Texas On-Site Insights
Information about On-Site Wastewater Treatment Systems in Texas
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TNRCC Now in the Process of Revising Rules for On-Site Wastewater Systems

The Texas Natural Resource Conservation Commission (TNRCC) is currently in the process of revising the rules in Section 30 Texas Administrative Code, Chapter 285 pertaining to on-site sewage facilities (OSSF).

This process was started in March of 1998 to determine if the rules approved on December 18, 1996 needed any changes. A 20-member ad hoc committee was appointed at that time and consists of installers, designated representatives, individuals who perform site evaluations, designers, engineers, sanitarians, and TNRCC staff from all areas of the state. The committee began addressing issues in the rules during its initial meeting and recommended a significant number of changes.

Subsequently, legislative action resulted in a requirement that all state agencies review and consider for readoption rules adopted under the Administrative Procedures Act. The reviews were required to include, at a minimum, an assessment that the reason for the rules continues to exist.

As a result, the TNRCC posted notice in the *Texas Register* that a rules review was being undertaken and that comments should be submitted for consideration. A large number of comments were received. All of the comments were presented to the committee for review and recommendations in August. The TNRCC staff is currently in the process of developing appropriate revisions to the rules as a result of these recommendations.

It is estimated that these revisions will be completed in time to publish them in the *Texas Register* for comments in March of 2000. It is anticipated that the final revisions should be scheduled for approval by August of 2000, at the earliest.

For more details, contact Warren Samuelson of the TNRCC at (512) 239-4799 or wsamuels@tnrcc.state.tx.us.

Council-Funded Literature Search Assesses Methods Used to Identify Saturated Soils, Shallow Groundwater Tables

The proper methods to identify shallow groundwater tables and the implications for on-site wastewater treatment were the subject of a literature review which was recently conducted for the Texas On-Site Wastewater Treatment Research Council. The literature

review was developed by John Jacob of the Texas Agricultural Extension Service in Clear Lake and the Texas Sea Grant Program, with assistance from Joe Yelderman of the Baylor University Geology Department.

John Jacob teaches a class on soil identification for the Lower Colorado River Authority

Much of the review discusses issues related to soil mottling (marks and patterns in soils which result from long periods of being saturated or water-logged). According to the review, Jacob says there are a number of problems associated with using the presence of mottles as a way to distinguish areas with high groundwater tables. First, the person carrying out the evaluation has to determine if the mottles are a relic of past environmental conditions or if they were formed recently. Secondly, even if it can be found that relatively recent mottles are present, this still provides little quantifiable information about the nature and extent of water tables. Finally, because it takes an extended amount of time to form mottles (often as long as six months), short-term occurrences of soil saturation may be overlooked by using only this indicator.

"Clearly, the margin of error is too great to rely on soil mottling alone," Jacob says. "Any saturation period which allows untreated effluent to come into contact with ground or surface water should be considered too long."

As an alternative, Jacob suggests that it may be worthwhile to utilize a combination of factors which relate to soil wetness, including climate, landscapes, and soil morphology to more accurately identify shallow groundwater tables. For example, it is widely accepted that relatively flat landscapes east of Interstate Highway 35 become saturated for extended periods of most winters, regardless of the presence or absence of mottles. In contrast, in West Texas only closed depressions may ever become saturated.

"Our reading of the literature suggests that it may well be possible to develop semi-quantitative models, based on soil morphology, climate, and landscape considerations that would allow reasonable judgments to be made regarding the suitability of soils which may be saturated for on-site wastewater treatment," Jacob says. "Intensive data collection may be required at three or four sites to develop regional models," he added. "But, once these models were created, they would likely require little or no data to be implemented at the local level."

NOTE: Jacob can be contacted at (281) 291-9252 or jjacob@unix.tamu.edu. This literature review will soon be posted onto the Council's World Wide Web site (http://towtrc.tamu.edu).

Amendments to Texas Law Aim to Limit Spread of "Colonias"

Amended Texas laws will likely affect the installation of on-site wastewater treatment systems in colonias located in 51 Texas counties. The amendments are part of the State's effort to stop the spread of "colonias," which are subdivisions without proper water and wastewater treatment.

The amendments, which were passed as part of Senate Bill 1421, expand the coverage provided in Subchapters B and C of Chapter 232 of the Texas Local Government Code. They require subdivisions outside city limits in rural areas of 51 Texas counties to comply with minimum state rules for water, wastewater, and drainage.

Under terms of the revised law, any subdivision developer who has not installed water and sewer facilities (including on-site wastewater systems) must post a financial guarantee with the county to assure they will be completed by a future date. The guarantee must be posted when final plat approval is sought. The law also gives the Texas Attorney General's (AG) office greater power to investigate and prosecute those who break these laws.

Two groups of counties are primarily affected by the rules revision. Roughly 23 counties fall under Subchapter C, which applies to residential subdivisions with lots of less than five acres. Counties within 50 miles of the Rio Grande are subject to Subchapter B, which applies to subdivisions with two or more lots which are intended for residential use. Subchapter B also prohibits the sale of a residential lot outside city limits without proper water and wastewater service.

According to Joe Riddell of the AG's Natural Resources Division, developers will now have to provide utilities by installing septic tanks and drainfields or posting a bond to ensure proper systems will be installed at a set future date. "Two years ago, septic tanks were not being built and bonded," Riddell says. "As a result, people were moving into new colonias, but couldn't afford a septic system." For details, contact Riddell at (512) 463-2012 or joe.riddell@oag.state.tx.us.

Prairie View A&M Literature Search Assesses Ability of Soils to Accept Effluents Over the Long-Term

A recently completed literature search by researchers at Prairie View A&M University (PVAMU) provides a broad overview of the ability of soils to accept wastewater effluents over the long-term and suggests that it may be possible to develop a method to predict sustainable loading rates. This project, which was funded by the Texas On-Site Wastewater Treatment Research Council, was conducted by researcher Raghava Kommalapati and graduate student Ahmed Noman of the PVAMU Civil Engineering Department.

The main objective of the project was to review previous studies about the long-term infiltration rates of various soils and how the use of different types of subsurface on-site disposal systems may affect hydraulic loading. The scientists also wanted to investigate

whether Texas' hydraulic loading rates (contained in Section 30, Chapter 285 of the Texas Administrative Code) are supported by scientific data.

Defining System Failure and Acceptance Rates

The researchers began by evaluating information about what constitutes a system failure. For example, two types of failures are mentioned most often in published studies -- the inability of disposal systems to properly treat wastes, and hydraulic failures, which are instances in which effluents do not properly infiltrate but, instead, rise and pond on the surface. Typically, hydraulic failures result when daily average flows exceed the design rate, or if the long-term acceptance rate has not been properly evaluated.

The concept of long-term acceptance rates is often described in the literature in one of two ways. First, many scientists believe that disposal fields have a finite lifespan and that the ability of the soils to treat effluents is reduced as applications continue over time. Others suggest that, at the proper loading rate, rates of decomposition in the soil would reach an equilibrium with the amount of effluent being disposed. Thus, effluent disposal could continue indefinitely. Factors which influence long-term infiltration rates include the loading rate, clogging of the biomat, the soil and groundwater conditions present at individual sites, and procedures used during system construction. Overloading soils (using loading rates which are too great) may greatly decrease the soil's infiltration capacity and cause a sudden loss in permeability.

Currently, Texas bases its long-term acceptance rate on soil types. The long-term acceptance rate for Class IA (sandy-textured) soils is 0.3 gallons per square foot per day (gpd), while for Class IB soils (sands and loamy sands) it is 0.38 gpd. The rate for Class II sandy loam and loamy soils is 0.25 gpd, while the allowable loading for Class III fine loamy soils is 0.20 gpd. The long-term acceptance rate for Class IV fine textured soils is 0.10 gpd.

Factors Related to Soil Clogging

The literature review also described issues related to soil clogging. In general, whenever septic tank effluent is applied, a biomat begins to form at the interface of the soil and the trench. Generally, biomats form readily under anaerobic conditions. Once biomats have been established they retard the infiltration of effluents into the soil.

The effect of construction practices on long-term infiltration rates was also assessed. The researchers found that the infiltration rate can be significantly reduced if the soil surface becomes too compacted during construction (this is because large pores are eliminated). They note that Texas and U.S. Environmental Protection Agency construction standards for on-site systems should, if followed properly, reduce potential problems with reduced infiltration.

Finally, the literature search revealed that proper siting of systems and disposal areas is essential if long-term loading rates are to be optimized. For example, most studies

recommend that drainfields be located away from areas which are likely to be seasonally saturated or inundated.

Conclusions and Recommendations

One of the most important findings of this review, Kommalapati suggests, is that rates can be specified which allow for the successful long-term application of effluents at many sites. The best way to develop long-term loading rates, the literature suggests, is to incorporate information about soil permeability, hydraulic heads, effluent characteristics, and construction practices used to build the drainfield. The research shows that the ability of the soil to accept effluents over time can be predicted over the long-term, if there is an adequate assessment of the site, construction methods, system maintenance and effluent quality. When generating these long-term loading rates, the anticipated level of treatment from the on-site system and the resulting wastewater characteristics need to be factored in. Finally, the literature search interprets current Texas long-term infiltration rates as being more conservative than standards used elsewhere.

Kommalapati also developed recommendations for future research. He proposes that studies should be conducted to develop integrated loading rates for Texas, based on soil texture, other site-specific environmental factors, and wastewater quality.

For details, contact Kommalapati at (409) 857-2418 or r_kommalapati@pvamu.edu.

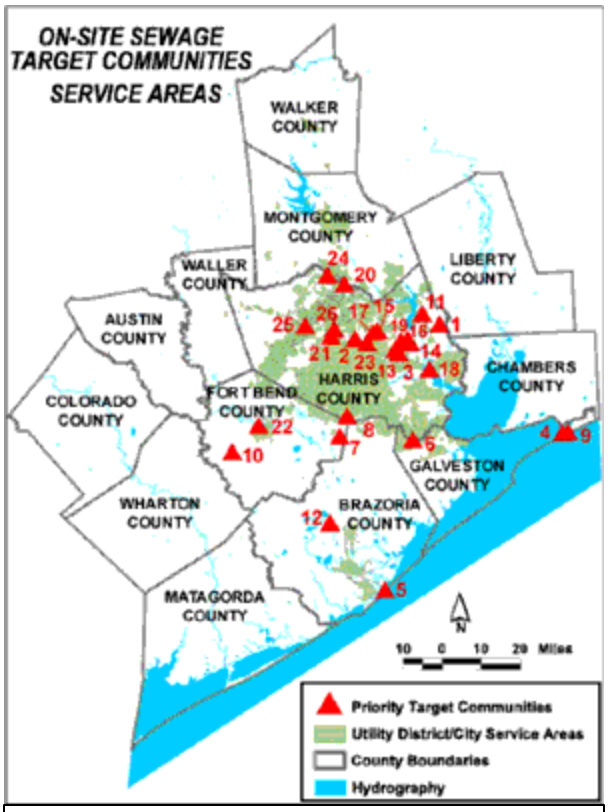
HGAC Project Identifies Sites in Houston Area with On-Site Problems; Helps Community Leaders Find Resources

A coalition of local governmental entities in the greater Houston area is now in the midst of a project to identify which neighborhoods and communities in the region may be experiencing problems with the performance of on-site wastewater treatment systems. The goal is to gather information about on-site needs and challenges as well as resources which may be available to correct these potential problems.

The Houston-Galveston Area Council (HGAC), a voluntary association of local governments which covers a 13-county area in Southeast Texas, is now administering a Section 319 (h) grant from the U.S. Environmental Protection Agency (EPA).

The concept for this project was developed by Lily Wells, who worked with the HGAC on-site wastewater program at the time. Currently, the project is led by Scott Bean, who now coordinates the agency's on-site wastewater efforts. Some of the key cooperators in this effort include Bruce Lesikar and other staff members of the Texas Agricultural Extension Service (TAEX), John Blount of the Harris County Engineer's Office, as well as personnel from other agencies.

The overall goal of this effort is to identify and replace failing on-site systems within the region. Other objectives are to evaluate the use of alternative on-site wastewater treatment and disposal technologies which may be useful at sites with documented on-site wastewater problems.



This map displays sites in the Greater Houston area with potential on-site wastewater problems.

One of the first steps involved identifying neighborhoods or small communities within watersheds which still utilize on-site systems. This was accomplished through utilizing existing environmental and infrastructure-related HGAC databases. Then, sites with problem soils (tight clays and shallow groundwater tables) were identified. Areas where on-site systems were sited over problem soils were ranked as vulnerable to pollution. In addition, interviews were carried out with community leaders and environmental professionals. Through this analysis, the 26 sites with the most pressing on-site problems were mapped using HGAC's geographic information system (GIS). Most of the areas facing on-site challenges were identified in Harris County (17 sites), although potential problems were also noted in Brazoria, Fort Bend and Galveston counties.

At the same time, HGAC staff members put together a series of meetings in which professionals from state and local government entities, the private sector, and universities in the region brainstormed to identify potential resources which could perhaps be utilized to replace failed septic systems or install more appropriate technologies. To help community leaders learn more about and contact potential sources of assistance, HGAC worked with TAEX to develop, print, and circulate a brochure, titled "Financial Aid for Sewage Disposal Projects."

HGAC is now in the midst of putting on a series of "town hall" meetings in each of the neighborhoods which face the greatest on-site challenges. At each meeting, HGAC staff want to gather "first hand" perspectives from people living in the immediate area who have to cope with on-site problems every day. At the same time, they want to identify the solutions that local neighborhood and city leaders would like to pursue to address these concerns.

In addition to improving the access between communities and needed resources, the project will demonstrate and test how well alternative treatment and disposal methods perform at sites plagued by small lot sizes, problem soils, and seasonally high groundwater tables. Some of the technologies being demonstrated in the region through this grant include spray distribution, subsurface drip irrigation, and low pressure dosing.

"HGAC can work to determine which resources may be available that may ultimately help solve some of these concerns. We hope to provide a bridge which connects sources

of funding and expertise with specific local areas which need help. Ultimately, we hope to improve the ability of individuals and neighborhoods to properly treat wastewater and to protect water quality throughout the region."

NOTE: HGAC is currently asking residents in the greater Houston area for assistance in identifying parts of its 13-county service area which may be encountering challenges associated with the use of on-site systems. They are seeking input from agencies and organizations which may be interesting in potentially providing assistance.

Bean can be contacted at (713) 627-3200 or bean@hgac.cog.tx.us. More details are on the HGAC World Wide Web site, which is located at http://www.hgac.cog.tx.us/intro/intro319.html.

City of Waco Waives $900 Connection Fee For Households Switching from On-Site Systems to Centralized Sewers

The City of Waco has developed and implemented an innovative strategy to persuade owners of potentially troublesome on-site wastewater systems to switch over to centralized sewers free of charge.

The premise of the program, which was begun in May 1999, is that the service tap charge (which helps pay to connect an individual home to a sewer) will be waived when people convert from on-site units to a centralized wastewater system. After homeowners agree to make the conversion, existing septic tanks must be filled with dirt or sand to ensure they will not be used again. Homeowners must make the conversion in the first year a centralized sewer becomes available. Typically, the cost saving for a homeowner is roughly $900.

Dennis Musick, an inspector with Waco Water Utilities, stands beside this aerobic system which was installed at a new home. Many aerobic untis are being installed along the Highway 84 corridor because problem soils often limit the use of conventional septic tanks and drainfields.

The program, which is led by Mike Jones, is an effort of the City of Waco Water Utilities Division, which manages the on-site wastewater program in the county. The utility's on-site wastewater staff consists of Jones, a supervisor, a secretary, and three inspectors.

The concept to waive the fee for those who opt to convert from on-site systems to centralized sewers was first brought up in 1998 when Waco decided to annex three neighborhoods west of the city along Highway 84. The Brazos River Authority (BRA) is currently performing the preliminary engineering designs for the Waco Metropolitan Regional Sewer System. BRA will operate the sewer for customer cities, including Waco. The sewer will serve all the newly annexed areas along Highway 84. The Authority hopes to begin extending wastewater lines to these neighborhoods within the next two years.

At some sites in these subdivisions, older conventional on-site systems were often failing and partially treated effluent was surfacing or ponding in lawns. Often, these failing conventional systems were replaced with aerobic units. Jones estimates that there may be as many as 400 households which currently utilize on-site systems along the Highway 84 corridor that could conceivably take advantage of this program. Throughout Waco's city limits, Jones suggests there could be an additional 300 on-site systems which are still in use and which could be connected to a centralized sewer.

According to Jones, the program makes sense for a number of reasons. "If we get many individuals to tie onto a sewer system, that will reduce the number of inspections of on-site systems we will have to perform. It will become easier to manage," he said. The other payback is the water quality of the South Bosque watershed, which this area drains into. "Taking people off on-site systems which have failed or may be likely to malfunction may reduce the risk that nutrients and fecal bacteria could impair water quality in area waters," he says.

In addition, Jones and city manager Wiley Stem also believe that putting as many individuals as possible onto a centralized sewer may also promote growth in these newly annexed areas. "We anticipate that as many as 2,000 people may choose to build homes in these subdivisions in the near future," Stem says. "It could be problematic to oversee that many individual systems. The existence of a centralized sewer will promote more orderly growth." Adding homes to the centralized sewer will increase the flows needed to make the sewer system receive the minimum flows it needs to function properly. For example, Stem suggests that it will initially take at least 60 homes to provide enough wastewater flow for the sewer system and its lift stations to function properly. Homeowners will also benefit because they won't have to face the prospect of potentially expensive repairs, in the event their on-site system fails. In addition, they will be able to use parts of their landscape again which may now be unusable after heavy rains when effluents surface.

In the future, the program will be expanded so that residents in any part of Waco's service area will be eligible when centralized wastewater treatment is available to them for the first time. It should be noted that, before this program was implemented, a few people (three or four a year) who previously used on-site wastewater systems asked to pay to be connected to a centralized sewer.

"We feel that eventually, perhaps, many individuals using on-site systems would ask to be connected to a centralized sewer," Jones says. "Providing a financial incentive will speed that process."

Jones also suggests that this may be a viable strategy other communities may want to use to promote the orderly conversion from on-site systems to centralized sewers.

NOTE: For details, contact Jones at (254) 750-8001 or mikej@ci.waco.tx.us or Stem at (254) 750-5645 or wileys@ci.waco.tx.us.

400 Participate in AIM/ TOWA On-Site Training Sessions in College Station, Earn CEU Credits

Roughly 400 people came to College Station October 25-27 to participate in a joint on-site wastewater training program sponsored by the Association of Installers and Manufacturers (AIM) and the Texas On-Site Wastewater Association (TOWA).

Titled "Texas Regional Onsite Training," the program featured discussions on such topics as inexpensive surveying techniques to produce accurate site plans, the design and use of peat biofilters, marketing homeowner financing for on-site systems, and the relative performance of leaching chambers versus systems which utilize gravel and pipe. Other talks dealt with combining aerobic treatment and drip systems, the use of effluent filters, how effluent moves from pretreatment units to the soil, and ways for maintenance personnel to deal with alarms, switches and controls.

According to Theo Terry, the president of AIM, one of the purposes of the training was to introduce industry professionals to the Association. "One of the goals of AIM is promote regional educational workshops like this one," he said. "In the future, we hope to have training like this somewhere in the region each year. The mission of AIM is to provide practical information that professionals in the industry can use every day."

Persons participating in this training received up to eight hours of continuing education units if they took part in a full day's worth of presentations.

A list of presenters and participants is available by contacting AIM at (877) 323-5246 or aimonsite@aol.com. For more details about TOWA, contact Charlie Digges at (830) 895-1809.

Videotape Discusses 'Next Generation' of On-Site Technologies

A videotape of a nationally broadcast teleconference about the future of on-site wastewater treatment is available from the University of Minnesota Extension Service. The teleconference, titled "The Next Generation of Sewage Treatment -- Flushing in the New Millennium," was broadcast nationally Oct. 28, 1999, as a joint venture with the National Small Flows Clearinghouse. Educational materials for the broadcast were developed by Ken Olson, a specialist with the University of Minnesota Extension Service's On-Site Sewage Treatment Program.

Some of the topics covered in the teleconference include case studies of how typical homeowners chose an alternative wastewater treatment system, and how the use of alternative technologies affected their lifestyle. The teleconference also provided perspectives about how individuals can work with local officials to implement alternative treatment technologies and proper management and maintenance strategies. Some of the specific alternative technologies which were discussed include single pass and recirculating sand and peat filters, constructed wetlands, aerobic units, and drip irrigation systems.

The videotape, as well as fact sheets developed specifically for this teleconference, are sold as a set. They can be purchased from the Minnesota Extension On-Site Program by calling (800) 719-2825. Olson can be contacted at 2735OLSO@co.sherburne.mn.us.

Meetings & Conferences

The Texas Engineering Extension Service (TEEX) is offering the following classes at the dates and locations shown below. The Installer I course will be taught January 11-12 in Abilene and March 14-15 in Mesquite. The Installer II class is being offered January 25-27 in San Antonio, February 8-10 in Abilene, and March 21-23 in Houston. The Designated Representative course is being taught November 30ÐDecember 3 in Prairie View. Operation and Maintenance of Surface Irrigation Systems with Aerobic Treatment class will be taught January 13 in Abilene, February 1 in Weslaco, and March 16 in Mesquite. For more information, contact TEEX at (800) 252-2420 or (409) 845-6246, or e-mail Kirk Chambers of TEEX at pskchamb@teexmail.tamu.edu for registration information.

The Texas On-Site Wastewater Treatment Research Council recently announced the dates and site of the 2000 Annual Conference. The Conference will be in Waco and will meet February 28-March 1. Few details are available so far, but Council Executive Secretary Warren Samuelson says that continuing education credits will once again be offered for those who attend. More details about the Conference will be announced in this newsletter as soon as they become available.

A section of the Texas Natural Resource Conservation Commission (TNRCC) World Wide Web (WWW) site provides a listing of continuing education (CE) opportunities and offerings in Texas. The WWW site address is http://www.tnrcc.state.tx.us/enforcement/csd/ics/ossf_ceu.html.

TRA Investigation Yields Information on Performance of Chlorinators Used with Aerobic Systems

A surprising number of aerobic systems used for on-site wastewater treatment and disposal around Lake Livingston may not be properly disinfecting effluents, according to a study recently funded by the Texas On-Site Wastewater Treatment Research Council. The research was directed by Richard Gerard of the Trinity River Authority (TRA), who supervises the agency's on-site wastewater program near the reservoir. Other TRA participants included field inspectors Marvin Taylor, Bob Steele, and Chuck Mason (who did much of the field work), water quality supervisor Mike Knight, and assistant public information officer Debbie Bronson. Wesley Metcalf, an undergraduate student at Sam Houston State University, assisted with data collection and analyses.

Background Information

Since 1969, TRA has enforced regulations about the use of on-site wastewater systems located within 2,000 feet of the lake. Soils in the area are not suitable for the use of

conventional septic tanks and drainfields. As a result, the most common alternative technology is the use of aerobic treatment followed by spray irrigation. Currently, roughly 600 aerobic systems near the lake are used for residential wastewater treatment.

Staff members of the Trinity River Authority collect an effluent sample from this aerobic system near Lake Livingston.

There are some concerns about the impact of the use of on-site wastewater systems, Gerard says. For example, roughly 25% of samples tested from aerobic units used in this area exceed fecal coliform criteria established by the Texas Natural Resource Conservation Commission (TNRCC). Reports filed by TRA on-site wastewater inspectors suggest the problem may often involve faulty chlorinators, the use of an inappropriate type of chlorine tablet, or a general lack of maintenance. Further complicating matters, there are no Federal or State standards for chlorinators used for on-site wastewater treatment.

How This Project Was Conducted

From May to August 1999, TRA staff and interns from area colleges inspected chlorinators used at each residence near the lake. The goal was to sample roughly 20 residential systems each day. Once at each site, the monitoring team visually inspected the system and determined which type of chlorination unit was utilized. Three types of chlorinators were found most often at lakeside sites: 1) a standard model which uses a straight 4-inch pipe and a 4-inch riser which can hold a stack of chlorine tablets, 2) a recessed unit which includes a reservoir beneath the chlorine tablets and increases the contact time between the tablets and the effluent, and 3) chlorinating units placed inside pump tanks. They also collected data about the types of chlorine tablets used for disinfection, the location of the individual systems, the property owner, the status of maintenance agreements and record-keeping, and whether alarm systems which signal a lack of disinfection were installed and operational.

The researchers noted whether calcium hypochlorite -- the specific type of chlorine tablet approved by the U.S. Environmental Protection Agency (EPA) -- or chlorine tablets designed for use in swimming pools were being used. Color test kits were used to determine chlorine residuals in the field. After samples were returned to the laboratory, they were immediately tested with a membrane filter procedure to determine if fecal coliform bacteria were present. By inoculating and incubating culture dishes containing a fecal coliform medium, colony forming units (cfu) were grown and counted. Samples of chlorine tablets were collected and returned to the lab, where they were tested with a cyanuric acid kit. Effluent samples were taken from the pump tank of each system to assess the amount of chlorine residual which was present and to determine concentrations of fecal coliform bacteria.

What Did the Study Show?

To put the information from this study in the proper perspective, Gerard emphasizes that this project gathered data on how systems are actually performing in the field. As a result, effluent flows were often erratic, since many sites were only used on weekends or during vacations. The value of this project is that it presents a clear picture of how aerobic systems are actually operating near the lake.

Some of the information the study attempted to collect focused on what type of chlorination unit is most frequently used and how well these various designs function. The research found that most (58%) of the units utilized a recessed design, followed by units installed in the pump tank (32%), and the standard model (8%). The findings also show that units utilizing the recessed design had fewer occasions when no chlorine residual was found (21%), compared to the standard design (26%) and in-tank units (33%). Another way of assessing system performance is to measure fecal coliform levels within the pump tank. In this project, counts of more than 600 cfu per 100 milliliters were considered to be excessive. The study shows that chlorinators in the pump tank were the units most frequently associated with high levels of fecal coliform (29%), followed by 23% for standard units and 18% for the recessed design.

Other questions TRA staff wanted to answer were which type of chlorine is used most often in this area and what condition the chlorine tablets were in. According to the study, nearly 90% of systems near the lake used chlorine tablets designated for swimming pools rather than EPA-approved calcium hypochlorite. They learned that chlorine tablets were found to be in "good" condition at the majority (73%) of sites, although 14% did not contain any tablets when they were spot checked. At the remaining 4% of the systems, chlorine tablets had broken or become compacted inside the tube.

The survey also shed light on operations and maintenance issues. For example, only one of the 600 units which were tested contained any type of visual alarm to indicate if there was a problem with chlorination. Many property owners told TRA they "just forgot" to check whether systems needed chlorine tablets after a system reached a certain age.

Summary

The main lesson to be learned from this project, Gerard says, is that many systems may fall short of expectations during low flows. It should be noted, though, that most units seem to work well during ideal conditions. Similarly, during low flows each type of chlorinator experienced problems which cause tablets to become soft and clog.

"The key issue with chlorinators is maintenance," Gerard says. "In general, maintenance companies do not assume responsibility for putting tablets in chlorinators and, even when they do, site visits are not frequent enough to always keep tablets in the tube. It is unacceptable to have 14% of the units without chlorine tablets." As a result of this project, Gerard recommends that the performance of chlorinators be tested by an

approved facility, and that all chlorinators be equipped with a visible alarm that notifies property owners when there are no chlorine tablets in the system.

NOTE: Gerard can be contacted at the TRA Lake Livingston office at (409) 365-2292. Limited numbers of this report can be obtained by contacting TRA. In the near future, much of this report will be posted on the Council's World Wide Web site at http://towtrc.tamu.edu/tra_rpt.pdf.