inorganic constituents.

We believe that the traditional concept of the loamy Brackett soils as published in the Travis County Soil Survey is incorrect. Early concepts were based primarily on field investigations conducted in the 1960's using the spade and auger as sampling tools. As in most county soil surveys, the depth and spatial frequency of sampling was determined by the objectives of the survey, intended land uses, and the scale of the base map. The county survey was never intended for site-specific applications, such as determining the feasibility of wastewater application. As a result, these maps do not show the details of spatial diversity or the true thicknesses of soil bodies, especially as they relate to the tread and riser formations. Results of the original county survey showed it was difficult to accurately define rock content, and the character of subsoils necessary to properly classify these soils.

Our observations, based on digging trenches and cross-sections with a backhoe, show that soils previously mapped as shallow loamy Brackett soils have a greater depth, spatial diversity, subsoil development, and biological activity than was previously recognized. As a result, we believe that Brackett soils comprise less of the soft limestone formations than was previously estimated.

Soil and Moisture Relationships

Our studies over the past 18 months show that the following soil-moisture relationships are occurring in the marly treads and risers of the study area: 1) Infiltration, storage and recharge of soils and bedrock strata in the Glen Rose Limestone is highly variable; 2)

Hydrology is highly responsive to rainfall events, indicating rapid infiltration is occurring along roots and cracks in stony soil materials; 3) The treads and risers function as independent hydrological units; 4) Local perched groundwater tables are divided into compartments among the hard and soft limestone layers with limited interconnection; and 5) Seasonal saturation of marly limestone zones occurs in winter and early spring, but moderate to severe water depletion occurs during summer months. These marly zones usually have adequate moisture for plant growth even in the summer.

Implications for On-Site Wastewater Treatment

The importance of this information for on-site wastewater application is that loading rates may need to be decreased during wet winter and early spring periods. For septic systems, this would mean more land area for drainfields would be needed for wet periods, when loading rates would need to be reduced. It may also mean that dosing should be employed to alternate filter lines, so that biological clogging of the soil would be reduced during these wet periods. Design strategy and practices must be followed that avoid surface seepage of effluents. Where surface irrigation of wastewater is an acceptable alternative, holding reservoirs would need to have sufficient capacity to contain the amount of wastewater that could not be used for irrigation in wet months.

On-site wastewaters also contain high levels of nutrients, organic matter and microbes, and would likely enhance plant growth and microbial activity. This could result in more effective biochemical remediation of the wastewaters during periods of soil oxidation, and could reduce nitrate levels by denitrification during the winter and early spring when wet conditions persist. Applications of on-site wastewaters that contain nitrates and phosphates would benefit plant growth and decrease summer periods of drought stress. The net result would be more rapid and sustained plant growth, greater water extraction and an expanded rooting volume that could improve the bioremediation of wastewater inputs. In these soils, there is a synergistic relationship between nutrient sufficiency, biological activity, plant growth, nutrient cycling and effective biochemical remediation of on-site wastewater.

Summary

Multiple natural buffers operate across the Central Texas Hill Country to lessen the adverse impacts of surface and groundwater pollutants. These buffers include riser and tread landforms and locally thick hydrologically active soils. Although unwise land-use practices may still cause pollution, prudent planning and design can use the natural attributes of the land to make on-site wastewater systems an environmentally acceptable option in this area.

The steep risers have the greatest potential for application of on-site wastewaters. They have the highest physical and chemical sorptive capacity, highest loading rate potential, and are the preferred locations for septic drainfields. The treads could be utilized for surface irrigation. The treads and risers may function as ideal, natural, filter strips, because they absorb effluents, control soil erosion and remediate wastewater applications.

NOTE: This research was supported by F.M. Properties. A full version of this paper was contained in the proceedings of the Texas On- Site Wastewater Treatment and Research Council. The proceedings are available by calling Chris Guzman or Terri Chapman of the City of Austin at (512) 322-3656.