Texas Water Resources Institute

Winter 1989
Volume 15
No. 4

Reclaiming Wastewater

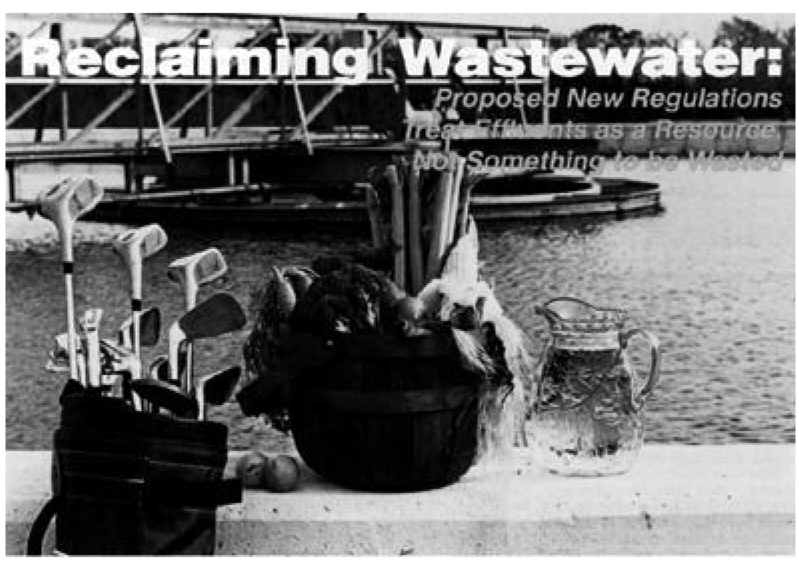
Proposed New Regulations Treat Effluents as a Resource, Not Something to be Wasted
by Ric Jensen Information Specialist, TWRI

For many years, wastewater, as its very name implies, was viewed as a waste product. It wasn't thought of as having real value. It was only regarded as something that had to be disposed or gotten rid of.

However, as Texas faces the prospect of declining water supplies and increasing demands, that perception is gradually beginning to change.

More and more, Texas cities are looking at wastewater as a valuable resource that can be treated and then reused to irrigate landscapes, agricultural crops, and golf courses; to provide water for power plants and other industrial purposes, and ultimately to convert to drinking water.

Eventually, it may be common for wastewaters to be reclaimed and utilized more fully.



Some reuse is taking place in Texas now. Roughly 1.5 billion gallons per day of wastewater is generated in the state and as much as 70 million gallons per day (MOD) or slightly less than 5% is reused, according to unofficial estimates from the Texas Water

Development Board.

Still, many have felt that water laws in the state have been overly restrictive of how reclaimed wastewater can be utilized, particularly when those statutes are compared to other states. That situation may change dramatically in the near future if proposed regulations are approved.

The Texas Water Commission (TWC) and the Texas Department of Health (TDH) have both proposed drafts of new regulations that could greatly expand how reclaimed wastewaters may be used. The proposed rule changes, if adopted, would allow municipalities to substitute reclaimed wastewaters for many uses including expanded irrigation of additional crops and unrestricted landscape areas, supplying water for aesthetic fountains and lakes, and other purposes. The regulations would also define the level of treatment that reclaimed wastewaters would have to achieve before being put to specific uses.

Both Irving and San Antonio have created wastewater reuse districts to facilitate the use of treated effluents. Las Colinas, in Irving, utilizes effluents to irrigate four championship golf courses, refill aesthetic manmade lakes, and supply canals so water taxis can transport visitors throughout the development. San Antonio is proposing that streams in the area be used to convey wastewater from treatment plants to golf courses, parklands and other users. Ultimately, San Antonio is considering making reuse water drinkable. El Paso is already recharging the Hueco Bolson aquifer with highly treated wastewater which is ultimately recovered and used for drinking water.

In the future, reuse may take on different forms. Many cities are considering storing additional effluents in reservoirs (a reservoir that is now comprised of only 5% wastewater may contain 25% to 30% effluents in the future). Many individuals may begin recycling greywater (from clothes washing machines, showers and bathtubs) and could install dual pipe distribution systems, allowing them to water lawns and gardens with reclaimed water.

Why has wastewater reuse become so important? A couple of reasons immediately come to mind. First, many areas of Texas are already water-short, either because of natural climate conditions or because of growth. Reusing wastewater often makes more sense economically than other water supply options such as building new reservoirs. Second, advancing technology and changes in laws and institutions make reuse more feasible and acceptable. Many are realizing that the "stigmas" associated with wastewater are being broken down as people evaluate the pros and cons of reusing a precious resource like wastewater as opposed to throwing it away (Allison, et al., 1988). Third, effluent reuse may emerge as a low-cost alternative to conventional and costly wastewater treatment and may reduce the amount of nitrogen, phosphorous and other pollutants that are now being discharged into rivers and streams.

Despite the rosy scenario, there are still major health and policy questions that have to be considered before safe effluent reuse takes place on a wide scale. Wastewater reuse projects utilize treated sewage which, if improperly treated, could contain disease-causing viruses and bacteria. Reuse programs must be conscientiously carried out so these problems are avoided. Careless management of water reuse projects could also possibly result in pollution.

Wastewater reuse may also impact water quality. The proposed regulations don't regulate the amount of sodium and chloride present in treated effluents. Even if the other water quality standards are met, treated wastewaters may contain enough salt to be toxic to some crops and plants and can promote salt buildup in soils. If treated effluents that contain high levels of phosphorus and nitrogen are stored in reservoirs, algal growth may be a problem.

There are also differences of opinion in how runoff should be controlled from sites where wastewaters are stored for reuse programs. The proposed revisions emphasize that adequate areas will be provided to store wastewaters (even during storms) and limit the amount of runoff that will be allowed. This could hinder the amount of wastewater reuse that may take place by requiring expensive storage facilities. As an alternative, it has been suggested that the regulations could allow seasonal discharges of effluents. For example, discharges during the spring and summer months could be prohibited, but could be allowed during the fall and winter when irrigation is not needed and rivers have higher flows to dilute effluents.

There are also policy questions about which forms of reuse should be allowed and for which purposes. For example, should utilizing effluents for land disposal be discouraged? Many programs irrigate agricultural crops with treated effluents, but the primary purpose is to employ the crops and soils to treat and dispose of wastewater. Some experts have proposed that criteria need to be developed to separate land disposal projects from "true" reuse projects. These could include the economic value or worth of the water in a particular project, whether the venture would be developed with conventional water sources if effluents were not available, and the impact of a reuse program on overall water supplies in the region. Although it may seem rather clear cut, the line between what is and is not acceptable can become muddled. Many urban areas such as the Highland Lakes, for example, built huge golf courses to both dispose of wastewaters and to create an economic resource. Are those really more desirable or safer than operations that grow hay or alfalfa with reclaimed wastewater?

Water reuse also raises a number of water rights questions, many of which have not yet been fully answered. Will reuse programs, especially ones that actually increase the total amount of water that's consumed, lessen the amount of water flowing in streams that's now available to downstream users? Are there legal remedies available to downstream water users who feel they have been deprived of the amount of water they are legally entitled to? In cases where aquifers and springs make a sizeable contribution to streamflows, are there safeguards to make sure that river levels are maintained? If a number of cities contribute wastewater to a treatment plant which then markets the water, do they have the right to profit from the sale of the effluents? If an area conserves and creates "new" water supplies, should it be allowed to market the excess?

Involvement by the university research community in water reuse issues has so far been limited. A study funded by the Texas Water Resources Institute recently evaluated current state policy on agricultural irrigation with reclaimed wastewater to determine if policy changes were needed, and a project at Southwest Texas State University is examining whether greywater reuse is now feasible at some campus facilities. Scientists at the University of Houston at Clear Lake have examined public attitudes toward reuse projects. A project at the University of North Texas helped Las Colinas determine how algal problems could be avoided in man-made lakes where effluents are stored (Ferstl,1986). Studies at Texas ABM University are now underway to measure the impact of water reuse programs on water supplies in Texas rivers.

Increased university involvement in wastewater reuse projects may occur in the near future. The On site Wastewater Treatment Council was created by the Texas Legislature in 1987. So far, it's collected more than $300,000 in fees from septic tank installers and some of the money is being earmarked for research. However, the money can't be obligated until more members of the council are appointed by the Governor. The council is hoping to conduct research in wastewater reuse and land disposal at the Center for Environmental Research at the Horns by Bend wastewater treatment plant in Austin. Scientists from Texas A&M University, the University of Texas at Austin, and other universities would be eligible for funding from the council.

EXISTING AND PLANNED REUSE PROJECTS

It's hard to gauge the amount of effluent reuse that's actually occurring in Texas, because state agencies don't routinely produce data on this subject. A study funded by TWRI (Carlile, in press) suggests that roughly 12% or 220 of the 1,800 municipal and industrial wastewater treatment permit holders in the state are now conducting wastewater reuse programs. Most of the reuse operations (69) are located in the High Plains, followed by the Rolling Plains (33), Rio Grande Valley (32), Edwards Plateau (26) and Blacklands Prairie (21).

Cities in west Texas have for many years operated land disposal programs where treated wastewater is applied to lands where agricultural crops are produced (Varma, 1987). Effluents have been used to irrigate such crops as grasses, small grains, sorghum, cotton, and golf course turfgrasses. The programs are effective because they lower the cost of wastewater treatment while providing plants with water and nutrients. Lubbock utilizes about 20 MGD (George et al., 1984), Midland roughly 15 MGD (Lowe, et al., 1984), and Amarillo more than 11 MGD for these projects. In general, the operations have been run without major health incidents although there were reports earlier this year that high nitrate levels may have been caused by wastewater irrigation at the Lubbock site. Since that time, Lubbock has provided additional acreage to accommodate the volume of wastewater flows. Irrigation of golf courses, cemeteries and other "restricted access. sites where human contact with the effluents can be controlled has also been fairly common in west and central Texas (Joerns and Moriarty, 1988).

Although many of the projects involve agricultural irrigation and are located in rural areas, the Las Colinas development in Irving is an exception. This project utilizes roughly 7 MGD of reclaimed wastewater which is blended with stormwater and water from the Elm Fork of the Trinity River to irrigate four golf courses, highway medians and open spaces and to supply water to 158 acres of man-made lakes. The amount of effluents in the lakes is limited to less than 25% of the overall water supply to prevent algae growth. Reusing wastewater makes sense for a number of reasons: it provides an dependable supply of water, it's less expensive than purchasing potable water, and the golf courses made possible by the reuse program provide a feeling of open space in the middle of a populated area. Irrigating landscapes at the Dallas Fort Worth International Airport with reclaimed wastewater has also been proposed.

One of the most technologically ambitious reuse projects is taking place in El Paso where effluents are being injected into the Hueco Bolson aquifer to increase groundwater supplies (Knorr, 1987). In this program, wastewater is treated to meet drinking water standards and injected into the aquifer. It takes at least two years for the effluent to reach production wells where it will be available for reuse. The plant has been in operation since 1985 and currently injects about 7 MGD into the aquifer. Costs of the program were less than other water supply alternatives.

New or expanded effluent reuse projects are also being planned in San Antonio, Austin, Odessa, Abilene and other areas.

In San Antonio, the recently created Alamo Conservation and Reuse District is coordinating plans to create localized advanced wastewater treatment facilities called "water factories" within watersheds where growth is expected. The effluent would be transported through rivers and streams in the area where it could later be used to irrigate golf courses, zoos and other landscaped areas, to augment river flows, and for other purposes. The district hopes to market the reclaimed water and to convert "surplus" waters which are not marketed to drinking water. The goal of the plan is to make 83,000 AF of effluents available by the year 2000 and 107,000 AF by the year 2030 (City of San Antonio, 1988). Interest in wastewater reuse in the San Antonio region is also being increased by the Drought Management Plan developed by the Edwards Underground Water District. Although the plan restricts the amount of fresh water that can be used during droughts, it places few limits on the amount of effluent reuse that will be allowed.

Improving water quality in the Highland Lakes near Austin is the goal of an effluent reuse program being undertaken by the Lower Colorado River Authority (LCRA). The TWC recently imposed a ban on new wastewater discharges into the lake system. As a result, developers are forced to dedicate a portion of their acreage to land disposal of effluents or are limited to constructing low density subdivisions with septic tank systems. As an alternative, LCRA has studied the feasibility and cost-effectiveness of widespread use of dual pipe distribution systems which would allow for expanded reuse of reclaimed water on unrestricted landscape areas. Preliminary results indicate that dual distribution systems are feasible if they are planned into new developments (LCRA, in press). Other reuse programs in the area include irrigating golf courses at Bergstrom Air Force Base and other sites with effluents that were traditionally irrigated with potable water.

The City of Odessa, which now reuses 3 or 4 MGD, is exploring additional uses for its effluents. The city has developed a plan where 25% of its effluents would be used for agricultural irrigation, 17% could be utilized to irrigate golf courses and cemeteries, 28% could be reused by local industries and the remaining 30% could be blended with existing raw water supplies to produce drinkable water that is as good as or better than current supplies (Varma, 1987).

Abilene, Dallas, and other cities are investigating reuse options that would increase the amount of effluents stored in reservoirs. For example, Abilene has expired the possibility of discharging effluents into a stream that feeds a nearby

reservoir as part of an overall reuse strategy that also includes providing effluents for urban irrigation (City of Abilene, 1988). The City of Dallas, as part of its long-term strategy, has suggested increasing the amount of effluents in Lake Ray Hubbard as a way to extend its water supplies. The North Texas Municipal Water District is constructing a wastewater treatment plant that will discharge 24 MGD into Lake Lavon in north Dallas. The district will use the lake as a water supply source.

PROPOSED NEW REGULATIONS

Major regulatory changes have been proposed by both TWC and TDH that could greatly enhance the amount of effluent reuse taking place in Texas. It has to be noted, however, that these regulations are in draft form and consequently may not be ultimately implemented.

The proposed rules have two major thrusts. Chapter 310 of TWC rules will specify water quality standards that must be met before certain types of reuse can be approved. Revisions to Chapter 297 would address some of the water rights questions.

The proposed Chapter 310 is meant "to encourage the conservation of water resources by reusing water where possible and appropriate." The TWC also said that "the Commission believes that reclaimed water may be used safely and beneficially for many purposes, some of which include irrigation of vegetation, source of water for landscape impoundments, restricted use recreational impoundments, ornamental fountains, and industrial uses such as cooling water and flush water for toilets.

The rules, if approved, would allow providers and users of reclaimed water to utilize treated domestic wastewater without making modifications to water quality permits. Standards for greywater reuse are also proposed.

Some of the more significant parts of the new regulations include the following items. Irrigation with untreated wastewater would be prohibited and food crops which may be consumed raw by humans could not be spray irrigated. Food crops which would be "substantially processed. prior to consumption by humans and vineyard and orchard crops could be spray irrigated. It should be noted that research in California suggests that wastewater irrigation of food chain crops is relatively safe (Sheikh, 1987).

Other rules would not allow nuisance conditions to result from the use of effluents, and would specify that use of reclaimed water shall not threaten groundwater quality. Pipes containing reuse water would have be separated from pipes carrying potable water, and signs would be required to be posted indicating that water reuse is taking place.

The storage of effluents is also addressed in the new regulations. Ponds would have to be designed to prevent groundwater contamination, and stormwaters could be diverted to holding ponds. Overflows would be allowed only when the amount of stormwater is 10 times greater than the amount of effluent in the ponds.

Specific levels of effluent water quality for different uses (based on 30-day averages) are the central point of the proposed changes (see Table 1). Application rates for the different crops being produced could be determined by preparing a detailed water balance to eliminate runoff and drainage.

The proposed regulations also provide detailed instructions for when and how effluents shall be applied. Irrigation sites would have to be maintained with a vegetative cover or be under cultivation when reclaimed water is being applied. irrigation practices would have to be designed to prevent accidental ponding or standing water and irrigation would be prohibited when grounds are saturated or frozen. Reclaimed wastewater could only be applied for irrigation when the area is not in use by humans or animals milked for human consumption. Reclaimed water applied to lands with public access would have to be disinfected following storage and prior to use. Irrigation spray should not reach any public drinking fountains or other areas that were not designated for irrigation.

Two sets of criteria are proposed for effluents that will be utilized to irrigate landscapes. Reuse water supplied to "unrestricted areas" where access is uncontrolled including parks, school yards, greenbelts, and residences would have to meet strict criteria. Reclaimed water utilized to irrigate "restricted" landscape areas where access can be controlled such as golf courses, cemeteries, roadway right-of-ways and median dividers would be able to meet less stringent standards. Water quality limits for reclaimed wastewaters are also being proposed for effluents utilized in landscape and restricted recreational impoundments and ornamental fountains.

Reclaimed waters would also be allowed for use in commercial business and industries under the new guidelines. Reclaimed water could be used in place of potable water and freshwater supplies. For example, reclaimed water and greywater could be used for toilet flushing, but would have to be dyed blue prior to use.

There are also suggested revisions to Chapter 297 that would impact water rights. The changes specify approved uses for reclaimed wastewaters, and would allow reclaimed waters to be substituted for potable water. Under the guidelines, cities that use surface water will in most cases have to obtain secondary use permits to implement wastewater reuse programs (exceptions would be if the reuse would take place on lands owned or operated by the city). Cities that are dependent on groundwater would not need the secondary use permits. The rules also note that use of reclaimed wastewater is a "beneficial" use.

WATER RIGHTS ISSUES

As wastewater reuse becomes more common, water rights issues may emerge involving spring and streamflows, conjunctive management of ground and surface water, ownership of "developed" water' and other topics (Bell' et al., 1983).

As a beginning, it's necessary to understand the TWC water rights permitting process. Water rights permits issued by the TWC before 1960 (and many permits granted since) typically do not specify how much wastewater that originated from surface water shall be returned to a river. There are no regulations that specify the levels of groundwater-derived wastewater that should be discharged. As a result' cities are not obligated to return a set amount of wastewater flow to a river or stream. If a reuse program results in increased water consumption' less water could be available for streamflows. The TWC considers the impact of wastewater reuse programs on surface water supplies when determining if secondary use permits should be issued.

Some critics (Booth, 1986) have charged that secondary use permits may not be necessary and may unnecessarily limit the amount of water reuse that will occur in Texas because the water is "developed" and would not be subject to the permitting process. That argument has not yet been tested in the courts.

How will wastewater reuse programs impact streamflows? Although there's a lack of data on this subject, generally it's estimated that 60% to 70% of the amount of water diverted by cities will still be available as return flows. San Antonio estimated that reducing water demands through reuse and other measures by 10% could cut wastewater flows by 20%. A basic question that needs to be answered is whether irrigation (a major part of many reuse programs) will consume more water than is lost due to evaporation from rivers and streams. If irrigation consumes more water, effluent reuse programs could reduce streamflows.

Many Texas rivers are effluent dominated (some more than 90%), especially during summer months and droughts. Reuse could lessen the major supply of flows during these months. Ron Griffin of the Agricultural Economics Department at Texas ABM University is studying the economic value of return flows and hopes to develop methods to simulate how return flows are affected by water reuse programs.

The level of protection that downstream users will have is apparently tied to whether the original source of water that is being reused is groundwater or surface water.

For example, when the City of Abilene (which depends on surface water) initiated its reuse program, the Brazos River Authority claimed the reuse would lessen the yield of one of its reservoirs. After TWC hearings, Abilene was required to return 40% of the amount of water it diverted back to the Brazos River basin in the form of treated effluents to compensate for potential losses in streamflows. It is unclear if this type of compensation will be required when other cities that utilize surface water implement wastewater reuse programs.

The ability of the state to control the effect of wastewater programs that are derived from groundwater appears to be limited. Many areas that pump groundwater end up supplying rivers and streams with treated wastewater. For example, 8 of Texas' 10 largest cities using groundwater (Beaumont, Bryan, El Paso, Houston, Midland, Odessa, San Antonio and Victoria) discharge more than 600 MGD of wastewater into rivers, streams and bayous (see Table 2). Widespread wastewater reuse could result in lessened flows, but there are no legal remedies to guarantee that flows will be provided. This problem could be especially serious in the San Antonio region where the City pumps water from the Edwards Aquifer, but discharges wastewater into area rivers. It should be noted that San Antonio has pledged to return roughly half its effluents to area rivers, and that a lawsuit is now underway to declare the Edwards Aquifer to be "state" water. Both of these measures could give the region some legal relief if losses to streamflows do occur.

Other potential water rights conflicts could arise when effluents are stored in reservoirs to replace potable water supplies, when wastewater diversion points change, and in determining who owns this "new" source of water. Some reuse projects involve changing the location where wastewaters are discharged into rivers. If the discharge point changes, downstream water users could be denied a potential source of water supplies. If many cities that rely on groundwater contribute to the wastewater flows to a large treatment plant and that plant decides to begin a reuse program, who would benefit (all the cities or just the operator of the plant)? It appears that wastewater treatment plants may own the effluent they produce (if it originates from groundwater), be able to market that water, and profit from its sale.

SUMMARY

Texas is taking bold steps to encourage water reuse. If the proposed rules changes are approved, they could signal increased beneficial use of a resource which has up until now been largely treated like a waste product.

Still, there are some policy questions that need to be answered if reuse will become as successful as it can and should be. These include assessing the impact of reuse programs on return flows and guaranteeing that downstream flows will be protected, particularly in those regions where water is already in short supply and those areas downstream of groundwater users.

Texas also needs to resolve the issue of what constitutes "beneficial" reuse and what does not. Although there is a consensus that wastewater should no longer be wasted, the issue of whether irrigating cropland with effluents in land disposal programs is beneficial needs to be evaluated.

REFERENCES

Allison, Richard, Roger Durand, and Gerhard Schwebach, "Risk: A Key Water Policy Issue," *Journal of the Water Pollution Control Federation,* Landcaster, PA, July, 1988.

Bell, Craig, William Cox, and Glen Fiedler, "Land Application of Wastewater: Water Rights *Issues, "Journal of Water Resources Planning and Management,* New York, NY, Vol 104, No. 9, (1983).

Booth, Frank, "Ownership of Developed Waters: A Property Right Threatened," St. *Mary's Law Journal,* San Antonio, TX, Vol. 17, No. 4, (1986).

Carlile, Bobby, *Design and Management Considerations and Evaluation of Land Treatment Systems Using Reclaimed Wastewater in Texas,* Texas Water Resources Institute, Texas A&M University, College Station, TX, (in press).

Ernst, Mark and Stanford Lynch, 'Water Reuse in Las Colinas, Irving, Texas," Pro*ceedings of the 1 7th Annual Water Reuse Conference,* American Society of Civil Engineers, Fort Worth, TX, (in press).

Ferstl, Sondra, "Texas Water Problems," *Resource,* University of North Texas, Denton, TX, Vol. 2, No.1, (1986).

George, D.B., N. Klein, and D.B. Leftwich, "A Critique of the Lubbock Land Treatment System Expansion," *Water for the 21st Century: Will It Be There?,* Southern Methodist University, Dallas, TX, 1984.

Joerns, John, and William Moriarty, "The Amazing Economics of *Water Reuse," Public Works,* Troy, NY, October, 1988.

Knorr, Daniel, "Reuse as a Municipal Supply Option," *Proceedings of the 21st Water for Texas Conference: Urban Water Resources Management,* Texas Water Resources Institute, College Station, TX, 1987.

Lowe, John, W.J. O'Brien, W.E. Carroll, and E.E. Patrick, "Wastewater Irrigation: the Midland Story," *Water for the 21st Century: Will It Be There?,* Southern Methodist University, Dallas, TX, 1984.

Feasibility Study of Wastewater Reuse at the Lakeway Municipal Utility District, Lower Colorado River Authority, Austin, TX, (in press).

Personett, Mike, "A Methodology for Demand Management Planning, Program Development and Implementation," *Proceedings of the 21st Water for Texas Conference:*

Urban Water *Resources Management,* Texas Water Resources Institute, College Station, TX, 1987.

Pettygrove, G., and Takashi Asano, *Irrigation With Reclaimed Municipal* Wastewater: *A Guidance Manual,* Lewis Publishers, Chelesea, Ml, 1985.

Regional Water Resources *Plan*, Joint Committee on Water Resources, City of San Antonio and Edwards Underground Water District, San Antonio, TX, 1988.

Sheikh, Bahman, *Monterrey* Wastewater *Reclamation Study for Agriculture,* Monterrey Regional Water Pollution Control Agency, Monterrey, CA, 1987.

Stagner, Steve and Mike Personett, "Toward a State Policy on Water Reuse," Texas Water *Alliance,* Texas Water Alliance, Austin, TX, June 1988.

Varma, Ashok, "Water Reuse - Options for Texas," *Proceedings* of the 21st Water for Texas *Conference: Urban Water Resources Management,* Texas Water Resources Institute, College Station, TX, 1987.

Water Reclamation Research Project (Summary Report), City of Abilene, Abilene, TX, 1988.