H.B. 1989 - AQUIFER STORAGE AND RECOVERY

A REPORT TO THE 75th LEGISLATURE

By The

TEXAS WATER DEVELOPMENT BOARD

"Leadership Today, for Water Tomorrow"

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TABLE OF CONTENTS

H.B. 1989 - AQUIFER STORAGE AND RECOVERY
A REPORT TO THE 75th LEGISLATURE
Executive Summary

ASR, as it is currently defined by regulation in Texas, is discreet underground storage and later recovery of water treated to drinking standards. A 95 percent recovery rate is often experienced. ASR system cost is typically 10 percent of an equivalent alternative impoundment. ASR can facilitate economy in water supply distribution, by creating storage depots of treated water. Pretreated supplies can augment the primary source to meet peak demands. With ASR, water is captured when it is abundant, rather than when it is needed. ASR does not increase the total water supply available but allows greater use of existing supplies. Off peak capture, treatment and storage allow water treatment plants to operate with greater efficiency, and delay treatment plant expansion. Environmental benefit can be realized by capturing water during abundance to reduce peak demand diversions and maintain stream flows. Fresh water aquifers may be used for ASR storage, but technical and political difficulties may result. The use of brackish aquifers or unused subsurface reservoirs containing undesirable water offer many advantages. By utilizing such reservoirs for ASR storage, fresh water aquifers may be reserved for less expensive direct development.

Investigation has revealed an ASR precedent in Texas (see Appendix E). In the 1970s, several communities began storing water underground out of necessity. In the High Plains, low demand relative to Lake Meredith allocations and fixed delivery charges provided an incentive to conduct ASR. In West Texas, a centrally located well field was recharged from a higher capacity field out of town. Eventually, demand overcame the excess stored supply and ended the practice.

TWDB has developed application guidelines for funding pilot feasibility investigations in the priority areas designated by H.B. 1989. Investigations are under way in Brownsville, Laredo, and San Antonio. TWDB has granted $661,000 for ASR feasibility investigations, with an additional $216,155 as "in kind" contributions, through TWDB staff, drill rig and geophysical logger participation. A non-state funded investigation has begun in Austin. All investigation results are favorable, but some require latitude to investigate additional strata. TNRCC has developed guidelines for diversion and injection permit issuance. No investigation has advanced to making application to TNRCC for surface water rights or injection well permits.

<u>Recommendations</u>

Geologic conditions are sufficiently localized that investigators should be allowed to examine any promising subsurface reservoir and not restricted to aquifers designated in HB 1989. Reconnaissance study may be initially required to provide data needed for subsequent ASR investigations. ASR is potentially viable state wide. Interest has been expressed in the potential of storing treated effluent in brackish strata for reuse and TWDB and TNRCC should be directed to study the implications and potential benefits. Funding for further ASR research from appropriated Water Assistance Fund monies will limit the number of pilot projects unless a special appropriation is made.

H.B. 1989 - AQUIFER STORAGE AND RECOVERY

A REPORT TO THE 75th LEGISLATURE

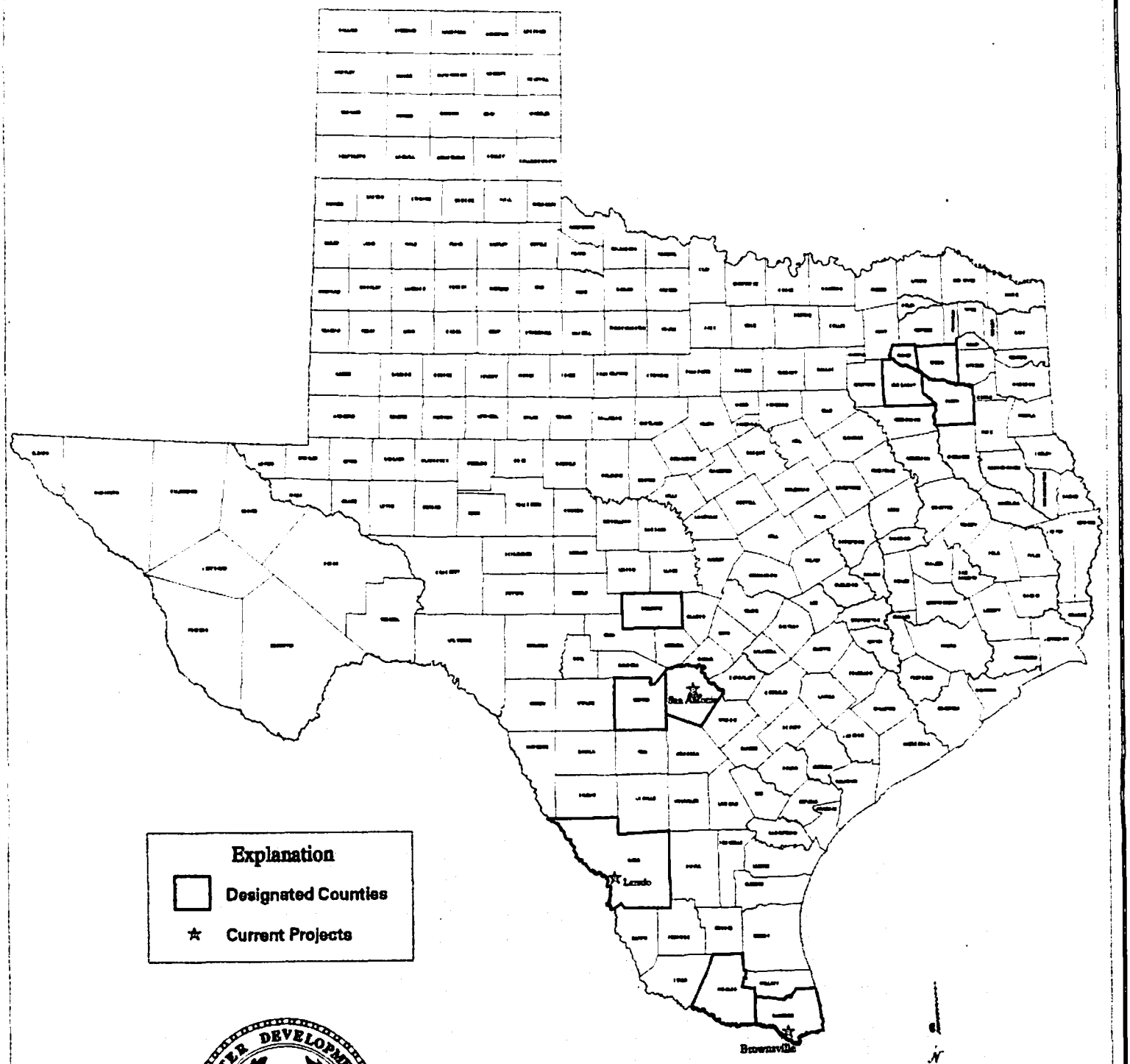
Introduction

In 1995, the 74th Legislative session enacted H.B. 1989 (see Appendix A) which recognizes the underground storage of appropriated water to be a beneficial use. HB 1989 also authorized pilot projects to investigate the feasibility of using appropriated water for Aquifer Storage and Recovery. ASR, is the underground injection, discreet storage, and subsequent recovery of water that has been treated to drinking water standards.

H.B. 1989 also encourages the Texas Water Development Board (TWDB) and the Texas Natural Resource Conservation Commission (TNRCC) to ... "evaluate additional aquifers within the state to identify the potential for storage of appropriated water underground to maximize and enhance the future availability and beneficial use of the water resources of the state (Sec.1(8))." HB 1989 directs the TNRCC to encourage the issuance of temporary or term permits for pilot demonstration projects in specific aquifers in specified counties. The TWDB is to make state funds eligible for the pilot projects. On completion of each project the TWDB and TNRCC are to prepare a report evaluating the success of the project.

The TWDB was further directed to prepare a biannual report to the legislature that includes progress of authorized pilot projects, results of TWDB studies of aquifers for storage potential and anticipated appropriations from general revenues necessary to investigate other aquifers during the upcoming biennium. This report is intended to fulfill this mandate. In addition to the listed required inclusions, this report also provides an overview of the ASR process and its historical and potential use in Texas.

H.B. 1989 DESIGNATED COUNTIES AND CURRENT PROJECTS



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Water Management Potential

General Perspective

The State of Texas faces an ever increasing need to better manage its existing water resources. To assist in meeting these management needs, ASR provides a technology which allows for increased conjunctive use management of surface water and ground water.

ASR can be an economical method of discreetly storing surplus water harvested during periods of low demand or peak availability and later retrieved to meet peak demand. ASR system operations are well suited to regions with divergent seasons of peak water demand and availability. ASR systems typically use treated water for storage. Water for storage is secured through the normal treatment stream. When needed, water from the ASR system is brought on-line in parallel to the primary supply. Quality of the treated water is maintained throughout the storage period such that water from the recovery wells requires only minor disinfection before distribution. This disinfection may not be necessary but helps to maintain disinfectant residuals at delivery end points.

An ASR system is desirably designed to store water away and apart from the primary source in an otherwise unused aquifer, typically of undesirable water quality, by creating a "bubble" of fresh water around the wellbore. ASR systems are constructed and operated to inject treated water through wells in such a manner so as to prevent or minimize chemical reaction and co-mingling with native ground water. The "bubble" is established after several cycles of injection and withdrawals have been completed. Experience has shown that successful recovery of 90 to 100 percent of the original injected water is normal. Even in the worst cases where fresh water is being stored in concentrate brine aquifers, efficiencies of 80 percent or greater are achieved. ASR recovery efficiencies are appealing when compared to evaporation losses associated with surface water reservoirs.

By incorporating ASR into existing facilities, operators may enjoy the benefits of highly efficient storage and avoid the cost of surface reservoir construction or infrastructure expansion. The cost of an ASR system is often 3 to 5 percent of the cost of a surface reservoir, 8 to 10 percent of the cost of expanding existing water treatment facilities, and typically less than the cost of above ground storage.

ASR is often confused with "aquifer recharge" projects. The two processes differ in that aquifer recharge is intended simply to replace water that has been extracted from the aquifer. This replacement water commingles with the existing ground water and in time becomes a part of the overall aquifer system. ASR is not intended as a mechanism for recharging an aquifer. ASR is a temporary storage depot with little or no commingling of waters.

ASR is perhaps best applied to aquifers from which ground water is not typically withdrawn. Although ASR can certainly be applied to commonly used aquifers, the practice is likely to be met with inherent problems, such as right of capture and regulatory pitfalls. When siting ASR in an aquifer with less than desirable water, few if any wells in the area will penetrate that aquifer and there is no likely degradation of the native water quality.

Issues of Concern

Regulatory:
The fundamental regulatory concern with ASR is one of ownership. The central question being that if state regulated surface water is injected underground, does its authority remain with the state, or does it revert to ground-water law with authority given to the above-ground landowner.

Environmental:
The use of ASR can virtually eliminate environmental impacts associated with surface reservoirs. ASR can help to maintain environmental quality in stream environments by allowing water to be captured and stored during high flow conditions, thereby reducing diversion rates necessary to meet demands during low flow conditions. This flexibility of the timing of water capture applies equally well to ground-water systems (ie., to protect spring flows).

Aquifer Depletion:
Perhaps the greatest objection to the application of ASR technology in Texas, is that it would serve as a ruse for aquifer depletion. Theoretically, ASR is used to store water underground with high efficiency, ie. very nearly the volume that was injected is recovered. In an ASR application which stores water in a saline or non-potable reservoir, nothing more will occur. In an ASR application which stores water in an active fresh water aquifer, once the storage volume has been recovered, ASR operators could continue pumping with potentially no limit on further withdrawals.

In areas with scarce ground-water resources, it has been feared that outside interests might use the "cover" of installing an ASR project to covertly export ground-water resources. In effect, "putting a little in and taking a lot out". Similar concerns have been voiced in areas where land subsidence has resulted from aquifer depletion.

To avoid ASR projects facing delays and sparking litigation or political conflict, ASR applications might best target storage zones which are considered otherwise undesirable, thus assuring only stored water will be withdrawn. Where storage zones of undesirable water are not readily available, ASR operators could limit withdrawals to volumes equal to that injected. If withdrawal of greater volumes from the aquifer are desired, these could be made through additional supply wells, subject to such spacing rules and pumping limits that may apply.

Need for Education

Although ASR technology has been around for some time worldwide, its more widespread use in Texas is relatively new. As water managers become better informed of its capabilities and benefits the process will be in greater demand. The most important educational aspects that need to be developed are a better understanding of the aquifer alternatives available for storage and the economic benefits of the process.

Minimum Requirements for Insuring Feasibility of ASR Projects

Subsurface Geology/Hydrology

A primary requirement for any water storage project is a place to store water. With respect to ASR, a suitable geologic strata or "aquifer" is required. This storage zone need not be a recognized fresh water aquifer to meet feasibility requirements. While fresh water aquifers could be utilized for ASR projects, other strata such as unutilized saline zones or "aquifers" may offer many advantages in terms of greater availability, reduced potential for water storage interference, and decreased potential for political or permitting challenges. To be suitable for an ASR project, a potential subsurface reservoir need only be present in a convenient location, have sufficient permeability to be recharged or produced at a rate which will meet the specific project requirements, and contain native ground water which will not react chemically with the water to be stored. The use of "non potable aquifers" as storage zones can offer potential feasibility to a substantially larger portion of the State than if fresh water aquifers alone are considered.

Water Supply Source

Another of the primary requirements of water storage projects is, of course, water. The type of water which is most typically associated with ASR projects is treated surface water (State water). Technically, other types of water such as ground water or tertiary-treated effluent could be utilized. The projects considered thus far in Texas have involved the use of surface water as a supply source. Whatever the source of the water to be stored, it is important that the stored water meet drinking water standards upon recovery, in ASR systems storing water for public supply. This allows the recovered water to be brought on-line in parallel to the primary source in order to achieve operational and economic benefits. If regulations would allow the practice, the use of ASR as an interim storage repository for treated effluent has intriguing possibilities.

Treatment and Conveyance Facilities

Economic feasibility favors choosing the source of water most convenient to convey to the point of storage. An important part of determining relative degrees of convenience is whether infrastructures such as treatment facilities, pumping stations, or pipelines will be required or if existing facilities could be utilized. Typically, but not necessarily, the existing source of water for a given community is determined to be most convenient to convey to storage.

Water Chemistry Compatibility

After determining which of the available water sources is the most convenient, that particular source must be further evaluated in terms of water chemistry. It is imperative that the chemical make up of the water to be stored is compatible with the chemical make up of the native ground water and the rock material of the proposed storage zone. In ASR storage, the two species of water do not mix but there does exist a water quality interface between the two species. This interface exists over a prolonged period of time and is mobilized outward and inward through the storage zone rock material over multiple storage and recovery cycles. This mechanism offers ample opportunity for potential chemical reactions to occur. If the various chemical species of the three components are not compatible, serious undesirable reactions may occur. Typical results are undesirable water quality upon recovery and clogging of the storage zone. Operational management practice can help to reduce reaction potential in areas where native and stored waters are less than fully compatible.

Project Need

Although ASR is a viable water supply technology, it must fulfill a specific need for a community to have value. ASR has the potential to meet many types of water supply challenges that a community may face. The use of ASR can allow the capture of water resources with a limited seasonal availability and provide efficient low-cost storage. ASR can also be applied to meet peak day or seasonal water supply demands or to forestall the need for water treatment plant expansion by allowing efficient year round operation. ASR can even be applied to reduce water system distribution burdens and cost. The potential applications of ASR are numerous but must economically fulfill an identifiable need for the community to achieve feasibility.

Best Economic Management Alternative

In addition to meeting a specific need, an ASR project must be the best economic management alternative. ASR projects are relatively low cost, but in order to make a fair comparison, the cost savings generated by ASR should also be considered. Justification can also be made on the basis of the relative speed at which an ASR project can be brought on-line. ASR is not a new technology, although it is considered so in Texas. While an economic justification for any water supply alternative is a wise practice, with ASR it is an absolute necessity to avoid criticism for indulging in the percieved higher risk of a non-traditional alternative.

Protection from Unauthorized Withdrawals

The final element necessary to insure feasibility of an ASR project is some measure of protection for the stored stock of water against unauthorized use or "piracy". While it would be difficult for potential water pirates to gain access to stored ASR water, it is possible to do so or at least disrupt operations of an ASR project. A necessary addition to any ASR project is a scheme to protect stored waters from unauthorized withdrawals. Protection from piracy of stored waters can be achieved through local ordinance capacity if within municipal boundaries or by maintaining physical control of the property overlying and surrounding the stored water. Additional protection may be achieved through storing water in relatively unused subsurface strata that underlie a fresh water aquifer or that is otherwise difficult to access. By including protection against piracy of ASR water stocks, the security of the investment of public funds in an otherwise viable ASR project can be assured.

Procedure for Pilot Project Application, Acceptance, and Funding

Feasibility Study Application Process

The Texas Water Development Board's Water Assistance Fund and its'sub-fund, the Research and Planning Fund, offers grants to political subdivisions of the State of Texas for studies and analyses to determine the feasibility of ASR projects. Grant funding is made prior to the implementation of pilot projects for the storage of appropriated water in aquifers and subsequent retrieval of such waters for beneficial use. Activities directly related to the preparation of applications for state or federal permits or other approvals, activities associated with administrative or legal proceedings by regulatory agencies, or preparation of engineering plans and specifications are not eligible for ASR planning grant assistance. Development of a water conservation plan must be included as a specific task in the scope of work for proposed planning areas without a Board approved water conservation plan. The planning grant instruction sheet and application checklist are contained in Appendix B.

Suitability Criteria for TWDB Consideration

There are a number of site-specific conditions that potentially can limit ASR from being the best water utility management option. These conditions include such considerations as the physical suitability of the underground formations, ability to protect the stored water, actual need for the project, and others. Prior to granting funds for an ASR feasibility study, the project sponsor will submit certain key "literature review" information to the TWDB. This initial analysis will provide some early-on indication that there are no obvious "fatal flaws" in ASR being a suitable tool to help meet the sponsor's water utility needs. The required information is listed in Appendix C.

Method of Project Funding

House Bill 1989 authorized use of the Water Assistance Fund for ASR feasibility studies. However, funding for these studies was not appropriated to the TWDB by the Legislature. When the TWDB allocated the remaining Water Assistance Fund balances for use in FY 96-97 through the Research and Planning Fund, $500,000 in funding was allocated for ASR feasibility studies. Due to the limited funding available for ASR studies, the Board limited eligible studies to those areas identified in HB 1989 and imposed a cap of $200,000 of State grant funds per study.

Of the $500,000 in State funds allocated for ASR studies, $64,000 remains uncommitted. The City of Laredo and the City of San Antonio, in cooperation with the Bexar Metropolitan Water District, received grants of $200,000 each. In addition, the Sabine River Authority, as part of a larger study to update their water supply master plan, will utilize $36,000 of these funds to study ASR. In addition to these investigations, $225,000 was provided to the Brownsville Public Utility Board for an ASR feasibility investigation in FY95 using some available Federal funds. In sum, a total of $661,000, including Federal Funds, has been provided in grants for ASR feasibility investigations

TWDB Studies, Investigations, and Surveys of Aquifers (Sec. 11.155(b)(1-3))

Aquifers Identified in Section 11.153(a)(1-4)

Anacacho:

The Anacacho Limestone in Bexar and Medina Counties, overlies the Austin Chalk and ranges in thickness from approximately 150 feet up to 500 feet, increasing in thickness from east to west. The contact between the Anacacho Limestone and the Austin Chalk indicates that the Austin Chalk experienced a period of erosion before deposition of the Anacacho Limestone occurred. The Anacacho Limestone represents deposition of a small carbonate bank over a portion of the much more widespread Austin Chalk. The Anacacho Limestone consists of a sandy limestone in general. In Bexar and Medina counties, however, a fine grain variety of limestone, known as mudstone, predominates and is interbedded with a calcareous clay known as marl.

The fine-grained, clay-rich nature of the Anacacho Limestone is a limiting factor for the aquifer or reservoir potential of this formation, due to low porosity and permeability. There have been only a few wells known to draw water from the Anacacho Limestone in Medina and Bexar counties. These wells have generally produced only a few gallons per minute and eventually were either deepened to penetrate a deeper aquifer or abandoned. Hydrocarbons are produced from the Anacacho Limestone in a trend extending across the Bexar-Medina county line, Southwest of San Antonio. Hydrocarbon production from the various fields in this trend are low, again due to low permeability. Individual wells are generally classified in the "stripper" production category.

Due to the overall low formation permeability values, the Anacacho Limestone is not an attractive exploration target for an ASR storage zone in Bexar and Medina counties. The degree of permeability offered by the Anacacho Limestone would clearly not support the rates of water recharge and production required for a viable ASR project. While the limestone formation material is potentially amenable to reservoir stimulation techniques such as acidizing, the clay-rich nature and low permeability would severely restrict the potential for a successful outcome.

Austin Chalk:

In Bexar and Medina counties, the Austin Chalk consists mainly of a thickly bedded yellow gray to tan colored impure chalky limestone interrupted by marl beds at intervals. The Austin Chalk contains many fossils and has been noted to contain significant deposits of the minerals marcasite and hematite. In the area bounded between IH 10/ U.S. 90 and the Balcones Escarpment the Austin Chalk is typically at or near land surface. The limestone of the Austin Chalk has been historically utilized for quarry operations, most notably at the old Alamo Cement Quarry in the Alamo Heights area of San Antonio and as the building material of the Medina County Courthouse.

In the San Antonio area, the Austin Chalk has been interpreted to be in hydrologic continuity with the Edwards Aquifer on an extremely limited and site specific basis. This interpretation has been drawn from observations of similar seasonal water-level changes and similarity of water quality at those specific locations. On an area wide basis, the Austin Chalk is classified as a poor or low yield aquifer. Only a very few wells have historically been found to draw water from the Austin Chalk and few of these have reported a yield of greater than 3 gallons per minute. The Austin Chalk has been observed to be fractured in various locations. The fracture porosity, has not been well developed such that it would contribute significantly to aquifer yield. Water quality of the Austin Chalk is characterized as marginal. Significant quantities of hydrogen sulfide, attributed to the presence of sulfide minerals, are reported in water-quality analyses from both counties. Additionally, a black sludge, interpreted as "dead oil", has been reported in some wells near the Culebra Anticline, a geologic structural feature near the Bexar-Medina county line.

The Austin Chalk in Bexar and Medina counties has a low, although somewhat greater reservoir potential than the overlying Anacacho Limestone. The limestone which composes the Austin Chalk in these counties is low in porosity and permeability, as demonstrated by low well yields. In an unaltered state, the Austin Chalk would probably offer a poor exploration target for an ASR storage reservoir, but should respond readily to stimulation techniques. The relatively hard crystalline and potentially fractured nature of the formation is well suited to stimulation by fracturing and acidizing methods. If viable stimulation methods could be economically employed, the Austin Chalk could potentially serve as a viable ASR reservoir.

Glen Rose Limestone:

The Glen Rose Limestone immediately underlies the Edwards Aquifer, but occurs at land surface in the Hill Country region above the Balcones Escarpment. It is subdivided into Upper and Lower units, which together represent approximately 80 percent of the Trinity Aquifer in Bexar and Medina counties. The nominal thickness of the Upper and Lower Glen Rose Limestones is approximately 850 feet.

The remaining water bearing units of the Trinity Aquifer are the Hensell Sand, Cow Creek Limestone and the Hosston Sand. The total thickness of these additional water bearing units varies, but is typically 250 feet or less. Many well owners who rely on the Trinity Aquifer in Bexar and Medina counties have constructed their wells to penetrate one or more of these formations to increase well yields and reliability of water supply.

The Glen Rose Limestone is composed of alternate beds of limestone and marl in the Upper unit and massive limestone in the Lower unit. The two units are separated by beds of anhydrite, which is similar to gypsum. These beds dissolve readily upon contact with water and are the cause of much of the high sulfate concentrations associated with water from the Glen Rose Limestone. Wells that penetrate through the entire Glen Rose Limestone require that the anhydrite zone be cased and cemented to avoid water-quality problems.

In areas above the Balcones Escarpment, where the Glen Rose Limestone has been reasonably well explored, well yields typically fall within two rather distinct ranges. The two ranges of well yields are probably best described as 'typically low' and 'surprisingly high'. In 'typically low yield' wells, the maximum yield may be as high as 20-50 gallons/minute on a "good well", but many wells may only produce 5-10 gallons/minute. In 'surprisingly high yield' wells, maximum yields may be as high as 300-400 gallons/minute with up to 1,000 gallons/minute reported in some cases.

There are, of course, individual wells that have maximum yields which fall between these two ranges, however they are in a distinct minority. A clear majority of wells penetrating the Glen Rose Limestone fall within the 'typically low yield' category. For this reason, many wells are drilled sufficiently deep to incorporate some or all of the additional water bearing members of the Trinity Aquifer, in order to increase potential maximum well yields.

Since limestone aquifers often produce only minor amounts of water through the matrix porosity of the rock texture, the primary control on potential maximum well yield is the degree of fracturing or solution cavities encountered by a well bore. In the Glen Rose Limestone, the occurrence of high density fracture zones and associated solution enlargement of the fracture planes has been noted, but is often extremely localized. This observation of the occurrence of Glen Rose Limestone fracture zones is consistent with the scattered grouping of known high yield wells.

The Glen Rose Limestone is a favorable target for ASR feasibility investigation for several reasons. Primarily, the Glen Rose Limestone is located at or near the land surface in an area where ASR could be of use in meeting present and future water supply demands. Unlike previously discussed formations, the Glen Rose Limestone is essentially bedded on a level plane. This level bedding structure essentially offers up a full formation thickness of 850 feet to be explored for potential storage zones.

Locating a high density fracture zone for a ready-made storage reservoir may be somewhat "hit or miss". However, the limestone rock texture of the Glen Rose should respond readily to well stimulation techniques. Methods such as acidizing and fracturing could easily be employed to maximize the reservoir potential of any promising features encountered.

Although the Glen Rose Limestone is an actively used fresh water aquifer, adequately protected storage zones should be possible to locate and exploit. Considering the Glen Rose Limestone together with the additional underlying members of the Trinity Aquifer would expand the possibility of locating either suitable single or stacked reservoirs. The stair-step structure of the fault blocks which compose the Balcones Escarpment greatly enhances the possibility of locating suitably isolated storage zones. Additionally, in the area immediately below the Escarpment, the Glen Rose Limestone is not utilized as a water-supply source as it underlies the Edwards Aquifer.

The availability and difficulty of bypassing the Edwards Aquifer would provide inherent protection from unwarranted intrusion into water stored in the Glen Rose Limestone. The potential for protection of stored waters is enhanced by the Balcones Escarpment in Bexar County being located almost wholly within the City of San Antonio corporate boundary or its ETJ. Permitting authority over the installation of new wells has been exercised by the City of San Antonio within these areas for many years.

Carrizo-Wilcox:

The Carrizo-Wilcox is classified as a Major Aquifer by the TWDB and serves Texans from the Rio Grande in South Texas to the Louisiana State line. The Carrizo Sand is a thick, fairly uniformly bedded sand that is highly productive of fresh water and which overlies the Wilcox Formation. The Wilcox Formation consists of an alternating series of sands and clays. Since the Carrizo Sand immediately overlies the Wilcox, the separate identities of these two units are often confused. For this reason, the term Carrizo-Wilcox is commonly employed. It is important to remember that the Carrizo Sand and Wilcox Formation are two distinct units, often having divergent aquifer capabilities and water quality. Across the large portion of Texas in which the Carrizo Sand occurs, it varies in thickness increasing from 100 feet in East Texas to over 600 feet in South Texas. The Wilcox Formation is highly variable in thickness and may vary between 300 to over 1,000 feet within a given region.

In Bexar County, the Carrizo-Wilcox occurs in the southern most portion of the county. This area extends from the "point" formed by the confluence of the Bexar, Atascosa and Wilson county lines northward, approximately 11 miles. The Carrizo-Wilcox occurs as an outcrop band with an east-west trend that dips to the south and comes to a feather edge on its northern boundary. This outcrop band is generally located south of the City of San Antonio. In this situation, the underlying Wilcox portion of the Carrizo-Wilcox is located closer to the City of San Antonio.

The proximity of the Wilcox Formation to the City of San Antonio infrastructure would facilitate ASR feasibility, should aquifer conditions prove favorable. The reservoir potential of the Wilcox Formation has extreme lateral variation, due to the meandering nature of the relict sand bars and tidal channels which form the water-bearing zones. Unfortunately, in Bexar County, the Wilcox Formation has not shown a well developed reservoir potential with the vast majority of formation material occurring as non water-bearing shale. It may be possible that a suitable reservoir could be found in the Wilcox Formation, however, such an exploratory venture could prove to be time consuming, expensive, and serendipitous. In Bexar County, ASR feasibility investigation should focus on the Carrizo Sand portion of the Carrizo-Wilcox.

The significance of the Carrizo Sand occurring in outcrop is that a full formation thickness is not available for exploration or development in most areas. It is additionally significant that the aquifer will not be under artesian pressure or protected from surface infiltration in these same areas. A sufficiently large formation thickness to host significant storage volumes or potentially artesian aquifer conditions may not be encountered until 200-300 feet formation thickness is present. These conditions will require the siting of an ASR test facility significantly further south than the upper (northern) margin of the Carrizo Sand outcrop.

With respect to overall reservoir potential, the Carrizo Sand is a favorable target for ASR feasibility investigation. The Carrizo Sand has high porosity and permeability which would allow large volumes of water to be stored and recovered. There is no question that the Carrizo Sand in Bexar County has the reservoir potential to support an ASR project. A questions which remains to be answered is whether a geologically favorable ASR test site is located sufficiently close to existing infrastructure to maintain economic feasibility. Another question is whether the integrity of stored water supplies might be adversely affected by regional aquifer drawdowns produced by heavy irrigation pumpage nearby.

The disposition of the Carrizo-Wilcox in Webb County is such that it occurs in outcrop, approximately 40 miles north of the City of Laredo, in the extreme north-west portion of the county. This area is near Carrizo Springs in Dimmit County for which the Carrizo Sand is named. From the outcrop in north-west Webb County, the Carrizo-Wilcox dips into the subsurface towards the south-east, reaching a depth of approximately 2,700 feet near Laredo.

In the outcrop and areas of shallow burial, the Carrizo-Wilcox can produce potable water in large quantities. The western portions of the Winter Garden irrigated farming region is adjacent to this area, but is largely undeveloped other than for ranching purposes. The potentially large yields from Carrizo-Wilcox wells in northern Webb County is due to the characteristically high porosity and permeability of the aquifer. As the Carrizo-Wilcox dips more deeply into the subsurface, porosity and permeabilty are decreased, reducing well yields. Water quality in the Carrizo Sand becomes increasingly mineralized with greater depth of burial.

The Carrizo-Wilcox in Webb County is not a favorable target for ASR feasibility investigations. The extreme depth of burial and low potential well yield of the Carrizo-Wilcox near population centers in Webb County would likely allow only minute benefit to be realized at great cost. Locating an ASR site in the northern portion of the county is technically feasible, but the cost of conveying water from the point of diversion to such a facility and back to the point of use would likely be prohibitive. Potential water resources development of the Carrizo-Wilcox in Webb County include development of fresh water supplies in the northern portion of the County and utilization of moderately deep saline water for desalting in other locations.

The Carrizo-Wilcox in the deignated counties of East Texas is a widely utilized aquifer. It shares many similarities with other areas discussed, but contrasts in many ways also. The thickness of the Carrizo Sand portion is much reduced in this region, typically about 100 feet thick. Well yields are still relatively high despite the reduced thickness due to the very high porosity and permeability of the formation.

In a large portion of East Texas, the geologic structure of the Carrizo-Wilcox differs markedly from that of Central and South Texas. In contrast to dipping like an inclined plane, the Carrizo-Wilcox forms a syncline, which is a broad trough, over much of East Texas. The counties of Smith, Rains, Van Zandt and Wood lie on the western flank of this syncline. The Carrizo Sand portion is not present in Rains County.

Where the syncline flanks intersect the land surface, the Carrizo-Wilcox occurs in outcrop. The Carrizo Sand portion crops out in the eastern corner of Van Zandt County along a roughly north-south axis that runs along the Smith-Van Zandt county line and across the width of Wood County. The Carrizo Sand again crops out on the eastern flank of the syncline in the extreme south-east corner of Smith County. The outcrop of the Wilcox Formation occurs east of the Carrizo Sand on the eastern syncline flank and occupies an analogous position on the western flank.

Water quality in the Carrizo Sand of East Texas is uniformly good. The Wilcox Formation has a somewhat less desirable water quality than the Carrizo Sand but is generally still of potable quality. The Carrizo-Wilcox, as a whole, does not become so highly mineralized as to exceed potability standards until reaching further south into the southern Sabine, San Augustine, and Angelina counties region. While some complaints of poor water quality in the Carrizo Sand portion have been noted in the Smith, Van Zandt, and Wood counties area, these complaints have been extremely localized and may possibly be a result of poor construction standards of particular wells. TWDB is currently investigating a method using geophysical logs to determine gross water quality of the Carrizo Sand in a large portion of East Texas, including Smith, Van Zandt, and Wood counties.

The Carrizo Sand portion of the Carrizo-Wilcox in East Texas, and specifically Smith, Van Zandt, and Wood counties, possesses favorable reservoir characteristics to be considered as a target for an ASR feasibility investigation. Although the Carrizo Sand could potentially serve as an ASR reservoir, the Wilcox Formation or other subsurface reservoirs might be a better choice, due to the fact that the Carrizo Sand is a widely used fresh water aquifer. The major population centers in the portions of Smith, Van Zandt, and Wood counties which are underlain by the Carrizo Sand either already utilize the Carrizo Sand directly or could easily do so. These same communities could expand direct development of the Carrizo Sand at lower cost than by utilizing it for ASR.

It should not be interpreted that ASR could not be of potentially great value to communities in the Smith, Rains, Van Zandt, and Wood counties region. ASR technology might best be applied to subsurface reservoirs in the Wilcox Formation that lie below the Carrizo Sand. One or another of these same reservoirs are available for investigation throughout nearly the entire four county area. If ASR feasibility investigations were structured to target reservoirs with less desirable water quality, potential ASR applications could operate in parallel to more broadly developed ground-water resources from the Carrizo Sand and surface water reservoirs. Such an effort could potentially maximize water resource availability for the upper East Texas region.

Hickory Sand:

The Hickory Sand is a member of the Riley Formation. It consists of quartz sandstone and may be up to 500 feet thick. The stratification of the Hickory Sand is thickly bedded near the base and becomes progressively more thinly bedded near the top. In many places, the Hickory Sand produces large quantities of fresh water.

Originally, the Hickory Sand was deposited over the undulous and eroded surface of the older igneous and metamorphic rocks of Central Texas. Because of hills and valleys in the surface upon which the Hickory Sand was deposited, it may have a highly variable thickness. Some of the hills, may extend completely through the Hickory Sand and reach into the overlying Cap Mountain Limestone.

Ultimately, the igneous rocks were uplifted and caused the overlying sediments to form broad dome structure. This sedimentary dome was subsequently eroded, reforming the remnant sedimentary rocks into a rough, intersected ring. The action of erosional forces have compounded the variable thickness of the Hickory Sand.

In Gillespie County, the variability of the Hickory Sand is particularly evident. Here, the Hickory Sand was apparently deposited over numerous hills of such high relief that the reservoir appears to have been effectively compartmentalized. Though sufficient porosity and permeability may exist, the Hickory Sand is apparently not uniformly water bearing.

The Hickory Sand appears to be a favorable target for ASR feasibility investigation. The compartmentalization of this subsurface reservoir may offer storage for large volumes with enhanced security from either dispersion or unwarranted capture. Though generalized knowledge of the Hickory Sand in Gillespie County exists, site-specific data is particularly lacking. To perform an ASR feasibility investigation, reconnaissance data will be necessary to select sites for focused ASR investigation. It is appropriate that a reconnaissance of the Hickory Sand in Gillespie County be performed to generate the data needed to support an ASR feasibility investigation. A reconnaissance effort, would facilitate an ASR investigaion by likely reducing the necessary scope and cost required to determine actual feasibility.

Ellenburger Aquifer:

The Ellenburger Group consists of the limestones and dolomites of the Tanyard, Gorman and Honeycut Formations. These formations taken together with the underlying San Saba Limestone of the Wilberns Formation compose the Ellenburger Aquifer. The Ellenburger Aquifer was deposited over the Central Texas igneous shield and ultimately eroded during uplift, leaving a roughly ring shaped structure. The Ellenburger Aquifer produces moderate to large quantities of fresh water, depending mainly on the degree of fracturing, solution features or cavernous porosity present in a particular location.

Although the Ellenburger Aquifer is present throughout much of Gillespie County and is a source of water supply for the City of Fredericksburg, there is comparatively little specific data available. It is doubtful that the Ellenburger Aquifer is compartmented like the Hickory Sand, due to differences in depositional environments. The Ellenburger Aquifer could possibly be a favorable target for ASR feasibility investigation, however, any judgement in that respect must be tempered by the lack of necessary data. As with the Hickory Sand, a reconnaissance investigation would be necessary to gather the preliminary data required to perform a focused ASR feasibility investigation.

Gulf Coast:

The Gulf Coast Aquifer is classified as a major aquifer by TWDB and serves a large portion of South and South-East Texas. The Lissie, Chicot and Evangeline Sands are the three major water bearing zones of the Gulf Coast Aquifer. These water bearing zones are variably productive, but yields are typically high where the individual sands are well developed.

In the Cameron and Hidalgo counties area, the widespread availability of surface water from the Rio Grande has nullified incentive for Gulf Coast Aquifer exploration. Although scattered data has been available, recent test hole data generated by TWDB, has allowed a greater clarity of observation. TWDB has drilled six test holes which penetrated the Gulf Coast Aquifer in the Cameron-Hidalgo counties area. Three test holes were drilled in separate locations in each county.

Data from the test holes has been surprisingly uniform and indicates that the Gulf Coast Aquifer is probably not a favorable target for ASR feasibility investigation. However, overlying sedimentsof the Rio Grande Alluvium have shown potential. The sediments which represent the components of the Gulf Coast Aquifer, are not sufficiently well developed to offer significant aquifer potential. Specifically, the sediments are almost entirely clay interspersed with a few thin silt lenses. Pumping tests have produced only minute quantities of water, indicating virtually non-existent recharge potential.

Aquifer Summary:
It can be generally said that ASR is possible across the Sate of Texas. However, due to the sometimes extreme variability of local conditions, remote or "desktop" determinations of aquifer or subsurface reservoir suitability is problematic. A preliminary reconnaissance of potential storage reservoirs must be conducted if such data is not readily available. Reconnaissance data is absolutely necessary for an ASR feasibility investigation to stay focused and succeed within a reasonable cost structure. ASR feasibility investigations must be free to explore the ASR potential of what appears to be the most suitable local reservoir, rather than be restricted by remote determinations.

There is little doubt that fresh water aquifers can serve as ASR storage reservoirs. The use of fresh water aquifers for ASR storage risks interference from other users of the aquifer and a perception of using ASR as a guise to overdraft the aquifer, potentially leading to conflict. Wherever possible the utilization of saline or otherwise non-potable subsurface reservoirs may be desirable, leaving fresh water aquifers reserved for less expensive direct development.

TNRCC Designated "Critical Areas"

The Critical Area Program, established by House Bill 2 (69th Legislature), was created to define areas of the State that are experiencing, or expected to experience within the following 20 years, critical ground-water problems and to initiate the creation of ground-water conservation districts within these areas. Initially, the TWDB and the TNRCC identified 16 areas for study. In 1990, the TNRCC designated four of these areas as critical.

"Critical Area 1" - Briscoe, Hale, and Swisher Counties:
.These counties were declared critical as a result of extensive water-level declines caused by heavy irrigation pumpage from the Ogallala aquifer. The Ogallala contains fine- to medium-grained sands and gravels that are relatively permeable. Earlier ASR projects by the towns of Lamesa, Levelland, and Lubbock demonstrated that the Ogallala formation can successfully be used for this purpose. Underlying the Ogallala, the Triassic Dockum Formation consists of fine-grained sands and clays and contains ground water of lesser quality than the Ogallala. Although this formation is less permeable than the Ogallala, it may be potentially viable for ASR. The primary limiting factor for this area is access to a supplemental water-supply source to be used for ASR feedstock. For technical references see TWDB Reports 288 and 313.

"Critical Area 2" - Dallam County:
Similar to Critical Area 1, water-levels in the Ogallala aquifer have declined significantly. ASR in the Ogallala of Dallam County is viable. Likewise, ASR potential is viable in the underlying Cretaceous, Jurassic, and Triassic formations which underlie the Ogallala in the eastern part of the county. Again, access to a supplemental water-supply source is a major limiting factor. For technical references see TWDB Reports 288 and 315.

"Critical Area 3" - Bandera, Bexar, Blanco, Comal, Gillespie, Hays, Kendall and Kerr Counties:
The Trinity Aquifer portion of the Hill Country was declared critical due to current and projected water demands that are in excess of available ground-water supplies and water-quality deterioration in some areas. Formations within the Trinity Group are composed mostly of limestone and clay. The limited porosity and permeability of some of these units may diminish ASR potential in some areas, however, the Kerrville ASR project has demonstrated that the process can work. A thorough hydrogeologic evaluation of an intended site in this region will be essential. Available supplemental water supplies may be limited in parts of this region. For technical references see TWDB Reports 273 and 339.

"Critical Area 4" - Midland, Reagan, and Upton Counties:
Historical water-level declines suggest that ground water in this region can potentially be depleted by heavy irrigation pumpage. Water-quality conditions are marginal in regard to meeting safe drinking water standards, although, the ground water supplied to the cities of Big Lake and Rankin is acceptable. The Trinity Antlers Sand Formation is similar to the Ogallala in that it is relatively permeable and could accommodate ASR operations. Again, a primary limiting factor is the lack of a supplemental water supply source. For technical references see TWDB Reports 235 and 312.

TWDB Policy and Procedure for Designation of Priority Areas Where Greatest Need Exists

The TNRCC has developed rules on the issuance of permits under the ASR research program and has identified three types of areas that are or may be eligible for such consideration:

(1) named counties/aquifers in Section 11.153(a),
(2) areas designated by the TNRCC as "critical areas" pursuant to Section 52.053, Texas Water Code, now repealed (and moved to Section 35.008) and
(3) *other areas in the State in a priority to be determined by the Board's ranking of where the greatest need exists.*

The TWDB defined a policy, method and means of making such finding to the TNRCC for the third type of area listed above. The following procedure was adopted by the Board for designation of priority areas of need for ASR pilot research under Section 11.155(b)(3) and directed the TWDB Executive Administrator to apply such policy and report its findings to the TNRCC as needed.

The Board's method of assessing priority areas where greatest needs exists is accomplished in a two-step fashion:

First, utilities most likely to have a "need" for ASR (as a means of avoiding water treatment plant expansions or to supplement their water distribution systems with localized storage) are those experiencing population growth and expanding water utility infrastructure needs. In that regard, a ranked list of municipalities expected to grow over the next 20 years, shown in Appendix D, will be used as a first screening basis to determine "need" for ASR. It is the intent of the Board that this city/town priority list be used more broadly to screen for growth *in and around the urban areas* and that municipal, special district or regional utility service areas that would provide for such metropolitan area water utility needs, and have the legal authority to plan, construct and operate such ASR facilities, will be considered as eligible for meeting the initial Board screening of ASR need.

Second, since the Legislation also directed the Board to conduct studies and investigations of other areas and to report on the success of the ASR pilot program, the Board feels it is important to further screen the long priority list of potential urban growth areas for conceptual-level ASR pilot feasibility of a particular entity need for ASR. Those entities wishing to be designated by the Board for ASR pilot study and TNRCC permit considerations under Sections 11.153-11.155, and not specifically qualified in Sections 11.155(b)(1) and 11.155(b)(2), should make application to the Board for a "designation of priority need" consideration and provide to the Board the information specified in Appendix C.

From this information, Board staff performs an assessment as to whether there are any obvious "fatal flaws" in ASR being a suitable tool to help meet the Sponsor's water utility needs. From this assessment, Board staff makes a recommendation to the TWDB Executive Administrator for approval or disapproval of the designation. This finding by the Executive Administrator will then be communicated to the TNRCC.

Status of HB 1989 Pilot Project Investigations

Brownsville - Cameron County

The Brownsville Public Utility Board (BPUB) was the first entity to submit an application for funding to TWDB. The Brownsville application was received, in fact, within days of the passage of HB 1989. The BPUB and Brownsville Navigation District are co-participants in the project, with BPUB serving as the lead local participant. With both a mandate and client at hand, TWDB staff quickly mobilized to get the project underway.

The initial investigation of existing data gave positive indications of potential compatibility between source water and native ground water. The presence of suitable reservoirs within the Rio Grande Alluvium was also indicated. Through the participation of the TWDB drilling rig and geophysical logging units, all exploratory field investigations are now complete. It has been determined that, while the potential storage zones were not uniformly present, there is sufficient promise of feasibility to proceed further. In addition to grant funds, a total of $117,000 of "in kind" services has been provided to the BPUB.

Currently, the Brownsville ASR Project is awaiting approval to enter the engineering design phase of the prototype ASR well. Once installed, the prototype well will be used for actual injection and recovery cycle testing. The testing cycles will investigate the rates at which water can be injected and recovered, the actual chemical compatibility of the stored water with the native water, and the potential volumes that could be stored by an operational ASR system. From the results of the cycle testing, an operational system can be designed and incorporate such modifications to the existing treatment and delivery streams as considered necessary.

Laredo - Webb County

The City of Laredo ASR project was the second application for funding received and approved by TWDB in the Fall of 1995. After incorporation of several changes to the proposed scope of work which were suggested by TWDB staff, work began in early 1996. A draft of the preliminary investigation of existing data has been received and reviewed by TWDB staff. As of December, 1996, the preliminary investigation process is being revisited to further refine geologic and water-quality data and the role which ASR could potentially serve in meeting Laredo's water supply needs.

The exploratory field investigation, supported by the TWDB drilling rig and geophysical logging units, is scheduled to begin in January, 1997. This effort will be preceded by additional support from the TWDB geophysical logging unit to help finalize the preliminary investigation. It is possible that exploratory field investigations will be complete by mid-1997. In sum, a total of $99,000 of "in kind" service has been committed to the City of Laredo.

San Antonio - Bexar County

The application for funding jointly submitted by Bexar Metropolitan Water District and San Antonio Water Systems (SAWS) was approved by the TWDB in September, 1996 and executed in December, 1996. Of the two partners, SAWS has assumed the role of lead participant with respect to project management. As of October, 1996, SAWS has made an open request for qualifications, so that an appropriately qualified consultant can be chosen. It is currently anticipated that the selection process will be completed by early-1997.

Smith, Woods, Rains and Van Zandt Counties

There have been no applicants for an ASR pilot project for these counties to come forth. The TWDB has granted the Sabine River Authority a broader water supply planning grant for the Sabine Master Plan. This plan will examine the potential for ASR applications among other water supply options.

Gillespie County

No potential operators of an ASR pilot investigation have made application for funding.

Status of ASR Pilot Project Investigations Outside of HB 1989

City of Austin

The City of Austin became interested in the ASR concept as an alternative to construction of an additional water treatment facility to serve outlying high-growth areas. A preliminary investigation of existing data along with an extensive financial benefit analysis has yielded positive results. The City of Austin was granted a "Designation of Priority" by TWDB. Currently, project progress has slowed due to budget constraints experienced by the City of Austin. Exploratory drilling will begin in late 1997, with a prototype well expected to be installed and cycle tested by late 1998.

City of Amarillo

The City of Amarillo was initially interested in ASR as an option to provide local distribution depot storage capacity. Concern was raised over the issue of needing to reach permitted operational status as soon as possible. Amarillo utility management has subsequently decided to pursue more traditional surface storage options.

City of El Paso

El Paso has gained a great deal of experience with aquifer recharge from the operation of the Fred Hervey treatment plant. The output of this plant is used to recharge the Hueco Bolson Aquifer, which has become somewhat depleted in recent years. Plans for a true ASR facility have been developed as part of the master plan for a proposed New Mexico\Texas (Rio Grande) Conveyance, Storage and Treatment System. Further investigation of the planned ASR application will await completion of various aspects of the conveyance system.

UGRA/Kerrville

This project is well beyond the pilot feasibility stage. All technical aspects have been finalized in preparation for entering operational status. TNRCC is in the process of making final inspections and granting water utility/public supply certifications.

Conclusions and Expectations for Next Biennium

While it is now more fully known that ASR is neither a new nor unproven water management technology in Texas, its feasibility still remains a site- and utility-specific question to be addressed. A main benefit of the passage of the legislation has been that of promoting *technology transfer.* It is one thing for a technology to exist, but it is of limited value unless its potential is known and utilized.

However, the goal of technology transfer has not yet been adequately fulfilled. The historical projects in the High Plains that demonstrated ASR feasibility (under those site specific conditions) are no longer operational due to lack of surplus water to store, and the existing Kerrville ASR project has not yet been made fully operational. While the level of knowledge about ASR among Texas water managers has increased significantly, it is still essentially an unproven and "exotic" new technology to many of them. It will take more study in, as-yet, unstudied areas of the State, and the active operation of successful pilot or full-scale ASR projects to bring this water management tool into the mainstream thinking of State water managers.

Legislative Proposals

More than two years have elapsed since the passage of the ASR research legislation. A more significant body of knowledge is now present on the technology than was the case when the bill was initially considered. Three major areas of potential legislative change have been identified by the Board, TNRCC, or water manager in the State:

(1) consider removing restriction in Section 11.153(a) 1-4 that designates certain counties and aquifers to be automatically eligible for the special consideration of the act so that any area which meets preliminary feasibility information requirements (to be specified by the Board) to be eligible to obtain State financial support and be eligible for TNRCC pilot research permitting.

(2) consider removing restriction in Section 11.153(d) that the TNRCC not issue any permanent ASR (surface water rights and/or injection well) permits before June 1, 1999. If a project has demonstrated pilot feasibility prior to that time and can address TNRCC issues related to issuance of a permanent permit, then the sponsor should be allowed to proceed to plan and develop a full-size ASR system.

(3) consider directing the TNRCC, with TWDB support, to investigate the feasibility and permitting of use of surface waters other than that of drinking water quality as ASR feedstock supplies, particularly when proposed for storage in aquifers of ambient water quality unsuitable for human use or of low threat to migration to aquifers of higher water quality.

Appropriation Needs

The State agencies were directed by the Legislative Budget Board not to seek any new appropriations in the upcoming biennium. As such, no additional funding for ASR research were requested by the TWDB or TNRCC in their FY1998-99 LAR.

No funds were specifically provided by the Legislature when the bill was initially passed, although the Board was able to make $ 661,000 in Federal and State grant funds available and additional in-kind support from its existing staff and equipment.

If appropriations are again made available for the Research and Planning Fund, then some portion of these proceeds could again provide for ASR research support. It is thought that some local interests may also be planning some Legislative initiative which may include a call for specific new appropriations for ASR research.

APPENDICES

HOUSE BILL 1989

AN ACT

relating to the underground storage of appropriated water incidental to a beneficial use.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF TEXAS:

SECTION 1. The legislature finds that:

(1) the underground storage of appropriated water, incidental to a beneficial use, is a beneficial use of water;

(2) the use of aquifers for storage of appropriated water:

(A) enhances the conservation and protection of appropriated water by minimizing seepage and evaporation losses;

(B) reduces the incidental environmental impacts associated with the construction of conventional water storage facilities such as aboveground reservoirs; and

(C) enhances and protects groundwater resources;

(3) the underground storage of appropriated water maximizes the conservation and beneficial use of water resources;

(4) the storage of appropriated water in aquifers recognizes existing property rights, including the rights of a landowner in groundwater;

(5) the storage of appropriated water in aquifers recognizes the authority and jurisdiction of an underground water conservation district;

(6) the use of aquifers for storage of appropriated water may reduce a portion of the economic burden on taxpayers and utility ratepayers associated with the construction of conventional water storage facilities;

(7) the successful storage of appropriated water underground has been demonstrated in Kerr County by the Upper Guadalupe River Authority in the Hosston-Sligo Aquifer; and

(8) the Texas Natural Resource Conservation Commission and the Texas Water Development Board are encouraged to evaluate additional aquifers within the state to identify the potential for storage of appropriated water underground to maximize and enhance the future availability and beneficial use of the water resources of the state.

SECTION 2. Subchapter D, Chapter 11, Water Code, is amended by adding Sections 11.153, 11.154, and 11.155 to read as follows:

{{{Sec. 11.153. PILOT PROJECTS FOR STORAGE OF APPROPRIATED WATER IN AQUIFERS. (a) The commission shall investigate the feasibility of storing appropriated water in various types of aquifers around the state by encouraging the issuance of temporary or term permits for pilot demonstration projects for the storage of appropriated water for subsequent retrieval and beneficial use in the following aquifers in the specified counties:}}}

{{{(1) the Anacacho, Austin Chalk, and Glen Rose Limestone aquifers in Bexar County and Medina County;}}}

{{{(2) the Carrizo-Wilcox aquifer in Bexar, Webb, Smith, Wood, Rains, and Van Zandt counties;}}}

{{{(3) the Hickory and Ellenberger aquifers in Gillespie County; and}}}

{{{(4) the Gulf Coast aquifer in Cameron and Hidalgo counties.}}}

{{{(b) A permit described by Subsection (a) must be for only the duration of the pilot project to provide the commission and the board further opportunity to evaluate the storage of appropriated water in aquifers for subsequent retrieval and beneficial use.}}}

{{{(c) At the conclusion of a pilot project, a permit holder may file an appropriate application for a permit or permit amendment. After considering the success of the project and the criteria set out in Section

11.154, the commission shall determine whether to issue a permit or permit amendment authorizing the continued storage of appropriated water in the aquifer.}}}

{{{(d) A final order granting a permit or amendment to a permit authorizing the storage of appropriated water in aquifers for subsequent beneficial use, other than for the pilot projects authorized by this section, may not be issued before June 1, 1999.}}}

{{{(e) The board shall participate in the study of the pilot projects authorized by Subsection (a). The pilot projects are eligible for grants from the water loan assistance fund established by Section 15.101. The board may authorize use of money from the research and planning fund established by Section 15.402 to participate in the study of pilot projects.}}}

{{{Sec. 11.154. PERMITS TO STORE APPROPRIATED WATER IN AQUIFERS. (a) An application filed with the commission to undertake a pilot project under Section 11.153 must include:}}}

{{{(1) the information required for an application for a permit or permit amendment to appropriate state water;}}}

{{{(2) all information required for an application for a permit for a Class V injection well without requiring a separate hearing or notice; and}}}

{{{(3) a map or plat showing the injection facility and the aquifer in which the water will be stored.}}}

{{{(b) If the application is for a permit or permit amendment to store appropriated water in an underground water reservoir or a subdivision of an underground water reservoir, as defined by Chapter 52, that is under the jurisdiction of an underground water conservation district:}}}

{{{(1) the applicant shall:}}}

{{{(A) provide a copy of the application to each underground water conservation district that has jurisdiction over the reservoir or subdivision;}}}

{{{(B) cooperate with the districts that have jurisdiction over the reservoir or subdivision to ensure compliance with the rules of each district;}}}

{{{(C) cooperate with each district that has jurisdiction over the reservoir or subdivision to develop rules regarding the injection, storage, and withdrawal of appropriated water stored in the aquifer; and}}}

{{{(D) comply with the rules governing the injection, storage, or withdrawal of appropriated water stored in the reservoir or subdivision that are adopted by a district that has jurisdiction over the reservoir or subdivision; and}}}

{{{(2) the commission shall require that any agreement the applicant reaches with a district that has jurisdiction over the reservoir or subdivision regarding the terms for the injection, storage, and withdrawal of appropriated water be included as a condition of the permit or permit amendment.}}}

{{{(c) On completion of a pilot project and receipt of an appropriate application for a permit or an amendment to an existing permit, the commission shall evaluate the success of the pilot project for purposes of issuing a final order granting a permit or permit amendment authorizing the storage of appropriated water incident to a beneficial use. The commission shall consider whether:}}}

{{{(1) the introduction of water into the aquifer will alter the physical, chemical, or biological quality of native groundwater to a degree that the introduction would:}}}

{{{(A) render groundwater produced from the aquifer

harmful or detrimental to people, animals, vegetation, or property; or}}}

{{{{(B) require treatment of the groundwater to a greater extent than the native groundwater requires before being applied to that beneficial use;}}}

{{{(2) the water stored in the receiving aquifer can be successfully harvested from the aquifer for beneficial use; and}}}

{{{(3) the permit holder has provided evidence that reasonable diligence will be used to protect the water stored in the receiving aquifer from unauthorized withdrawals to the extent necessary to maximize the permit holder's ability to retrieve and beneficially use the stored water without experiencing unreasonable loss of appropriated water.}}}

{{{(d) In making its evaluation under Subsection (c), the commission may consider all relevant facts, including:}}}

{{{(1) the location and depth of the aquifer in which the stored water is located;}}}

{{{(2) the nature and extent of the surface development and activity above the stored water;}}}

{{{(3) the permit holder's ability to prevent unauthorized withdrawals by contract or the exercise of the power of eminent domain;}}}

{{{(4) the existence of an underground water conservation district with jurisdiction over the aquifer storing the water and the district's ability to adopt rules to protect stored water; and}}}

{{{(5) the existence of any other political subdivision or state agency authorized to regulate the drilling of wells.}}}

{{{(e) A permit to store appropriated water in an underground water reservoir or subdivision, as defined by Chapter 52, shall provide as a condition to the permit that the permit holder shall:}}}

{{{(1) register the permit holder's injection and recovery wells with an underground water conservation district that has jurisdiction over the reservoir or subdivision, if any; and}}}

{{{(2) each calendar month, provide the district, if any, with a written report showing for the previous calendar month:}}}

{{{{(A) the amount of water injected for storage; and}}}

{{{{(B) the amount of water recaptured for use.}}}

{{{Sec. 11.155. AQUIFER STORAGE PILOT PROJECT REPORTS. (a) On completion of each pilot project, the board and the commission jointly shall:}}}

{{{(1) prepare a report evaluating the success of the project; and}}}

{{{(2) provide copies of the report to the governor, lieutenant governor, and speaker of the house of representatives.}}}

{{{(b) The board shall make other studies, investigations, and surveys of the aquifers in the state as it considers necessary to determine the occurrence, quantity, quality, and availability of other aquifers in which water may be stored and subsequently retrieved for beneficial use. The board shall undertake the studies, investigations, and surveys in the following order of priority:}}}

{{{(1) the aquifers identified in Section 11.153(a);}}}

{{{(2) areas designated by the commission as "critical areas" under Section 52.053; and}}}

{{{(3) other areas of the state in a priority to be determined by the board's ranking of where the greatest need exists.}}}

{{{(c) Not later than January 1 of each odd-numbered year, the board shall prepare and provide to the legislature a report that includes at least the following information:}}}

{{{(1) the progress of the pilot projects authorized under this

subchapter and of any related project;}}}

{{{(2) the results of the board's studies of the other aquifers of the state during the preceding biennium; and}}}

{{{(3) the anticipated appropriation from general revenues necessary to investigate other aquifers in the state during the upcoming biennium.}}}

SECTION 3. (a) The change in law made by this Act applies only to an application made on or after the effective date of this Act for a permit or a permit amendment for a pilot project to appropriate water and to store appropriated water in an aquifer identified in this Act.

(b) A permit issued by the commission authorizing the storage of appropriated water in an aquifer incident to a beneficial use before the effective date of this Act or an application for a permit or permit amendment to appropriate water that includes authorization to store appropriated water in an underground structure filed before the effective date of this Act is not affected by the changes in law made by this Act.

SECTION 4. The importance of this legislation and the crowded condition of the calendars in both houses create an emergency and an imperative public necessity that the constitutional rule requiring bills to be read on three several days in each house be suspended, and this rule is hereby suspended, and that this Act take effect and be in force from and after its passage, and it is so enacted.

_____ _____

President of the Senate Speaker of the House

I certify that H.B. No. 1989 was passed by the House on April 28, 1995, by the following vote: Yeas 136, Nays 0, 2 present, not voting; and that the House concurred in Senate amendments to H.B. No. 1989 on May 18, 1995, by the following vote: Yeas 144, Nays 0, 1 present, not voting.

_____

Chief Clerk of the House

I certify that H.B. No. 1989 was passed by the Senate, with amendments, on May 15, 1995, by the following vote: Yeas 31, Nays 0.

_____

Secretary of the Senate

APPROVED: _____

Date

_____

Governor

APPENDIX B

TEXAS WATER DEVELOPMENT BOARD
RESEARCH AND PLANNING FUND
AQUIFER STORAGE AND RECOVERY PLANNING
INSTRUCTION SHEET

The Texas Water Development Board's Research and Planning Fund offers grants to political subdivisions of the State of Texas for studies and analyses to determine the feasibility of aquifer storage and recovery (ASR) projects prior to the implementation of pilot projects for the storage of appropriated water in aquifers and subsequent retrieval of such waters for beneficial use. Activities directly related to the preparation of applications for state or federal permits or other approvals, activities associated with administrative or legal proceedings by regulatory agencies, or preparation of engineering plans and specifications are not eligible for ASR planning grant assistance. Development of a water conservation plan must be included as a specific task in the scope of work for proposed planning areas without a Board approved water conservation plan.

When to apply:
Unsolicited applications may be filed at any time, but funding is dependent upon the availability of funds. In addition, study areas will be considered for funding in the order of priority as defined in Sections 11.153-11.155 of the Texas Water Code, enacted by the 74th Regular Session of the Texas Legislature.

Who may apply:
Political subdivisions of the State of Texas with the legal authority to plan, construct, and operate ASR facilities are eligible applicants for ASR planning grants. **Political subdivisions include cities, counties, districts or authorities created under the Texas Constitution, Article III, Section 52, or Article XVI, Section 59; any other political subdivision of the State; any interstate compact commission to which the State is a party; and any non-profit water supply corporation created and operating under Texas Civil Statutes Article 1434a.**

Planning Information:
The Phase I ASR feasibility study shall include the development of detailed documentation that favorable geologic conditions exist for ASR; an investigation of the source, quantity, and quality of water available for ASR injection and the quality of water to be ultimately recovered from the ASR facility; a preliminary cost estimate of the development of the ASR facility; an investigation of other applicable water supply options; and an evaluation of the use of ASR in conjunction with other supply and storage options. A report on the findings on the feasibility of ASR should draw firm conclusions on the best water supply/storage options, determine if the scheme developed to store water in a subsurface reservoir fits within the definition of ASR, and, if ASR is determined to be feasible, include preliminary pilot program options.

Upon successful completion of the Phase I feasibility study, the Phase II ASR study shall include the design of a pilot project, the development of a project implementation plan, cost estimates of the entire pilot project including any drilling costs or construction of facilities, and assurance of regulatory compliance. To be considered for TWDB matching funds for a pilot project, the minimum information that must be provided includes a plan for full implementation of the pilot supply option and an assurance that a source of funds exists for the local share of the pilot project.

Application Submittal:
Applications are to be copied on both sides of the paper and recycled materials should be used when possible. A total of ten (10) copies of a complete application should be submitted to the following address:

Texas Water Development Board
Regional Planning and Projects
1700 North Congress
P. O. Box 13231
Austin, Texas 78711-3231

All applications **must be complete** and include general information, proposed planning information, existing system information, written assurances, and proof of notification. A list of required items with check boxes has been provided in the following pages to assist you in completing the application. **Please check the boxes after you have included the respective items in the application and return the completed checklist with the application.**

If a Grant is Awarded:
A copy of our standard contract for Research and Planning Fund grants is attached for your review.

If you have questions regarding preparation of an application, call the Texas Water Development Board's Regional Planning and Projects Section at (512) 463-7926.

Application Checklist

I. GENERAL INFORMATION

- ☐ 1. Legal name of applicant(s).
- ☐ 2. Participating political subdivision(s).
- ☐ 3. Authority of law under which the applicant was created.
- ☐ 4. Applicant's official representative, Name, Title, Mailing address, Phone number, Fax number, and, if available, E-mail Address.
- ☐ 5. Citations of applicant's legal authority to plan, construct, and operate an aquifer storage and recovery (ASR) facility for the planning area or if authority to plan is by interlocal agreement, attach agreement to application.
- ☐ 6. Total proposed planning cost
- ☐ 7. Applicant Cash Contribution to the study.
- ☐ 8. List source of cash contribution, explanation of source of local cash contribution.
- ☐ 9. Applicant In-kind contribution including a description of in-kind services to be provided.
- ☐ 10. Total grant funds requested from the Texas Water Development Board.
- ☐ 11. Detailed description of why state funding assistance is needed.
- ☐ 12. Identify potential sources and amounts of funding available for implementation of viable solutions resulting from proposed planning.

II. PLANNING INFORMATION

- ☐ 13. Describe the geographical planning area, including the proposed site of the pilot project investigation, (specify river basins, counties, cities, districts, etc. and provide explanation for selecting planning boundaries).
- ☐ 14. A map of proposed planning area including the site of the pilot project.
- ☐ 15. Average per-capita income of proposed planning area.
- ☐ 16. Current population of proposed planning area.
- ☐ 17. Current unemployment rate of proposed planning area.
- ☐ 18. Current population density of proposed planning area in persons/acre.
- ☐ 19. Average population growth rate in proposed planning area for the past 10 years.
- ☐ 20. List date(s) and description(s) of most recent water supply and/or wastewater planning in proposed planning area.
- ☐ 21. List of political subdivisions, as defined earlier, in proposed planning area.
- ☐ 22. Percentage of political subdivisions in proposed planning area that are participating.
- ☐ 23. Description of utilitiy's current or future water infrastructure needs and how the intended use of such ASR capability would address these needs, answering the following questions as appropriate. Does ASR for this project have the potential to:
    a. increase the available supply through seasonal availability and capture?

b. help meet peak distribution demands?
c. forestall expansion of existing treatment facilities?
d. alleviate the need to develop alternative storage reservoirs?
e. decrease environmental concerns by reducing seasonal diversion?

☐ 24. Identification of intended source and quality of water to be used for injection. If a source of water is not currently available, provide a plan for obtaining water that has a reasonable feasibility of being approved.

☐ 25. Identification of underground formation proposed to be used for injection reservoir.

☐ 26. Identification of the current or proposed regulatory authority or method for controlling or limiting unintended use by others of the ASR storage.

☐ 26. A detailed scope of work for proposed planning.

☐ 27. A task budget for detailed scope of work by task. *Example is attached.*

☐ 28. An expense budget for detailed scope of work by expense category. *Example is attached.*

☐ 29. A time schedule for completing detailed Scope of Work by task.

☐ 30. Method of monitoring study progress.

☐ 31. Qualifications and direct experience of proposed project staff.

III. WRITTEN ASSURANCES

Written assurance of the following items:

☐ Proposed planning does not duplicate existing projects;

☐ Implementation of viable solutions identified through the proposed planning will be diligently pursued and identification of potential sources of funding for implementation of viable solutions;

☐ If a grant is awarded, written evidence that local matching funds and in-kind services are available for the proposed planning must be provided when the contract is executed.

☐ An approved water conservation plan has been implemented in the proposed planning area or will be developed as part of the overall planning project.

IV. PROOF OF NOTIFICATION

☐ Proof of notification

Applicants must notify all political subdivisions (see cover page for definition), including especially any underground water conservation district(s), located within the proposed planning area by certified mail that an application for planning grant assistance is being filed with the Texas Water Development Board. Prior to Texas Water Development Board action on an application, the applicant must provide one copy of the notice mailed to the affected political subdivisions, a list of political subdivisions to which notice was sent, and the date the notice was sent. **The Board may not act on an application before the end of the 30-day notice period** unless all political subdivisions to which notice was required to be sent agree in writing to waive the notice period. The notification shall include the following:

☐ Name and address of applicant and applicant's official representative;

☐ Brief description of proposed planning area;

- ☐ Purpose of the proposed planning;
- ☐ Texas Water Development Board Executive Administrator's name and address; and
- ☐ Statement that any comments on the proposed planning must be filed with the applicant and the Texas Water Development Board Executive Administrator within 30 days of the date on which the notice was mailed. Included in the comments should be any conditions to be imposed on the project by any applicable underground water conservation district.

APPENDIX C

APPLICATION CRITERIA FOR TWDB CONSIDERATION OF ASR PILOT STUDY/DEMONSTRATION PROJECT SUITABILITY

For a project site to be considered for designation of an area of priority need for Aquifer Storage and Recovery (ASR) study and pilot demonstration, the Project Sponsor should submit to the Texas Water Development Board (TWDB) staff an initial feasibility report, based on available information, that would provide some early-on indication that there are no obvious "fatal flaws" in ASR being a suitable tool to help meet the Sponsor's water utility needs.

Required information in the initial feasibility report to be submitted to the TWDB:

(1) Name, address, and contact person representing the Project Sponsor,

(2) Citation of legal authority/powers to fund, construct and operate such facility,

(3) Description of the proposed site of pilot project investigation (please provide specific mapped locations),

(4) Description of the utility's current or future water infrastructure needs and how the intended use of such ASR capability would address these needs, answering the following questions as appropriate, i.e. does ASR for this project have the potential to:

a. increase the available supply through seasonal availability and capture?
b. help meet peak distribution demands?
c. forestall expansion of existing treatment facilities?
d. alleviate the need to develop alternative storage reservoirs?
e. decrease environmental concerns by reducing seasonal diversion?

(5) Documentation that a suitable source of water is currently available or description of a plan for obtaining water that has reasonable feasibility of being approved.

(6) In cases where use of treated is being contemplated, demonstration that water treatment capacity is available to produce water for the ASR project.

(7) Documentation of favorable subsurface reservoir conditions.

(8) The Sponsor's current or proposed regulatory authority or method for controlling or limiting unintended ground-water use by others of the ASR storage.

(9) If project is planned in an underground water conservation district, provide copy of notice to the district and any related comments and/or concerns made by the district.

(10) Describe the water quality of the water to be introduced into the ASR storage, the general water quality of the receiving aquifer, and the anticipated quality of the water recovered from the ASR facility.

During conduct of any later ASR pilot feasibility studies or test operations, provide TWDB staff current copies of any significant project status or study reports, as produced (as the TWDB and TNRCC are required by law to prepare a joint report to the Legislature evaluating the success of each ASR project).

Appendix D
Rank of Texas Cities by Projected Population Growth 1990-2020
(Most-likely Scenario of TWDB Projection for Year 2020)

Rank	NAME	Population 1990	Projection 2020	% change 1990-2020
1	FRISCO	6,138	40,856	565.62
2	FLOWER MOUND	15,527	73,949	376.26
3	SOUTHLAKE	7,082	33,450	372.32
4	ALLEN	19,315	90,582	368.97
5	CEDAR PARK	5,161	22,714	340.11
6	ROUND ROCK	30,923	128,044	314.07
7	GEORGETOWN	14,842	57,148	285.04
8	ROCKWALL	10,486	39,626	277.89
9	CORINTH	3,944	14,878	277.23
10	LEANDER	3,398	12,809	276.96
11	ROYSE CITY	2,206	8,311	276.75
12	CIBOLO	1,563	5,830	273.00
13	COLLEYVILLE	12,724	47,451	272.93
14	SACHSE	5,346	19,300	261.02
15	THE WOODLANDS (CDP)	29,205	100,081	242.68
16	LITTLE ELM	1,255	4,226	236.73
17	HIGHLAND VILLAGE	7,027	22,395	218.70
18	JUSTIN	1,234	3,886	214.91
19	CONVERSE	8,887	27,634	210.95
20	ZAPATA	7,119	21,732	205.27
21	KATY	8,004	24,171	201.99
22	GARDEN RIDGE	1,450	4,352	200.14
23	ROMA-LOS SAENZ	8,059	24,056	198.50
24	MANSFIELD	15,615	46,214	195.96
25	MIDLOTHIAN	5,040	14,789	193.43
26	KENNEDALE	4,096	11,974	192.33
27	HEWITT	8,983	26,099	190.54
28	SHENANDOAH	1,718	4,911	185.86
29	PATTON VILLAGE	1,155	3,299	185.63
30	LORENA	1,158	3,304	185.32
31	HEATH	2,108	5,957	182.59
32	WHITEHOUSE	4,018	11,289	180.96
33	KELLER	13,683	38,146	178.78
34	MCKINNEY	21,283	58,632	175.49
35	WOODBRANCH	1,312	3,607	174.92
36	PRESIDIO	3,072	8,437	174.64
37	KRUM	1,542	4,212	173.15
38	GATESVILLE	11,492	30,958	169.39
39	TAYLOR	11,472	30,886	169.23
40	PLANO	127,885	340,788	166.48
41	EL CENIZO	1,333	3,551	166.39
42	PANORMA VILLAGE	1,556	4,124	165.04
43	LA JOYA	2,604	6,893	164.71
44	FRIENDSWOOD	22,814	59,968	162.86
45	LAGO VISTA	2,199	5,764	162.12
46	HUDSON OAKS	711	1,859	161.46
47	WEST LAKE HILLS	2,542	6,628	160.74
48	AUBREY	1,138	2,959	160.02
49	CRANDALL	1,652	4,295	159.99
50	HIDALGO	3,292	8,492	157.96
51	TROPHY CLUB	3,922	10,087	157.19
52	HUMBLE	12,060	30,923	156.41
53	ROANOKE	1,616	4,125	155.26
54	COPPER CANYON	978	2,489	154.50
55	BROOKSHIRE	2,922	7,405	153.42
56	COPPELL	16,881	42,230	150.16
57	MISSION	28,653	71,664	150.11
58	JONESTOWN	1,250	3,108	148.64
59	SCHERTZ	10,597	26,325	148.42
60	RIO GRANDE CITY	10,725	26,642	148.41

61	FAIRVIEW	1,554	3,855	148.07
62	HEBRON	1,128	2,798	148.05
63	LAKEWAY	4,044	9,880	144.31
64	ALEDO	1,169	2,855	144.23
65	NEEDVILLE	2,199	5,366	144.02
66	WYLIE	8,716	21,252	143.83
67	GRANITE SHOALS	1,378	3,359	143.76
68	LAREDO	122,899	299,080	143.35
69	TOMBALL	6,370	15,500	143.33
70	ROWLETT	23,260	56,571	143.21
71	CEDAR HILL	19,988	48,446	142.38
72	GARFIELD CDP	1,336	3,211	140.34
73	NEW BRAUNFELS	27,334	65,417	139.32
74	SEAGOVILLE	8,969	21,443	139.08
75	PFLUGERVILLE	4,444	10,611	138.77
76	SUGAR LAND	33,712	80,489	138.75
77	FAIROAKS RANCH	1,860	4,409	137.04
78	PHARR	32,921	77,929	136.72
79	MABANK	1,739	4,110	136.34
80	SANTA FE	8,444	19,932	136.05
81	HICKORY CREEK	1,893	4,410	132.96
82	KEMP	1,184	2,758	132.94
83	LUCAS	2,205	5,135	132.88
84	PILOT POINT	2,538	5,910	132.86
85	PEARLAND	18,927	43,990	132.42
86	GRANBURY	4,045	9,399	132.36
87	RED OAK	3,124	7,213	130.89
88	LEWISVILLE	46,521	106,403	128.72
89	PALMVIEW	1,818	4,145	128.00
90	LA VILLA	1,388	3,154	127.23
91	CONROE	27,675	62,836	127.05
92	ALTON	3,069	6,946	126.33
93	WILLIS	2,764	6,251	126.16
94	SAN ELIZARIO (CDP)	4,385	9,839	124.38
95	ANAHUAC	1,993	4,456	123.58
96	SPRINGTOWN	1,740	3,873	122.59
97	LA PORTE	27,910	61,948	121.96
98	SOCORRO	22,995	51,027	121.90
99	PROSPER	1,018	2,256	121.61
100	FULSHEAR	557	1,231	121.01
101	PELICAN BAY	1,271	2,800	120.30
102	DOUBLE OAK	1,664	3,643	118.93
103	ALAMO	8,210	17,955	118.70
104	HOLIDAY LAKES	1,039	2,264	117.90
105	CLEAR LAKE SHORE	1,096	2,377	116.88
106	BUDA	1,795	3,884	116.38
107	SANGER	3,514	7,594	116.11
108	STAFFORD	8,397	18,145	116.09
109	ST. HEDWIG	1,443	3,107	115.32
110	JOSHUA	3,821	8,189	114.32
111	GRANGER	1,190	2,548	114.12
112	WILLOW PARK	2,328	4,981	113.96
113	MARBLE FALLS	4,007	8,567	113.80
114	DALWORTHINGTON G	1,758	3,749	113.25
115	MANOR	1,041	2,208	112.10
116	OLD RIVER-WINFRE	1,233	2,613	111.92
117	HELOTES	1,535	3,251	111.79
118	WIMBERLEY (CDP)	2,403	5,001	108.11
119	MELISSA	557	1,158	107.90
120	BAYOU VISTA	1,320	2,744	107.88
121	LA GRULLA	1,335	2,772	107.64
122	LUMBERTON	6,640	13,779	107.52
123	BARTONVILLE	849	1,758	107.07
124	PARKER	1,213	2,505	106.51
125	OAK POINT	645	1,329	106.05
126	PALMER	1,659	3,407	105.36
127	LACOSTE	1,021	2,092	104.90

128	FLORENCE	829	1,682	102.90
129	QUINLAN	1,360	2,752	102.35
130	BEACH CITY	852	1,709	100.59
131	SHADY SHORES	1,045	2,092	100.19
132	CELINA	1,737	3,476	100.12
133	SAN PERLITA	512	1,024	100.00
134	WALLER	1,493	2,984	99.87
135	DONNA	12,652	25,213	99.28
136	RICHMOND	10,042	19,985	99.01
137	MAGNOLIA	940	1,869	98.83
138	AUSTIN	472,020	938,489	98.82
139	BURLESON	16,113	32,036	98.82
140	HORIZON CITY	2,308	4,585	98.66
141	SHELDON	1,653	3,279	98.37
142	WINNIE	2,238	4,439	98.35
143	MISSOURI CITY	36,176	71,661	98.09
144	LEAGUE CITY	30,159	59,613	97.66
145	HASLET+	795	1,569	97.36
146	HALLSVILLE	2,288	4,514	97.29
147	BRIAR	3,899	7,682	97.02
148	EDINBURG	31,091	61,208	96.87
149	MORGANS POINT RE	1,766	3,450	95.36
150	WEATHERFORD	14,804	28,817	94.66
151	EAGLE PASS	20,651	40,117	94.26
152	PROGRESO	1,951	3,785	94.00
153	ANTHONY	3,328	6,422	92.97
154	ROLLINGWOOD	1,388	2,678	92.94
155	BOERNE	4,361	8,401	92.64
156	SUNNYVALE	2,228	4,292	92.64
157	DRIPPING SPRINGS	1,033	1,989	92.55
158	WESLACO	22,739	43,710	92.22
159	GREGORY	2,458	4,720	92.03
160	KRUGERVILLE	735	1,409	91.70
161	JERSEY VILLAGE	4,826	9,235	91.36
162	ITALY	1,699	3,235	90.41
163	FARMERSVILLE	2,640	4,999	89.36
164	BOYD	1,041	1,968	89.05
165	BASTROP	4,044	7,631	88.70
166	RIO HONDO	1,793	3,380	88.51
167	MEADOWS	4,606	8,667	88.17
168	NORTH RICHLAND H	45,895	86,349	88.14
169	GRAPEVINE	29,198	54,652	87.18
170	ONALASKA	728	1,358	86.54
171	CHINA GROVE	872	1,624	86.24
172	PRIMERA	2,030	3,763	85.37
173	COMBES	2,042	3,785	85.36
174	ARGYLE	1,575	2,898	84.00
175	LIVE OAK	10,023	18,430	83.88
176	KILLEEN	63,535	116,767	83.78
177	ADDISON	8,783	16,128	83.63
178	ELMENDORF	568	1,043	83.63
179	MURPHY	1,547	2,834	83.19
180	HUNTSVILLE	27,925	51,151	83.17
181	HARKER HEIGHTS	12,932	23,612	82.59
182	SOUTH PADRE ISLA	1,677	3,046	81.63
183	RICHWOOD	2,732	4,959	81.52
184	GLENN HEIGHTS	4,564	8,276	81.33
185	DE SOTO	30,544	55,264	80.93
186	HILL COUNTRY VIL	1,038	1,874	80.54
187	UNIVERSAL CITY	13,057	23,502	80.00
188	SAN JUAN	12,561	22,507	79.18
189	NOLANVILLE	1,834	3,285	79.12
190	AZLE	8,868	15,871	78.97
191	OAK RIDGE NORTH	2,454	4,391	78.93
192	COPPERAS COVE	24,079	43,053	78.80
193	CARRIZO SPRINGS	5,745	10,259	78.57
194	BLOSSOM	1,440	2,566	78.19

195	HOLLYWOOD PARK	2,870	5,114	78.19
196	LIBERTY CITY	1,607	2,863	78.16
197	DEER PARK	27,424	48,828	78.05
198	PALM VALLEY	1,199	2,132	77.81
199	WEBSTER	4,678	8,309	77.62
200	THRALL	550	976	77.45
201	BANDERA	877	1,551	76.85
202	FORNEY	4,070	7,193	76.73
203	CLINT	1,035	1,824	76.23
204	ALVIN	19,220	33,822	75.97
205	CHATEAU WOODS	641	1,127	75.82
206	CANUTILLO	4,442	7,804	75.69
207	ANNETTA	672	1,180	75.60
208	NATALIA	1,216	2,126	74.84
209	STOWELL (CDP)	1,419	2,477	74.56
210	LA FERIA	4,360	7,610	74.54
211	BROWNSVILLE	107,027	186,487	74.24
212	WAXAHACHIE	17,984	31,330	74.21
213	HILLCREST	695	1,210	74.10
214	SEADRIFT	1,277	2,212	73.22
215	JONES CREEK	2,160	3,729	72.64
216	HEBBRONVILLE	4,465	7,670	71.78
217	MERCEDES	12,694	21,797	71.71
218	KIRBY	8,326	14,276	71.46
219	ARP	812	1,391	71.31
220	ANDERSON	320	547	70.94
221	SAN FELIPE	618	1,055	70.71
222	JOHNSON CITY	932	1,589	70.49
223	SEABROOK	6,685	11,355	69.86
224	EL PASO	515,342	873,710	69.54
225	OVILLA	2,027	3,430	69.22
226	HOLLAND	1,118	1,891	69.14
227	SAN ANTONIO	959,295	1,621,857	69.07
228	CUT AND SHOOT	903	1,523	68.66
229	SANTA ROSA	2,223	3,745	68.47
230	BURNET	3,423	5,764	68.39
231	ANGLETON	17,140	28,835	68.23
232	BLOOMINGTON	1,888	3,174	68.11
233	BAYTOWN	63,843	107,326	68.11
234	ROSENBERG	20,183	33,802	67.48
235	IRAAN	1,322	2,212	67.32
236	SEALY	4,541	7,598	67.32
237	MERKEL	2,469	4,130	67.27
238	ROMAN FOREST	1,033	1,724	66.89
239	WOODVILLE	2,636	4,398	66.84
240	CHANDLER	1,630	2,718	66.75
241	FREER	3,271	5,451	66.65
242	ALVARADO	2,918	4,851	66.24
243	INGLESIDE	5,696	9,462	66.12
244	MCALLEN	84,021	139,070	65.52
245	LOCKHART	9,205	15,229	65.44
246	KAUFMAN	5,251	8,672	65.15
247	ROCKPORT	5,355	8,839	65.06
248	WOODWAY	8,695	14,335	64.86
249	SAN MARCOS	28,738	47,370	64.83
250	MANVEL	3,733	6,153	64.83
251	PORT ISABEL	4,467	7,340	64.32
252	COMBINE	1,329	2,181	64.11
253	HARLINGEN	48,746	79,739	63.58
254	PRAIRIE VIEW	4,004	6,549	63.56
255	CADDO MILLS	1,068	1,742	63.11
256	BRAZORIA	2,717	4,430	63.05
257	SAN BENITO	20,125	32,721	62.59
258	SPLENDORA	745	1,211	62.55
259	OYSTER CREEK	912	1,482	62.50
260	HUNTINGTON	1,794	2,914	62.43
261	KERRVILLE	17,384	28,226	62.37

262	LA VERNIA	639	1,036	62.13
263	HEDWIG VILLAGE	2,616	4,232	61.77
264	CHARLOTTE	1,475	2,383	61.56
265	MIDLAND	89,443	144,454	61.50
266	LIVINGSTON	5,019	8,102	61.43
267	KINGSVILLE	25,276	40,702	61.03
268	SAGINAW	8,551	13,757	60.88
269	TAYLOR LAKE VILL	3,352	5,392	60.86
270	LOS FRESNOS	2,473	3,970	60.53
271	CORRIGAN	1,764	2,830	60.43
272	SHOREACRES	1,316	2,110	60.33
273	CLUTE	9,467	15,169	60.23
274	BELTON	12,463	19,917	59.81
275	ALPINE	5,622	8,981	59.75
276	CACTUS	1,529	2,441	59.65
277	HIGHLANDS	6,632	10,566	59.32
278	TERRELL	12,490	19,872	59.10
279	SULLIVAN CITY (CDP)	2,371	3,768	58.92
280	LAKE JACKSON	22,771	36,133	58.68
281	HITCHCOCK	5,868	9,294	58.38
282	CLEVELAND	7,124	11,265	58.13
283	PINE FOREST	709	1,121	58.11
284	TIKI ISLAND	537	848	57.91
285	EDCOUCH	2,878	4,542	57.82
286	HUTCHINS	2,719	4,290	57.78
287	SPRING VALLEY	3,392	5,345	57.58
288	UVALDE	14,729	23,185	57.41
289	DENTON	66,270	104,283	57.36
290	SHAVANO PARK	1,708	2,687	57.32
291	MESQUITE	101,484	159,638	57.30
292	RANCHO VIEJO	885	1,392	57.29
293	MISSION BEND+(CDP)	24,945	39,221	57.23
294	ELGIN	4,846	7,612	57.08
295	LYTLE	2,255	3,542	57.07
296	HART	1,221	1,909	56.35
297	TOWN WEST (CDP)	6,166	9,638	56.31
298	CROWLEY	6,974	10,900	56.29
299	OAK GROVE	557	869	56.01
300	LA GRANGE	3,951	6,158	55.86
301	EL LAGO	3,269	5,090	55.71
302	RENO	1,784	2,774	55.49
303	COTTONWOOD SHORES	548	852	55.47
304	SABINAL	1,584	2,460	55.30
305	GUN BARREL CITY	3,526	5,473	55.22
306	PLEASANTON	7,678	11,904	55.04
307	NACOGDOCHES	30,872	47,855	55.01
308	SUNRAY	1,729	2,678	54.89
309	BREMOND	1,110	1,719	54.86
310	DICKINSON	11,692	18,088	54.70
311	MOUNT VERNON	2,219	3,428	54.48
312	NEWTON	1,885	2,908	54.27
313	ODEM	2,366	3,648	54.18
314	HUTTO	630	971	54.13
315	INGRAM	1,408	2,170	54.12
316	SOUTHSIDE PLACE	1,392	2,143	53.95
317	THE COLONY	22,113	34,036	53.92
318	BALCH SPRINGS	17,406	26,774	53.82
319	CHANNING	277	426	53.79
320	JOURDANTON	3,220	4,952	53.79
321	POTTSBORO	1,177	1,809	53.70
322	SURFSIDE BEACH	611	939	53.68
323	PASADENA	119,604	183,389	53.33
324	ANNA	904	1,381	52.77
325	RENO	2,322	3,546	52.71
326	POTH	1,642	2,507	52.68
327	PINEY POINT VILL	3,197	4,873	52.42
328	CASTROVILLE	2,159	3,289	52.34

329	FRANKLIN	1,336	2,032	52.10
330	DECATUR	4,245	6,453	52.01
331	POTEET	3,206	4,870	51.90
332	NEW SUMMERFIELD	521	791	51.82
333	RICHLAND HILLS	7,978	12,109	51.78
334	LAGUNA VISTA	1,166	1,766	51.46
335	STOCKDALE	1,268	1,915	51.03
336	BUFFALO	1,555	2,347	50.93
337	HUNTERS CREEK VI	3,954	5,967	50.91
338	PETERSBURG	1,292	1,944	50.46
339	CROSBY	1,811	2,721	50.25
340	WOLFFORTH	1,941	2,916	50.23
341	WALLIS	1,001	1,503	50.15
342	BENBROOK	19,564	29,354	50.04
343	ELSA	5,242	7,860	49.94
344	DENVER CITY	5,145	7,714	49.93
345	IOWA COLONY	675	1,012	49.93
346	OAK LEAF	984	1,474	49.80
347	FIRST COLONY (CDP)	18,327	27,453	49.80
348	SAN ANGELO	84,462	126,204	49.42
349	NEWARK+	651	971	49.16
350	HOUSTON	1,637,859	2,440,170	48.99
351	GRAND PRAIRIE	99,606	148,144	48.73
352	LACY-LAKEVIEW	3,617	5,379	48.71
353	MOODY	1,329	1,976	48.68
354	HEMPSTEAD	3,556	5,284	48.59
355	COLUMBUS	3,367	5,003	48.59
356	RAYMONDVILLE	8,880	13,181	48.43
357	CENTERVILLE	812	1,202	48.03
358	NASSAU BAY	4,320	6,391	47.94
359	LAKE TANGLEWOOD	637	941	47.72
360	CORPUS CHRISTI	257,453	379,799	47.52
361	CLEBURNE	22,205	32,649	47.03
362	BEEVILLE	13,547	19,906	46.94
363	DEL RIO	30,705	44,960	46.43
364	EUSTACE	662	968	46.22
365	KOUNTZE	2,067	3,018	46.01
366	HONDO	6,018	8,782	45.93
367	ARANSAS PASS	7,180	10,455	45.61
368	LITTLE RIVER-ACA	1,390	2,024	45.61
369	PREMONT	2,914	4,239	45.47
370	FLORESVILLE	5,247	7,631	45.44
371	LAKESIDE CITY+	865	1,258	45.43
372	MCNAIR	2,000	2,908	45.40
373	LIBERTY	7,690	11,166	45.20
374	FERRIS	2,229	3,236	45.18
375	MATHIS	5,423	7,871	45.14
376	GRANDVIEW	1,245	1,805	44.98
377	AMES	989	1,433	44.89
378	FABENS	5,599	8,110	44.85
379	SEGUIN	18,692	27,040	44.66
380	SOUTHMAYD	643	928	44.32
381	SHALLOWATER	1,708	2,462	44.15
382	FORT DAVIS	900	1,296	44.00
383	GARDEN CITY	300	431	43.67
384	CARROLLTON	82,169	118,043	43.66
385	BISHOP	3,337	4,789	43.51
386	BROOKSIDE	1,571	2,253	43.41
387	BRYAN	55,002	78,839	43.34
388	VAN VLECK	1,534	2,198	43.29
389	EAST BERNARD	1,544	2,212	43.26
390	DANBURY	1,447	2,069	42.99
391	RHOME	605	865	42.98
392	ROCKDALE	5,235	7,474	42.77
393	SMITHVILLE	3,196	4,561	42.71
394	LAKE DALLAS	3,656	5,214	42.61
395	HEARNE	5,132	7,305	42.34

396	DILLEY	2,632	3,746	42.33
397	DUMAS	12,871	18,312	42.27
398	DELL CITY	569	809	42.18
399	SOUTH HOUSTON	14,207	20,165	41.94
400	ZAVALLA	701	993	41.65
401	GALVESTON	59,067	83,629	41.58
402	MARFA	2,424	3,428	41.42
403	WEST COLUMBIA	4,372	6,171	41.15
404	PEARSALL	6,924	9,770	41.10
405	LYFORD	1,674	2,360	40.98
406	SOUR LAKE	1,547	2,179	40.85
407	SINTON	5,549	7,810	40.75
408	EULESS	38,149	53,634	40.59
409	BRIDGE CITY	8,010	11,258	40.55
410	DAYTON	5,042	7,085	40.52
411	LINDSAY	610	856	40.33
412	VAN ALSTYNE	2,090	2,930	40.19
413	ARLINGTON	261,717	366,760	40.14
414	SUNDOWN	1,759	2,464	40.08
415	TOOL	1,712	2,393	39.78
416	AMARILLO	157,571	219,534	39.32
417	BELLVILLE	3,378	4,705	39.28
418	BEVERLY HILLS	2,048	2,852	39.26
419	CELESTE	733	1,020	39.15
420	SWEENY	3,297	4,587	39.13
421	EAGLE LAKE	3,551	4,939	39.09
422	LANCASTER	22,117	30,759	39.07
423	ROSE CITY	572	795	38.99
424	GRAPELAND	1,450	2,015	38.97
425	RANSOM CANYON*	763	1,060	38.93
426	WACO	103,590	143,723	38.74
427	LUFKIN	30,206	41,875	38.63
428	TROY	1,395	1,933	38.57
429	BALCONES HEIGHTS	3,022	4,182	38.39
430	BRIDGEPORT	3,581	4,951	38.26
431	PORT ARANSAS	2,233	3,084	38.11
432	WHITE OAK	5,136	7,089	38.03
433	FLATONIA	1,295	1,787	37.99
434	COTULLA	3,694	5,096	37.95
435	JEWETT	668	920	37.72
436	COLLEGE STATION	52,443	72,224	37.72
437	GUNTER	898	1,235	37.53
438	FREDERICKSBURG	6,934	9,528	37.41
439	FARWELL	1,373	1,885	37.29
440	KEENE	3,944	5,412	37.22
441	SHEPHERD	1,812	2,485	37.14
442	EAST MOUNTAIN	762	1,045	37.14
443	WORTHAM	1,020	1,397	36.96
444	MARTINDALE	904	1,238	36.95
445	FAIRFIELD	3,234	4,420	36.67
446	BRUSHY CREEK (CDP)	5,833	7,972	36.67
447	BARRETT	3,052	4,169	36.60
448	MART	2,014	2,751	36.59
449	GARRISON	883	1,206	36.58
450	ANDREWS	10,678	14,551	36.27
451	PALACIOS	4,418	6,016	36.17
452	BAY CITY	18,170	24,721	36.05
453	SONORA	2,751	3,736	35.81
454	MILFORD	711	964	35.58
455	RUNGE	1,139	1,544	35.56
456	KARNES CITY	2,916	3,949	35.43
457	BOVINA	1,549	2,097	35.38
458	TEXAS CITY	40,822	55,261	35.37
459	KENEDY	3,763	5,092	35.32
460	DEVINE	3,928	5,310	35.18
461	OLMOS PARK	2,161	2,920	35.12
462	CASTLE HILLS	4,198	5,667	34.99

463	ROBINSON	7,111	9,595	34.93
464	DIMMITT	4,408	5,947	34.91
465	JOAQUIN	805	1,086	34.91
466	WEST ORANGE	4,187	5,647	34.87
467	GLADEWATER	6,027	8,121	34.74
468	CALVERT	1,536	2,066	34.51
469	IDALOU	2,074	2,789	34.47
470	HEREFORD	14,745	19,824	34.45
471	ODESSA	89,699	120,534	34.38
472	SPRING (CDP)	33,111	44,407	34.12
473	EAST TAWAKONI	642	861	34.11
474	LA MARQUE	14,120	18,931	34.07
475	BERRYVILLE	749	1,004	34.05
476	STERLING CITY	1,096	1,468	33.94
477	BULLARD+	890	1,191	33.82
478	SAN AUGUSTINE	2,337	3,127	33.80
479	ABERNATHY	2,720	3,636	33.68
480	HUDSON	2,374	3,169	33.49
481	CRANE	3,533	4,716	33.48
482	VICTORIA	55,076	73,496	33.44
483	ENNIS	13,869	18,484	33.28
484	TAFT	3,222	4,293	33.24
485	BIG LAKE	3,672	4,888	33.12
486	MARKHAM (CDP)	1,206	1,605	33.08
487	ORE CITY	898	1,194	32.96
488	PORTLAND	12,224	16,251	32.94
489	MALAKOFF	2,038	2,708	32.88
490	PLAINS	1,422	1,889	32.84
491	IRVING	155,037	205,810	32.75
492	LEXINGTON	953	1,264	32.63
493	BRENHAM	11,952	15,847	32.59
494	ABILENE	106,707	141,446	32.56
495	GILMER	4,824	6,390	32.46
496	ANDERSON MILL+(CDP)	9,468	12,540	32.45
497	RANKIN	1,011	1,338	32.34
498	KILGORE	11,066	14,644	32.33
499	TROUP	1,659	2,193	32.19
500	BIG SANDY	1,185	1,566	32.15
501	BELLMEAD	8,336	11,006	32.03
502	FORT STOCKTON	8,524	11,246	31.93
503	OMAHA	833	1,099	31.93
504	WINNSBORO	2,904	3,831	31.92
505	BROWNFIELD	9,560	12,602	31.82
506	ROGERS	1,131	1,487	31.48
507	GIDDINGS	4,093	5,379	31.42
508	ASHERTON	1,608	2,113	31.41
509	CALDWELL	3,181	4,180	31.41
510	PECOS	12,069	15,857	31.39
511	LUELLA	559	734	31.31
512	LEON VALLEY	9,581	12,577	31.27
513	CANYON	11,365	14,913	31.22
514	GALENA PARK	10,033	13,163	31.20
515	FRIONA	3,688	4,836	31.13
516	COMFORT (CDP)	1,477	1,936	31.08
517	SEMINOLE	6,342	8,308	31.00
518	CANTON	2,949	3,861	30.93
519	WHARTON	9,011	11,788	30.82
520	EARLY	2,380	3,111	30.71
521	JACINTO CITY	9,343	12,196	30.54
522	DUNCANVILLE	35,008	45,691	30.52
523	EDGEWOOD	1,284	1,674	30.37
524	PAYNE SPRINGS	606	790	30.36
525	VAN HORN	2,930	3,814	30.17
526	PALO PINTO	350	455	30.00
527	CUMBY*	584	759	29.97
528	BLUE RIDGE	521	677	29.94
529	VAN	1,854	2,408	29.88

530	FORT WORTH	447,619	580,375	29.66
531	LONGVIEW	70,311	91,157	29.65
532	THORNDALE	1,092	1,415	29.58
533	GLEN ROSE	1,949	2,520	29.30
534	OZONA	3,181	4,109	29.17
535	CAMPBELL	683	882	29.14
536	SOMERVILLE	1,542	1,991	29.12
537	BARTLETT	1,439	1,858	29.12
538	TEMPLE	46,150	59,513	28.96
539	LINDALE	2,428	3,131	28.95
540	SAN DIEGO	4,983	6,423	28.90
541	MERIDIAN	1,390	1,791	28.85
542	ROBSTOWN	12,849	16,549	28.80
543	ROCKSPRINGS	1,339	1,723	28.68
544	LEAKEY	399	513	28.57
545	NORTH SAN PEDRO	953	1,225	28.54
546	OAKWOOD	527	677	28.46
547	WATAUGA	20,009	25,700	28.44
548	CLIFTON	3,195	4,102	28.39
549	ROSEBUD	1,638	2,102	28.33
550	PANHANDLE	2,353	3,018	28.26
551	DAISETTA	969	1,242	28.17
552	RICHARDSON	74,840	95,883	28.12
553	ORANGE GROVE	1,175	1,505	28.09
554	COLORADO CITY	4,749	6,071	27.84
555	FREEPORT	11,389	14,559	27.83
556	WINK	1,189	1,517	27.59
557	SARITA	185	236	27.57
558	BUNKER HILL VILL	3,391	4,323	27.48
559	NAVASOTA	6,296	8,022	27.41
560	WILLS POINT	2,986	3,802	27.33
561	CENTER	4,950	6,301	27.29
562	QUITMAN	1,684	2,140	27.08
563	HAWKINS	1,309	1,663	27.04
564	ELDORADO	2,019	2,565	27.04
565	CHINA	1,144	1,452	26.92
566	MINEOLA	4,321	5,480	26.82
567	LUBBOCK	186,206	236,144	26.82
568	HOMESTEAD MEADOWS (CDP	4,978	6,312	26.80
569	BESSMAY-BUNA	2,127	2,695	26.70
570	BEVIL OAKS	1,350	1,710	26.67
571	PORT LAVACA	10,886	13,784	26.62
572	TERRELL HILLS	4,592	5,810	26.52
573	JAMAICA BEACH	624	789	26.44
574	YORKTOWN	2,207	2,786	26.23
575	BENAVIDES	1,788	2,257	26.23
576	ORANGE	19,370	24,444	26.20
577	SEBASTIAN (CDP)	1,598	2,016	26.16
578	MCCAMEY	2,493	3,142	26.03
579	KYLE	2,225	2,803	25.98
580	ALICE	19,788	24,910	25.88
581	GARLAND	180,635	227,100	25.72
582	SNYDER	12,195	15,330	25.71
583	HALLETTSVILLE	2,718	3,413	25.57
584	BELLAIRE	13,842	17,379	25.55
585	YOAKUM	5,611	7,043	25.52
586	FALFURRIAS	5,788	7,264	25.50
587	GRAND SALINE	2,630	3,296	25.32
588	CLARKSVILLE CITY+	720	900	25.00
589	VINTON	605	756	24.96
590	PINEHURST	2,682	3,351	24.94
591	MCGREGOR	4,683	5,845	24.81
592	SALADO (CDP)	1,216	1,514	24.51
593	SCHULENBURG	2,455	3,053	24.36
594	GEORGE WEST	2,586	3,204	23.90
595	MURCHISON	510	631	23.73
596	MORTON	2,597	3,213	23.72

597	WHITE DEER	1,125	1,391	23.64
598	ALVORD	865	1,068	23.47
599	ATHENS	10,982	13,555	23.43
600	MARSHALL	23,682	29,199	23.30
601	AURORA	623	768	23.27
602	KIRBYVILLE	1,871	2,306	23.25
603	WEIMAR	2,052	2,526	23.10
604	VEGA	840	1,034	23.10
605	MUENSTER	1,387	1,705	22.93
606	NAPLES	1,508	1,852	22.81
607	VENUS+*	979	1,201	22.68
608	DETROIT	706	866	22.66
609	LONE OAK	521	639	22.65
610	COMMERCE	6,825	8,363	22.53
611	COLLINSVILLE	1,033	1,265	22.46
612	WOLFE CITY	1,505	1,842	22.39
613	COMO	563	689	22.38
614	TAHOKA	2,868	3,509	22.35
615	WEST ODESSA (CDP)	16,568	20,264	22.31
616	WINDCREST	5,331	6,520	22.30
617	POINT COMFORT	956	1,169	22.28
618	TRINIDAD	1,056	1,291	22.25
619	WILMER	2,479	3,027	22.11
620	KERMIT	6,875	8,393	22.08
621	JACKSBORO	3,350	4,083	21.88
622	BURKBURNETT	10,145	12,359	21.82
623	LOMETA	625	761	21.76
624	MARLIN	6,386	7,774	21.74
625	STANTON	2,576	3,135	21.70
626	GOLIAD	1,946	2,368	21.69
627	ANTON	1,212	1,474	21.62
628	WEST TAWAKONI	932	1,133	21.57
629	BLUE MOUND	2,133	2,593	21.57
630	WEST UNIVERSITY	12,920	15,693	21.46
631	BAILEY'S PRAIRIE	634	769	21.29
632	HOWE	2,173	2,635	21.26
633	NASH	2,162	2,621	21.23
634	SHINER	2,074	2,510	21.02
635	LAMPASAS	6,382	7,708	20.78
636	ELECTRA	3,113	3,758	20.72
637	BEAUMONT	114,323	137,900	20.62
638	MEADOWLAKES	514	620	20.62
639	NEW WAVERLY	936	1,128	20.51
640	GROESBECK	3,360	4,049	20.51
641	COLMESNEIL	569	685	20.39
642	CHICO	800	962	20.25
643	WESTWAY (CDP)	2,381	2,862	20.20
644	LAKE WORTH VILLA	4,591	5,517	20.17
645	CUSHING	587	704	19.93
646	KEMAH	1,094	1,312	19.93
647	LEVELLAND	13,986	16,744	19.72
648	HUGHES SPRINGS	1,938	2,320	19.71
649	TULIA	4,703	5,629	19.69
650	FARMERS BRANCH	24,250	29,021	19.67
651	GAINESVILLE	14,256	17,052	19.61
652	MONT BELVIEU	1,323	1,580	19.43
653	ALAMO HEIGHTS	6,502	7,759	19.33
654	STAMFORD	3,817	4,552	19.26
655	KERENS	1,702	2,029	19.21
656	HURST	33,574	39,989	19.11
657	LLANO	2,962	3,527	19.07
658	SOMERSET	1,144	1,361	18.97
659	EDNA	5,343	6,355	18.94
660	TOM BEAN	827	983	18.86
661	WAKE VILLAGE	4,761	5,657	18.82
662	TIMPSON	1,029	1,222	18.76
663	O'DONNELL	1,102	1,307	18.60

664	VIDOR	10,935	12,955	18.47
665	GONZALES	6,527	7,725	18.35
666	PALESTINE	18,042	21,342	18.29
667	FOREST HILL	11,482	13,580	18.27
668	WASKOM	1,812	2,143	18.27
669	STRATFORD	1,781	2,104	18.14
670	NIXON	1,995	2,353	17.94
671	ALTO	1,027	1,211	17.92
672	TENAHA	1,072	1,264	17.91
673	QUEEN CITY	1,748	2,061	17.91
674	MCQUEENEY (CDP)	2,063	2,432	17.89
675	BIG WELLS	756	891	17.86
676	FORT GATES	818	964	17.85
677	IOWA PARK	6,072	7,154	17.82
678	EARTH	1,228	1,446	17.75
679	PECAN HILL	564	664	17.73
680	REFUGIO	3,158	3,717	17.70
681	ELKHART	1,076	1,266	17.66
682	DALHART	6,246	7,347	17.63
683	CLAUDE	1,199	1,410	17.60
684	POINT	645	758	17.52
685	MOUNT PLEASANT	12,291	14,438	17.47
686	CUERO	6,700	7,869	17.45
687	MAYPEARL	781	917	17.41
688	CORSICANA	22,911	26,899	17.41
689	HALE CENTER	2,067	2,426	17.37
690	NEW DEAL	521	611	17.27
691	NEW BOSTON	5,057	5,926	17.18
692	HEMPHILL	1,182	1,384	17.09
693	SIERRA BLANCA	574	672	17.07
694	HALTOM CITY	32,856	38,443	17.00
695	LEONARD	1,744	2,039	16.92
696	LITTLEFIELD	6,489	7,584	16.87
697	SEVEN POINTS+	723	845	16.87
698	HAMLIN	2,791	3,260	16.80
699	FRANKSTON	1,127	1,316	16.77
700	ROSCOE	1,446	1,687	16.67
701	ANSON	2,644	3,084	16.64
702	MINERAL WELLS	14,935	17,408	16.56
703	NEW LONDON	926	1,079	16.52
704	SAN LEON (CDP)	3,328	3,873	16.38
705	PERRYTON	7,619	8,863	16.33
706	SUDAN	983	1,141	16.07
707	REDWATER	824	956	16.02
708	STEPHENVILLE	13,502	15,663	16.01
709	MEXIA	6,933	8,042	16.00
710	TURKEY	507	588	15.98
711	WICHITA FALLS	96,259	111,590	15.93
712	LINDEN	2,375	2,753	15.92
713	RIO VISTA	541	627	15.90
714	PORT NECHES	12,908	14,953	15.84
715	PITTSBURG	4,007	4,641	15.82
716	OLTON	2,116	2,449	15.74
717	RICE+	564	652	15.60
718	THORNTON	540	624	15.56
719	CRYSTAL CITY	8,263	9,547	15.54
720	LAMESA	10,809	12,485	15.51
721	CANADIAN	2,417	2,789	15.39
722	MILES	793	915	15.38
723	PORT ARTHUR	58,551	67,548	15.37
724	MEADOW	547	631	15.36
725	GROVES	16,744	19,314	15.35
726	BRUCEVILLE-EDDY	1,075	1,239	15.26
727	TYLER	75,450	86,947	15.24
728	SHERMAN	31,584	36,378	15.18
729	WOODCREEK	889	1,022	14.96
730	GROVETON	1,071	1,229	14.75

731	THREE RIVERS	1,889	2,163	14.51
732	DE KALB	1,976	2,261	14.42
733	WHITEWRIGHT	1,713	1,960	14.42
734	WALNUT SPRINGS	716	819	14.39
735	WINTERS	2,905	3,320	14.29
736	BEDFORD	43,762	50,000	14.25
737	MCLEAN	849	970	14.25
738	JASPER	7,160	8,178	14.22
739	BERTRAM	849	969	14.13
740	COLDSPRING	538	614	14.13
741	SEAGRAVES	2,398	2,736	14.10
742	BATESVILLE (CDP)	1,313	1,497	14.01
743	COCKRELL HILL	3,746	4,270	13.99
744	WELLS BRANCH (CDP)	7,094	8,084	13.96
745	TRINITY	2,648	3,016	13.90
746	KNOX CITY	1,440	1,640	13.89
747	FLOYDADA	3,896	4,437	13.89
748	PINE ISLAND	571	650	13.84
749	EL CAMPO	10,511	11,961	13.80
750	JACKSONVILLE	12,765	14,525	13.79
751	PAMPA	19,959	22,698	13.72
752	BOLING-IAGO (CDP)	1,119	1,271	13.58
753	WOODSBORO	1,731	1,964	13.46
754	GANADO	1,701	1,928	13.35
755	BENJAMIN	225	255	13.33
756	SLATON	6,078	6,884	13.26
757	LAKEPORT	710	804	13.24
758	CROCKETT	7,024	7,952	13.21
759	BALLINGER	3,975	4,492	13.01
760	GOLDTHWAITE	1,658	1,869	12.73
761	NEW HOPE	523	589	12.62
762	LOCKNEY	2,207	2,485	12.60
763	PANTEGO	2,371	2,668	12.53
764	LOTT	775	871	12.39
765	MARION	984	1,104	12.20
766	TATUM	1,289	1,445	12.10
767	BIG SPRING	23,093	25,885	12.09
768	NEWCASTLE	505	566	12.08
769	ATLANTA	6,118	6,857	12.08
770	DALLAS	1,007,618	1,127,608	11.91
771	MONAHANS	8,101	9,054	11.76
772	EDEN	1,567	1,750	11.68
773	COOPER	2,153	2,403	11.61
774	POST	3,768	4,204	11.57
775	SANDERSON	1,128	1,258	11.52
776	KINGSLAND (CDP)	2,725	3,036	11.41
777	COAHOMA	1,133	1,261	11.30
778	SPEARMAN	3,197	3,555	11.20
779	SAVOY	877	975	11.17
780	TEAGUE	3,268	3,633	11.17
781	FRITCH	2,335	2,595	11.13
782	CAMERON	5,635	6,260	11.09
783	ALDINE (CDP)	11,133	12,365	11.07
784	HASKELL	3,362	3,731	10.98
785	TAFT SOUTHWEST	2,012	2,231	10.88
786	FULTON	763	846	10.88
787	DENISON	21,505	23,841	10.86
788	GREENVILLE	23,071	25,565	10.81
789	CARTHAGE	6,496	7,196	10.78
790	GRUVER	1,172	1,297	10.67
791	STINNETT	2,166	2,396	10.62
792	HILLSBORO	7,072	7,822	10.61
793	CHILDRESS	5,055	5,586	10.50
794	LULING	4,661	5,146	10.41
795	DUBLIN	3,190	3,517	10.25
796	VERNON	12,001	13,215	10.12
797	CHANNELVIEW (CDP)	25,564	28,145	10.10

798	PINELAND	882	971	10.09
799	ITASCA	1,523	1,671	9.72
800	NORTHCREST	1,725	1,892	9.68
801	MULESHOE	4,571	5,013	9.67
802	MUNDAY	1,600	1,751	9.44
803	CLYDE	3,002	3,284	9.39
804	PLAINVIEW	21,781	23,805	9.29
805	TYE	1,088	1,188	9.19
806	MIAMI	675	737	9.19
807	HUBBARD	1,589	1,734	9.13
808	BOOKER	1,236	1,348	9.06
809	SULPHUR SPRINGS	14,062	15,320	8.95
810	RULE	783	853	8.94
811	RUSK	4,366	4,751	8.82
812	HIGHLAND PARK	8,739	9,497	8.67
813	OLNEY	3,519	3,822	8.61
814	BLANCO	1,238	1,341	8.32
815	BRECKENRIDGE	5,665	6,131	8.23
816	SAINT JO	1,048	1,134	8.21
817	BROWNSBORO	545	589	8.07
818	SWEETWATER	11,967	12,929	8.04
819	BRIAROAKS	535	578	8.04
820	NEDERLAND	16,192	17,489	8.01
821	MADISONVILLE	3,569	3,852	7.93
822	ARCHER CITY	1,784	1,925	7.90
823	LIPSCOMB	190	205	7.89
824	DIBOLL	4,341	4,680	7.81
825	WHITNEY	1,626	1,748	7.50
826	DEPORT+	746	801	7.37
827	SILSBEE	6,368	6,830	7.26
828	WESTWORTH VILLAG	2,350	2,518	7.15
829	GODLEY	569	609	7.03
830	BROWNWOOD	18,387	19,659	6.92
831	HOOKS	2,684	2,869	6.89
832	LOVELADY	587	627	6.81
833	MENARD	1,606	1,715	6.79
834	SANSOM PARK VILL	3,928	4,192	6.72
835	WAELDER	745	794	6.58
836	HENDERSON	11,139	11,866	6.53
837	HOLLIDAY	1,475	1,566	6.17
838	BALMORHEA	765	812	6.14
839	PAINT ROCK	227	240	5.73
840	GROOM	613	648	5.71
841	WHEELER	1,393	1,472	5.67
842	BAIRD	1,658	1,748	5.43
843	BORGER	15,675	16,519	5.38
844	OVERTON	2,105	2,218	5.37
845	CHILLICOTHE	816	859	5.27
846	PARIS	24,799	26,047	5.03
847	WELLINGTON	2,456	2,577	4.93
848	QUANAH	3,413	3,581	4.92
849	THORNTONVILLE	693	727	4.91
850	SILVERTON	779	816	4.75
851	HARDIN	563	588	4.44
852	EMORY	963	1,005	4.36
853	MOULTON	923	963	4.33
854	BANGS	1,555	1,620	4.18
855	UNIVERSITY PARK	22,259	23,163	4.06
856	VALLEY MILLS	1,085	1,129	4.06
857	MAUD	1,049	1,091	4.00
858	RIVER OAKS	6,580	6,838	3.92
859	WEST	2,515	2,612	3.86
860	TEXARKANA	32,294	33,529	3.82
861	COMANCHE	4,087	4,234	3.60
862	SPUR	1,300	1,344	3.38
863	JEFFERSON	2,199	2,273	3.37
864	DE LEON	2,190	2,263	3.33

865	EDGECLIFF	2,715	2,800	3.13
866	WHITE SETTLEMENT	15,472	15,950	3.09
867	SHAMROCK	2,286	2,356	3.06
868	GUTHRIE	140	144	2.86
869	BRYSON	520	533	2.50
870	WHITESBORO	3,209	3,286	2.40
871	DAINGERFIELD	2,655	2,717	2.34
872	BECKVILLE	783	801	2.30
873	LONE STAR	1,615	1,643	1.73
874	BRADY	5,946	6,020	1.24
875	EVERMAN	5,672	5,721	0.86
876	ROBY	616	621	0.81
877	SAN SABA	2,626	2,644	0.69
878	BRACKETTVILLE	1,740	1,748	0.46
879	CRAWFORD	631	632	0.16
880	FORT BLISS	13,915	13,915	0.00
881	FORT HOOD	35,580	35,580	0.00
882	FORT SAM HOUSTON	12,000	12,000	0.00
883	LACKLAND AFB	9,352	9,352	0.00
884	LAUGHLIN AFB	2,556	2,556	0.00
885	RANDOLPH AFB	4,000	4,000	0.00
886	REESE AFB	1,263	1,263	0.00
887	TILDEN	500	499	-0.20
888	DICKENS	322	321	-0.31
889	GRANDFALLS	583	581	-0.34
890	WELLS	761	755	-0.79
891	MOUNT ENTERPRISE	501	496	-1.00
892	DRISCOLL	688	679	-1.31
893	GRAHAM	8,986	8,868	-1.31
894	SKELLYTOWN	664	650	-2.11
895	ASPERMONT	1,214	1,182	-2.64
896	NOCONA	2,870	2,794	-2.65
897	BONHAM	6,688	6,502	-2.78
898	CROWELL	1,230	1,194	-2.93
899	MASON	2,041	1,975	-3.23
900	THROCKMORTON	1,036	1,002	-3.28
901	BYERS	510	493	-3.33
902	JUNCTION	2,654	2,553	-3.81
903	ALBANY	1,962	1,885	-3.92
904	GORMAN	1,290	1,238	-4.03
905	HONEY GROVE	1,681	1,613	-4.05
906	LORENZO	1,208	1,159	-4.06
907	CISCO	3,813	3,657	-4.09
908	CROSBYTON	2,026	1,942	-4.15
909	HICO	1,342	1,285	-4.25
910	RALLS	2,172	2,077	-4.37
911	PETROLIA	762	728	-4.46
912	RANGER	2,803	2,675	-4.57
913	TRENTON	655	624	-4.73
914	ROTAN	1,913	1,811	-5.33
915	CLARKSVILLE	4,311	4,068	-5.64
916	EASTLAND	3,690	3,467	-6.04
917	VALLEY VIEW	640	601	-6.09
918	BELLS	962	903	-6.13
919	BOWIE	4,990	4,677	-6.27
920	TOLAR	523	489	-6.50
921	LORAINE	731	680	-6.98
922	RISING STAR	859	799	-6.98
923	TIOGA	625	581	-7.04
924	GHOLSON	692	643	-7.08
925	BRONTE VILLAGE	962	891	-7.38
926	SANTA ANNA	1,249	1,154	-7.61
927	HAMILTON	2,937	2,710	-7.73
928	CLARENDON	2,067	1,904	-7.89
929	MONTAGUE	500	460	-8.00
930	COLEMAN	5,410	4,970	-8.13
931	MEMPHIS	2,465	2,264	-8.15

932	ROBERT LEE	1,276	1,167	-8.54
933	CROSS PLAINS	1,063	970	-8.75
934	TUSCOLA	620	565	-8.87
935	DAWSON	766	696	-9.14
936	FROST	579	524	-9.50
937	MERTZON	778	701	-9.90
938	GRAFORD	561	505	-9.98
939	JAYTON	608	545	-10.36
940	HAPPY+	588	527	-10.37
941	BOGATA	1,421	1,263	-11.12
942	HENRIETTA	2,896	2,537	-12.40
943	CAMP WOOD*	679	592	-12.81
944	PADUCAH	1,788	1,558	-12.86
945	BLOOMING GROVE	847	735	-13.22
946	KOSSE	505	436	-13.66
947	PRINCETON	2,448	2,112	-13.73
948	COOLIDGE	748	645	-13.77
949	ROXTON	639	551	-13.77
950	GAIL	200	172	-14.00
951	MATADOR	790	679	-14.05
952	AMHERST	742	634	-14.56
953	LEFORS	656	559	-14.79
954	AGUA DULCE	794	674	-15.11
955	HAWLEY	606	503	-17.00
956	NORMANGEE+	689	569	-17.42
957	WHITEFACE	512	418	-18.36
958	KRESS	739	597	-19.22
959	STRAWN	709	572	-19.32
960	BARSTOW	535	431	-19.44
961	LA PRYOR (CDP)	1,343	1,068	-20.48
962	RIESEL	839	667	-20.50
963	WILSON	568	447	-21.30
964	SEYMOUR	3,185	2,462	-22.70
965	TALCO	592	449	-24.16
966	WICKETT	560	423	-24.46
967	QUITAQUE	513	379	-26.12
968	ENCINAL	620	453	-26.94
969	POTOSI (CDP)	1,441	1,011	-29.84
970	MENTONE	50	35	-30.00

APPENDIX E

Historical Applications of ASR in Texas

The application of ASR in the Kerrville area and the passage of HB 1989 have been widely acknowledged as the pioneering efforts which opened the ASR frontier for the rest of the State. While the importance of these accomplishments can not be overstated, the first attempts to apply ASR technology in Texas began as early as 1971 in the High Plains region of West Texas. The application of ASR was first made in the City of Lamesa, and with the success of this effort, the practice spread. The communities of Levelland and Lubbock soon began operating similar ASR projects.

The early High Plains ASR projects stored water in the Ogallala Formation, which is a fresh water aquifer. The source of the water stored was the normal community supply of treated surface water from Lake Meredith. The water was stored in the aquifer by simply reversing the flow through the column pipes of the wells in the various cities' existing well fields. The chemical compatibility of the native and stored waters was apparently good, as there were no undesirable effects reported. The reported efficiencies of recovery were quite high, with an average of approximately 95 percent of stored volumes being recovered. Stored volumes ranged between 40 and 2,072 acre/feet per year. Determining the recovery efficiency was relatively easy due to the elevated concentration of chlorides in the stored water as compared to the native ground water. By monitoring the water produced from the storage wells for this particular analytical parameter, the recovery efficiencies could be accurately gaged.

The motivation for these communities to engage in the practice of ASR was not water shortage, but rather an abundance of available supply relative to demand and their "take or pay" water supply arrangement. The water supply demand of the communities was, at that time , relatively low as compared to their Lake Meredith water supply allocations. The nature of the common water supply arrangement was that the cities paid fixed pumping and treatment cost shares whether or not the water was actually delivered in the full amount of the individual allocations. The communities determined that it was in their best interest to take full delivery of their individual allocations and store the excess water. By the early to mid-1980s, the water supply demands of the various communities had grown sufficiently to more fully utilize their supply allocations. Subsequently the water supply allocations to the communities were curtailed due to low water levels in Lake Meredith. Since the original motivation to store water no longer existed, the practice was halted.

The High Plains region was also the site of another pioneering ASR effort. The City of Midland has long utilized well fields for part of their water supply. During approximately the same time period that surface water was being stored by ASR in the High Plains, the City of Midland found it advantageous to transfer water from the outlying, but more productive McMillan Well Field, during off-peak seasons to the centrally located Airport Terminal Field to aid in meeting peak distribution demand.

The McMillan Field draws water from the Ogallala Aquifer while the Airport Terminal Field draws water from the Antlers Aquifer. While these two fields produce water from distinct geologic units at each field location, the two units are geologically interfingered in the area in between. The significance of this effect is that the chemical species of the water contained in each field are essentially similar. Different formation materials in the two aquifers cause the divergent production capacities in each field. The high capacity McMillan Field was used to recharge the less productive, but more convenient, Airport Terminal Field without any significant water chemistry compatibility complications.

After being recharged the Airport Terminal wells produced water at a much higher rate, due to increased aquifer saturation, which aided in meeting peak distribution demands. Eventually, growth in the Midland area reached a point where water supply demand required increased rates of production from both well fields. The increased water supply demands required peak rates of production to meet distribution demands. While operating full time at peak capacity, there was no longer any opportunity to redistribute water in storage between the two well fields.

APPENDIX F

TNRCC Procedure for Pilot Project Application, Acceptance and Funding

TNRCC Pilot Project Rules, Application Process and Status:
The Commission adopted rules under 30 TAC Chapters 295, 297, and 331 to implement House Bill 1989 (74th Regular Session, 1995) for pilot project temporary authorization, effective June 28, 1996. These rules define aquifer storage and retrieval (ASR) projects, provide for interim approval of pilot projects and set out water quality protection measures under the agency's Underground Injection Control program. The rules authorize pilot projects under temporary or term water rights permits and amendments to permits. The rules provide requirements for pilot projects which include injection well construction standards, operation and maintenance requirements, requirements for testing and data collection, and reporting of testing results and pilot project feasibility.

The rules provide application procedures and provide for combined water rights and underground injection control processing. The rules allow submittal of an application for projects located in the areas and aquifers identified in House Bill 1989 as well as areas designated by the Board through a petition process determined on the basis of water supply need and ASR feasibility. The rules also reflect provisions in House Bill 1989 requiring cooperation of ASR project sponsors with affected groundwater conservation districts. The rules require the applicant to provide notice and a copy of the application to a groundwater conservation district having jurisdiction over the aquifer where water is proposed for storage. The rules further require an applicant to provide copies of any agreements reached by applicants with affected districts reflecting applicant cooperation in the development of and compliance with any district rules addressing aquifer storage and retrieval.

In the six-month time period since the effective date of the pilot project rules, the Commission has not received any applications for permitting. Commission staff have responded, though, to a number of inquiries and information requests regarding ASR and the permitting process.

TNRCC Final Project Rules and Application Process:
The Commission adopted rules addressing final permit authorization for aquifer storage and retrieval projects and the underground storage of state water under House Bill 1989 on December 18, 1996, which became effective January 10, 1997. These rules define and specify permit and technical requirements necessary for obtaining final authorization for the underground storage of state water. The requirements include protection of water quality from injection operations, proper management and conservation of state water, and appropriate reporting and record keeping for demonstration of compliance. The rules provide application procedures and provide for combined water rights and underground injection control processing. The procedures further minimize duplication through coordinating reporting with the Commission's existing public water supply system and water rights rules. The new rules reflect provisions in House Bill 1989 prohibiting the issuance of a final permit or permit amendment before June 1, 1999.

TNRCC ASR PHASE 1 RULES

SUBCHAPTER A : DEFINITIONS
§297.1

The amendment to this section is adopted under the Texas Water Code, §5.103 and §5.105, which provide the commission with the authority to adopt rules necessary to carry out its powers and duties under the code and the laws of the state.

§297.1. Definitions.

The following words and terms, when used in this chapter and in Chapter 295 of this title (relating to Water Rights Rules, Procedural), shall have the following meanings, unless the context clearly indicates otherwise:

Aquifer Storage and Retrieval Project - A project with two phases that anticipates the use of a Class V aquifer storage well, as defined in §331.2 of this title (relating to Definitions), for injection into a geologic formation, group of formations, or part of a formation that is capable of underground storage of appropriated surface water for subsequent retrieval and beneficial use. Phase I of the project is to determine feasibility for ultimate storage and retrieval for beneficial use. Phase II of the project requires commission authorization by permit or permit amendment after the commission has determined that Phase I of the project has been successful.

SUBCHAPTER B : CLASSES OF PERMITS
§297.13, §297.19

The amendments to these sections are adopted under the Texas Water Code, §5.103 and §5.105, which provide the commission with the authority to adopt rules necessary to carry out its powers and duties under the code and the laws of the state.

§297.13. Temporary Permit Under Texas Water Code, §§11.138 and 11.153 - 11.155.

A temporary permit, as its name implies, is short-lived in nature and designed for purposes of a temporary nature. A temporary permit may not be granted for a period of time exceeding three years. This permit does not vest in the holder any permanent right to the use of state water and expires in accordance with its terms. (It is primarily designed for those persons who require state water for highway construction, oil or gas well drilling projects, evaluation of Phase I of an aquifer storage and retrieval project, and other types of short duration projects.) Temporary permits may be issued for beneficial purposes to the extent that they do not interfere with or adversely affect prior appropriations or vested rights on a stream. The period of time to use water authorized by a temporary permit which was initially granted for a period of less than three years may be extended, but in no event shall the entire period exceed three years nor shall an extension of time seek a change of diversion rate, diversion point, or additional water.

§297.19. Term Permit under Texas Water Code, §§11.1381 and 11.153 - 11.155.

The commission may grant a permit for a limited term of years when it determines that inadequate water is available in the source of supply on a perpetual basis to satisfy an application but that adequate water is available on a limited basis due to the underutilization of existing water rights in the source of supply. The commission may grant a permit under this section for an aquifer storage and retrieval project as defined in §297.1 of this title (relating to Definitions).

The Texas Natural Resource Conservation Commission (commission) adopts amendments to §331.2 and §331.11, and new §§331.181-331.186, concerning additional standards and requirements for Class V aquifer storage wells. The amended and new sections are adopted without changes to the proposed text as published in the March 19, 1996, issue of the *Texas Register* (21 TexReg 2173).

The rules implement recent legislation in House Bill 1989 (1995) that directs the commission to investigate the feasibility of storing appropriated water in various aquifers around the state by encouraging the issuance of temporary or term permits for aquifer storage and retrieval projects that would store appropriated water in certain aquifers for subsequent retrieval and beneficial use.

A public hearing on the proposal was held on March 22, 1996, in Austin, Texas. The comment period closed on April 18, 1996, in accordance with an Extension of Deadline for Written Comments published in the March 29, 1996, issue of the *Texas Register* (21 TexReg 2587). Three persons appeared and offered comments at the hearing and five written comments were received by the deadline on April 18, 1996. The oral and written comments were received from individuals representing the following: Texas Water Development Board (board), Hill Country Underground Water Conservation District, Bexar, Medina and Atascosa Water Control and Improvement District, Bexar Metropolitan Water District, Upper Guadalupe River Authority, Canyon Regional Water Authority, City of Austin, and CH2M Hill. All of the above commentors, except for the board, provided comments in support of the rules as proposed.

The board provided the commission with no specific comments, but did provide a copy of its draft proposed policy and procedural and administrative methods for assessing designation of priority areas of need as defined in §11.155 (b)(3) of the Texas Water Code.

The amended and new rules are adopted under the Texas Water Code, §§5.103, 5.105, and 27.019, and Texas Health and Safety Code, §361.017 and §361.024, which authorize the commission to adopt any rules necessary to carry out its powers and duties under the Texas Water Code and other laws of Texas and to establish and approve all general policy of the commission.

SUBCHAPTER A : GENERAL PROVISIONS
§331.2, §331.11

The amendments to these sections are adopted under the Texas Water Code, §§5.103, 5.105 and 27.019, which provide the Texas Natural Resource Conservation Commission (commission) with the authority to adopt rules necessary to carry out the powers and duties under the provisions of the Codes and other laws of this state; and under the Texas Health and Safety Code, §361.017 and §361.024, which further provide the commission with the authority to adopt rules necessary to manage industrial solid and municipal hazardous wastes.

§331.2. Definitions.

The following words and terms, when used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise.

Aquifer Storage Well - A Class V injection well used for the injection of water into a geologic formation, group of formations, or part of a formation that is capable of underground storage of water for later retrieval and beneficial use.

§331.11. Classification of Injection Wells.

(a) Injection wells within the jurisdiction of the commission are classified as follows:

(1) Class I.

(A) Wells used by generators of hazardous wastes or owners or operators of hazardous waste management facilities to inject hazardous waste, other than Class IV wells.

(B) Other industrial and municipal waste disposal wells which inject fluids beneath the lower-most formation which within one quarter mile of the wellbore contains an underground source of drinking water.

(2) Class III. Wells which inject for extraction of minerals, including:

(A) mining of sulfur by the Frasch process;

(B) solution mining of minerals which includes sodium sulfate, sulfur, potash, phosphate, copper, uranium, and other minerals which can be mined by this process.

(3) Class IV. Wells used by generators of hazardous wastes or of radioactive wastes, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous wastes or radioactive wastes into or above a formation which within one quarter mile of the wellbore contains an underground source of drinking water.

(4) Class V. Injection wells within the jurisdiction of the commission, but not included in Classes I, III, or IV. Class V wells include, but are not limited to:

(A) - (J) (No change.)

(K) Aquifer storage wells used for the injection of water for storage and subsequent retrieval for beneficial use.

(b) (No change.)

SUBCHAPTER K : ADDITIONAL REQUIREMENTS FOR CLASS V AQUIFER STORAGE WELLS §§331.181-331.186

These new sections are adopted under the Texas Water Code, §§5.103, 5.105 and 27.019, which provide the commission with the authority to adopt rules necessary to carry out its powers and duties under the code and laws of the state.

§331.181. Applicability.

In addition to the requirements of Subchapter H of this chapter (relating to Standards for Class V Wells), the requirements of this subchapter apply to all Class V aquifer storage wells.

§331.182. Area of Review.

The area of review for a Class V aquifer storage well is the area determined by a radius of 1/4 mile from the proposed or existing wellbore. In the application for authorization, the applicant shall provide information on the activities within the area of review including the following factors and their adverse impacts, if any, on the injection operation:

(1) location of all artificial penetrations that penetrate the interval to be used for aquifer storage, including but not limited to: water wells and abandoned water wells from TNRCC well files or ground water district files; oil and gas wells and saltwater injection wells from the Railroad commission files; and waste disposal wells/other injection wells from the TNRCC disposal well files;

(2) completion and construction information, where available, for identified artificial penetrations; and

(3) site specific, significant geologic features, such as faults and fractures.

§331.183. Construction and Closure Standards.

All Class V aquifer storage wells shall be designed, constructed, completed, and closed to prevent, commingling, through the wellbore and casing, of injection waters with other fluids outside of the authorized injection zone; mixing through the wellbore and casing of fluids from aquifers of substantively different water quality; and infiltration through the wellbore and casing of water from the surface into ground water zones.

(1) Plans and specifications. Except as specifically required in the terms of the Class V aquifer storage well authorization, the drilling and completion of a Class V aquifer storage well shall be done in accordance with the requirements of §331.132 of this title (relating to Construction Standards) and the closure of a Class V aquifer storage well shall be done in accordance with the requirements of §331.133 of this title (relating to Closure Standards).

(A) If the operator proposes to change the injection interval to one not reviewed during the authorization process, the operator shall notify the executive director immediately. The operator may not inject into any unauthorized zone.

(B) The executive director shall be notified immediately of any other changes, including but not limited to, changes in the completion of the well, changes in the setting of screens, and changes in the injection intervals within the authorized injection zone.

(2) Construction materials. Casing materials for Class V aquifer storage wells shall be constructed of materials resistant to corrosion.

(3) Construction and workover supervision. All phases of any aquifer storage well construction, workover or closure shall be supervised by qualified individuals who are knowledgeable and experienced in practical drilling engineering and who are familiar with the special conditions and requirements of injection well and water well construction.

§331.184. Operating Requirements.

(a) All Class V aquifer storage wells shall be operated in such a manner that they do not present a hazard to or cause pollution of an underground source of drinking water.

(b) Injection pressure at the wellhead shall not exceed a maximum which shall be calculated so as to assure the pressure in the injection zone does not cause movement of fluid out of the injection zone.

(c) The owner or operator of an aquifer storage well that has ceased operations for more than two years shall notify the executive director 30 days prior to resuming operation of the well.

(d) The owner or operator shall maintain the mechanical integrity of all wells operated under this section.

(e) The quality of water to be injected must meet the quality criteria prescribed by the commission's drinking water standards as provided in Chapter 290 of this title (relating to Water Hygiene).

§331.185. Monitoring and Reporting Requirements.

(a) The following must be monitored at the required frequency and reported to the executive director on a quarterly basis or a schedule to be agreed upon by the executive director:

(1) monthly average injection rates;

(2) monthly injection volumes;

(3) monthly average injection pressures;

(4) monthly water quality analyses; and

(5) other information as determined by the executive director as necessary for the protection of underground sources of drinking water.

(b) A final report for Phase I of a project must be submitted to the executive director within 45 days of the completion of Phase I of a project addressing items in §331.186 of this title (relating to Additional Requirements Necessary for Final Project Authorization).

§331.186. Additional Requirements Necessary for Final Project Authorization.

Upon completion of the aquifer storage well, the following information shall be obtained during the first phase of the project and submitted along with the application for final authorization:

(1) as-built drilling and completion data on the well;

(2) all logging and testing data on the well;

(3) formation fluid analyses;

(4) injection fluid analyses;

(5) injectivity and pumping tests determining well capacity and reservoir characteristics;

(6) hydrogeologic modeling, with supporting data, predicting mixing zone characteristics and injection fluid movement and quality; and

(7) other information as determined by the executive director as necessary for the protection of underground sources of drinking water.

Effective: January 10, 1997

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
Permanent Rule Changes

CHAPTER 295 - WATER RIGHTS, PROCEDURAL

Subchapter A
§295.21 and §295.22

Subchapter F
§295.202

1. Purpose. This change transmittal provides the pages that reflect changes and additions to the Texas Natural Resource Conservation Commission (TNRCC)Volume of Permanent Rules.

2. Explanation of Change. The TNRCC adopted amendments to §§295.21, 295.22, and 295.202, concerning additional requirements for storage of appropriated surface water in aquifers under Texas Water Code §§11.153-11.155. Section 295.202 is adopted with changes to the proposed text as published in the October 4, 1996 issue of the *Texas Register* (21 TexReg 9600). Sections 295.21 and 295.22 are adopted without changes and will not be republished.

3. Effect of Changes. The adopted amendments to §§295.21, 295.22, and 295.202 will complete the implementation of recent legislation in House Bill 1989 (Regular Session, 74th Legislature, 1995) which directs the TNRCC to investigate the feasibility of storing appropriated surface water in various aquifers around the state by encouraging the issuance of permits for aquifer storage and retrieval (ASR) projects (as defined in the adopted amendment to §297.1 of this title (relating to Definitions)), which would store appropriated surface water in specific aquifers for subsequent retrieval and beneficial use.

HISTORY PAGE

CHAPTER 295 - WATER RIGHTS, PROCEDURAL

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INDEX

CHAPTER 295 - WATER RIGHTS, PROCEDURAL

SUBCHAPTER A: REQUIREMENTS OF WATER USE PERMIT APPLICATIONS

GENERAL PROVISIONS

ADDITIONAL REQUIREMENTS FOR THE STORAGE OF APPROPRIATED SURFACE WATER IN AQUIFERS

ADDITIONAL REQUIREMENTS FOR IRRIGATION

ADDITIONAL REQUIREMENTS FOR DAMS AND RESERVOIRS

REQUIREMENTS FOR APPLICATIONS FOR PERMITS UNDER TEXAS WATER CODE §11.143

§295.51. Application for Texas Water Code, §11.143, Permit.

ADDITIONAL REQUIREMENTS FOR APPLICATIONS FOR TEMPORARY PERMITS

§295.61. Applications.
§295.62. Extension of Time for Temporary Permits.

REQUIREMENTS FOR APPLICATIONS FOR AMENDMENTS TO WATER USE PERMITS AND EXTENSIONS OF TIME

§295.71. Applications To Amend a Permit.
§295.72. Applications for Extensions of Time.

REQUIREMENTS FOR APPLICATION FOR DIVERSION FOR DOMESTIC OR LIVESTOCK USE FROM UNSPONSORED AND STORAGE-LIMITED PROJECTS

§295.81. Application.
§§295.82-295.84. Reserved.
§295.85. Application.

REQUIREMENTS FOR APPLICATION FOR EMERGENCY WATER USE PERMIT

§295.91. Application.

FILING REQUIREMENTS FOR WATER SUPPLY CONTRACTS AND AMENDMENTS

§295.101. Documents To Be Filed.

REQUIREMENTS FOR APPLICATIONS FOR AUTHORIZATION TO CONVEY STORED WATER

§295.111. Application.

MAPS, PLATS, AND DRAWINGS ACCOMPANYING APPLICATIONFOR WATER USE PERMIT

§295.121. Requirements.
§295.122. Drawings Not To Be Folded.
§295.123. Content Requirements of Maps.
§295.124. Additional Requirements for Dams and Reservoirs.
§295.125. Requirements for Temporary Permits.
§295.126. Requirements for Texas Water Code §11.143 Permits.

SUBCHAPTER B: WATER USE PERMITS FEES

§295.131. Fees Required.
§295.132. Filing, Recording, and Notice Fees.
§295.133. One-Time Use Fees.
§295.134. Maximum Fees.
§295.135. Inquiries as to Fees.
§295.136. Return of Fees.
§295.137. Diversion From Unsponsored or Storage-Limited Projects.
§295.138. Extension of Time To Commence or Complete Construction.
§295.139. Miscellaneous Fees.
§295.140. Local Sponsor Designation Fees.

SUBCHAPTER C : NOTICE REQUIREMENTS FOR WATER USE PERMIT APPLICATIONS

§295.151. Notice of Application and Commission Action.
§295.152. Notice by Publication.
§295.153. Notice by Mail.
§295.154. Notice for Temporary Water Use Permit.
§295.155. Notice for Interwatershed Transfers.
§295.156. Notice for Emergency Water Use Permits.
§295.157. Notice of Hearing.
§295.158. Notice of Amendments to Water Rights.
§295.159. Notice of Extension of Time To Commence or Complete Construction.
§295.160. Notice of Applications to Convey Stored Water.

SUBCHAPTER D : PUBLIC HEARING

§295.171. Request for Public Hearing.
§295.172. Public Hearing.
§295.173. Action on Application Without Public Hearing.
§295.174. Applications for Temporary Permits, Emergency Permits, and Authorization to Divert Water From Unsponsored and Storage-Limited Projects for Domestic and Livestock Purposes.
§295.175. Cancellation of Water Rights.
§295.176. Public Hearing on Application for Local Sponsor Designation.

SUBCHAPTER E : SPECIAL ACTIONS OF THE COMMISSION

§295.181. Provisional Disposition of Application for Temporary Permit.
§295.182. Application for Authorization to Divert Water From Unsponsored and Storage-Limited Projects for Domestic and Livestock Use.
§295.183. Application for an Amendment Based on a Water Supply Contract Action of the Commission.
§295.184. Extension of Time for Construction.
§295.185. Condemnation.
§295.186. Reservoirs Without Low-Flow Outlets.

SUBCHAPTER F : MISCELLANEOUS

§295.201. Filing of Instruments.
§295.202. Reports.

..... SUBCHAPTER A : REQUIREMENTS OF WATER USE PERMIT APPLICATIONS

GENERAL PROVISIONS

§295.1. Use of Forms.

The executive director will furnish without charge forms and instructions for preparing an application. The use of such forms is not mandatory, but the information required by such forms must be provided in any event. Supplements may be attached if there is not sufficient space on the printed form. If supplements are used, the data and information entered thereon shall be separated into paragraphs numbered to correspond with those on the printed form. A supplement explaining the project and planned operation may be attached to an application.

§295.2. Preparation of Application.

All applications shall be typewritten or printed legibly in ink. Illegible applications will be returned to the applicant. Applicants will be notified if additional information is needed to process an application, pursuant to §281.4 of this title (relating to Applications for Use of State Water). The applicant should confer with the staff of the executive director on any questions concerning preparation of the application, especially if the application is unusual or unique. Upon express written or verbal approval of the applicant or the applicant's agent, any employee of the commission may make non-substantive changes in any documents submitted by the applicant. Substantive changes in an application may be made only by the applicant or the applicant's agent who submitted the application and only in the form of a written, notarized amendment to the application signed by the proper person; provided, however, that no substantive changes may be made after an application has been filed with the chief clerk of the commission by the executive director.

§295.3. Name and Address.

For each applicant, the full name, post-office address, telephone number, and social security or federal identification number shall be given. If the applicant is a partnership, it shall be designated by the firm name followed by the words "a partnership." If the applicant is acting as trustee for another, it shall be designated by the trustee's name followed by the word "trustee." If one other than the named applicant executes the application, the name, position, post-office address, and telephone number of the person executing the application shall be given.

§295.4. Source of Supply.

The applicant shall clearly state the name of the source from which the diversion or use of water is proposed. "Source" refers not to the origin of the water, but to the stream, spring or body of water from which the proposed diversion will be made. If the source has no name, it may be designated as "an unnamed watercourse" or "an unnamed spring." If the source is a tributary, the next stream into which it flows and the river basin wherein it lies shall be given.

§295.5. Amount and Purpose of Diversion and Use.

The total amount of water to be used shall be stated in definite terms, i.e., a definite number of acre-feet annually or, in the case of a seasonal, emergency, or temporary permit application, over the period for which application is made. The purpose or purposes of each use shall be stated in definite terms. If the water is to be used for more than one purpose, the specific amount to be used for each purpose shall be clearly set forth. If the amount to be consumptively used is less than the amount to be diverted, both the amount to be diverted and the amount to be consumptively used shall be specified.

§295.6. Rate and Method of Diversion.

If the applicant proposes to divert from a stream or reservoir, the maximum rate of diversion in gallons per minute or cubic feet per second shall be stated. The method to be used shall be described as portable pump, stationary pump, or gravity flow.

295.7. Location of Diversion Point, Reservoir, and Dam.

The application shall state the location of point(s) of diversion and, if applicable, the location of dam(s) or off-channel storage reservoir(s). These locations shall also be shown on the application maps with reference to a corner of an original land survey and/or other survey point of record, giving both course and distance. The distance and direction from the nearest county seat or town shall also be stated.

§295.8. Return and Surplus Water.

The application shall describe the location at which return water or surplus water will be returned to the stream. If practicable, this must also be shown on the application map. In addition, the application shall state with as much accuracy as possible the quantity of return flow expressed in acre-feet per annum.

§295.9. Conservation Plan.

An application relating to the appropriation or use of state water must include a water conservation plan meeting applicable requirements contained in this section. An application not accompanied by such plan is not administratively complete and shall not be considered by the commission, unless expressly exempted by this section. The plan must demonstrate that reasonable diligence will be used to avoid waste and achieve water conservation in order that appropriated waters will be beneficially used for the authorized purposes. Conservation means those practices, techniques, and technologies that will reduce the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water so that a water supply is made available for future or alternative uses for the benefit of the public health, safety and welfare, and of the environment.

(1) Applications to appropriate or to use water for municipal use, industrial or mining use, or irrigation use. A water conservation plan submitted with an application to appropriate or to use state water for municipal use, industrial or mining use, or irrigation use must be submitted in accordance with the guidelines set forth in chapter 288 of this title (relating to Water Conservation Plans, Guidelines and Requirements).

(2) Application to appropriate or to use water by wholesale water suppliers. A water conservation plan submitted with an application to appropriate or to use state water by a wholesale water supplier must be submitted in accordance with the guidelines set forth in Chapter 288 of this title.

(3) Applications to appropriate or to use water for any other purpose or use. A water conservation plan submitted with an application to appropriate or to use state water for any other purpose or use shall include a water conservation plan providing information where applicable about those practices, techniques, and technologies that will be used to reduce the consumption of water, prevent or reduce the loss or waste of water, maintain or improve the efficiency in the use of water, increase the recycling and reuse of water, or prevent the pollution of water.

(4) Applications to amend existing water rights. An application to amend an existing water right for any of the following reasons must be accompanied by a water conservation plan in accordance with the applicable provisions of this section:

(A) to increase the amount of the appropriation;

(B) to extend the term of the appropriation;

(C) to change the place of use, unless the request is to expand the amount of acreage to be irrigated adjacent to the existing, authorized irrigated tract without an increase in the appropriation; or

(D) to change the purpose or use of the appropriation; (a conservation plan to change the purpose or use of an appropriation need only address the proposed change in purpose or use; however, the executive director may require an applicant to submit a water conservation plan which addresses the applicant's entire water uses and/or appropriations).

(5) Exemptions to the requirement to submit water conservation plans. Applications to impound water for in-place use only, for emergency use in accordance with §295.91 of this title (relating to Requirements for Application for Emergency Water Use Permit), and for temporary use of water in accordance with §295.61 of this title (relating to Additional Requirements for Applications for Temporary Permits) are exempt from having to submit a water conservation plan pursuant to this section. However, all water right holders must exercise reasonable diligence to avoid waste and achieve water conservation so that the right to use state water is limited to the amount which is being or can be beneficially used for the authorized purposes but not to exceed the amount specifically appropriated.

§295.10. Proposed Installation or Reservoir.

If the applicant does not have the power of condemnation and proposes to inundate or to place any installation upon the land of another, the name(s) and address(es) of such landowner(s) shall be given. A copy of a duly acknowledged written easement, consent, or license from the landowner(s) or of a written lease or other evidence of agreement between the landowner(s) and the applicant shall be filed with the application.

§295.11. Multiple Ownership of Existing Reservoir.

Except as otherwise provided herein, if an existing reservoir inundates land owned by more than one person, an application for a permit to authorize the dam and reservoir and to use state water impounded in the reservoir shall be joined by all of the landowners. A copy of any operating agreement affecting the reservoir or the distribution of water therefrom shall be submitted with the application. If there is incomplete joinder, the applicant shall submit the name and address of any landowner who does not join the application, and shall file a copy of an easement or a consent, license, lease, or other type of agreement from the landowner(s), as provided in §295.10 of this title (relating to Proposed Installation or Reservoir).

§295.12. Storage in Another's Reservoir.

In an application for a permit to appropriate state water for storage in another's lawful reservoir and/or to divert and use water therefrom, a copy of a duly acknowledged document evidencing the consent of the reservoir owner shall be submitted. If the reservoir is a project of the Soil Conservation Service, U. S. Department of Agriculture, a copy of a duly acknowledged document evidencing consent from the Soil and Water Conservation District and any others having jurisdiction over the reservoir shall be provided.

§295.13. Interwatershed Transfers.

An applicant seeking to transfer state water from one watershed to another watershed shall so state in the application. Hearing shall be held in the same manner as required for water use applications. For purposes of this section, a watershed refers to a named river basin or coastal basin.

§295.14. Signature of Applicant.

The application shall be signed as follows:

(1) If the applicant is an individual, the application shall be signed by the applicant or the applicant's duly appointed agent. An agent shall provide written evidence of his or her authority to represent the applicant. If the applicant is an individual doing business under an assumed name, the applicant shall attach to the application an assumed name certificate from the county clerk of the county in which the principal place of business is located.

(2) A joint application shall be signed by each applicant or each applicant's duly authorized agent, with written evidence of such agency to be submitted with the application. If land is owned by both husband and wife, each shall sign the application. Joint applicants shall select one among them to act for and represent the others in pursuing the application with the commission, with written evidence of such representation to be submitted with the application.

(3) If the application is by a partnership, the application shall be signed by one of the general partners. If the applicant is a partnership doing business under an assumed name, it shall attach to the application an assumed name certificate from the county clerk of the county in which the principal place of business is located.

(4) If the applicant is an estate or guardianship, the application shall be signed by the duly appointed guardian or representative of the estate, and a current copy of the letters issued by the court shall be attached to the application.

(5) If the applicant is a corporation, public district, county, municipality or other corporate entity, the application shall be signed by a duly authorized official. Written evidence in the form of by-laws, charters, or resolutions which specify the authority of the official to take such action shall be submitted. A corporation may file a corporate affidavit as evidence of the official's authority to sign.

(6) If the applicant is acting as trustee for another, the applicant shall sign as trustee, and in the application shall disclose the nature of the trust agreement and give the name and current address of each trust beneficiary.

§295.15. Sworn Application Required.

Each applicant shall subscribe and swear to the application before any person entitled to administer oaths, who shall also sign his or her name and affix his or her seal of office to the application.

ADDITIONAL REQUIREMENTS FOR THE STORAGE OF APPROPRIATED SURFACE WATER IN AQUIFERS

§295.21. Aquifer Storage and Retrieval Projects.

(a) For the purposes of this chapter, aquifer storage and retrieval projects that propose the underground storage of appropriated surface water for subsequent retrieval and beneficial use shall be limited to the following areas:

(1) the Anacacho, Austin Chalk, and Glen Rose Limestone aquifers in Bexar County and Medina County;

(2) the Carrizo-Wilcox aquifer in Bexar, Webb, Smith, Wood, Rains, and Van Zandt Counties;

(3) the Hickory and Ellenberger aquifers in Gillespie County;

(4) the Gulf Coast aquifer in Cameron and Hidalgo counties;

(5) areas designated by the commission as "critical areas" under §35.008 of the Texas Water Code; and

(6) other areas of the state designated by the Texas Water Development Board in accordance with §11.155 (b)(3) of the Texas Water Code.

(b) Except as provided by subsection (c) of this section, an applicant shall file the appropriate application and obtain the issuance of the following:

(1) a temporary or term permit under Chapter 297 of this title (relating to Water Rights, Substantive) and the necessary authorization under Chapter 331 of this title (relating to Underground Injection Control) prior to commencement of construction of Phase I of an aquifer storage and retrieval project, as defined in §297.1 of this title (relating to Definitions); or

(2) a permit under §297.11 of this title (relating to Permit Under Texas Water Code, §11.121) and the necessary authorization under Chapter 331 of this title (relating to Underground Injection Control) prior to actual storage of state water for underground storage and retrieval for purposes other than a Phase I project.

(A) An application for permit under paragraph (2) of this subsection will not be accepted for processing by the executive director until such time as the applicant has obtained the necessary authorizations and successfully completed a Phase I project.

(B) A final order granting a permit or amendment to a permit authorizing the storage of appropriated water in aquifers for subsequent beneficial use, for purposes other than a Phase I project, will not be issued before June 1, 1999.

(c) A water right permit is not required for Phase I of an aquifer storage and retrieval project that proposes the temporary storage of appropriated surface water in an aquifer for testing and subsequent retrieval and beneficial use if the diversion and purpose of use (e.g., municipal, industrial, etc.) of the surface water is covered by an existing water right. The water right holder or person holding a valid contract with a water right holder shall notify the executive director, in writing, of the proposed temporary storage and shall submit the information required by §295.22 of this title (relating to Additional Requirements for Storage of Surface Water for Subsequent Retrieval and Beneficial Use) with the written notification not later than 60 days prior to the proposed temporary storage of water in an applicable aquifer. Upon completion of Phase I of the project, an amendment to the existing water right is required for permanent authorization to store appropriated surface water in an aquifer for subsequent retrieval and beneficial use.

(d) This section does not apply to any existing permit or permit amendment issued by the commission or to any administratively complete application for a permit or permit amendment filed with the commission prior to June 5, 1995.

Adopted December 18, 1996 Effective January 10, 1997

§295.22. Additional Requirements for the Underground Storage of Surface Water for Subsequent Retrieval and Beneficial Use.

(a) Phase I projects. In addition to the applicable information required by Subchapter A of this chapter (relating to Requirements of Water Use Permit Application), the appropriate permit application must include:

(1) all information sufficient to demonstrate compliance with Chapter 331, Subchapter K of this title (relating to Additional Requirements for Class V Aquifer Storage Wells) and those portions of Chapter 331, Subchapters A and H of this title (relating to General Provisions and Standards for Class V Wells, respectively) which relate to aquifer storage injection wells;

(2) a map or plat showing the proposed depth and location of all injection facilities, retrieval wells, and the aquifer in which the water will be stored;

(3) if applicable, a letter from the Texas Water Development Board indicating an area has been designated in accordance with §11.155 (b)(3) of the Texas Water Code; and

(4) if applicable, the application for storage of surface water in an underground water reservoir or a subdivision of an underground water reservoir, as defined by Chapter 35 of the Texas Water Code, that is under the jurisdiction of an underground water conservation district, must include:

(A) evidence of service, by certified mail, of a copy of the application or notification submitted in accordance with §295.21 of this title (relating to Aquifer Storage and Retrieval Projects) to the underground water conservation district having jurisdiction over the aquifer; and

(B) a copy of an agreement, if any, reached by the applicant with the underground water conservation district reflecting the applicant's consent to cooperate in the development of, and abidance with, the rules governing the injection, storage, or retrieval of appropriated surface water in the underground water reservoir or a subdivision thereof.

(b) Phase II projects. In addition to the information required by subsection (a) of this section, the appropriate permit application must include:

(1) a copy of the final report on the Phase I project required under §331.185(b) of this title (relating to Monitoring and Reporting Requirements);

(2) an operations plan for the life of the project detailing the following:

(A) injection rates and volumes;

(B) frequency of injection periods;

(C) retrieval rates and volumes;

(D) frequency of retrieval periods;

(E) radial distances of travel from the injection wells on an annual basis;

(F) maximum extent of travel for the life of the project; and

(G) location of all injection, retrieval and monitoring wells.

(3) a report identifying any potential impacts to artificial penetrations within one-quarter mile of the perimeter of the buffer zone, as described in subsection (e)(5) of this section;

(4) a proposed monitoring plan which would address the quality of water injected and retrieved and the water levels of the receiving body of underground water within the perimeter of the buffer zone and within one-quarter mile of the perimeter of the buffer zone. In addition, the proposed monitoring plan shall describe how waters injected and retrieved will be measured and reported;

(5) other information as determined by the executive director as necessary for the protection of underground sources of drinking water.

(c) Control of Stored State Water. If the applicant does not have the power of condemnation and proposes to store state water in and withdraw it from underneath or to place any installation upon the land of another, the name(s) and address(es) of such landowner(s) shall be given. A copy of a duly acknowledged written easement, consent, or license from the landowner(s) or of a written lease or other evidence of agreement between the landowner(s) and the applicant shall be filed with the application.

(d) Map Requirements. All maps, plats and drawings accompanying the application shall be submitted in accordance with §§295.121-295.123 of this title (relating to Requirements, Drawings Not To Be Folded and Content Requirements of Maps, respectively).

(e) Additional Map Requirements. In addition to the preceding requirements, maps or plats submitted with the application for an aquifer storage and retrieval project shall include the following, if applicable:

(1) an overall plan of the project area showing the locations and extent of the proposed works and the locations of all pertinent features, including structures, pipelines, roads, natural springs, artesian wells and property lines. Also, such plan shall include all proposed or existing injection and retrieval facilities, by course and distance from a corner of an original land survey and/or other survey point of record, associated with the aquifer storage and retrieval project;

(2) name(s) and location(s) of the underground formation(s) in which state water will be stored for later retrieval and the general direction of flow indicated;

(3) cross sections and profiles of the underground formation(s) into which water will be injected and stored, any underground formation which confines the injection interval, any underground formation(s) located between the storage area and the land surface and the actual and/or proposed operating depths of all planned injection and retrieval facilities;

(4) if applicable, the location of any area or areas proposed for underground storage which would be within any part or portion of a critical area designated or proposed for designation by the commission under Chapter 294 of this title (relating to Underground Water Management Areas).

(5) for Phase II projects, the location of a buffer zone surrounding the land surface area under which the underground storage of state water will occur and beyond which pumpage by other wells will not interfere or significantly affect the movement or storage of the state water.

(6) for Phase II projects, the location and ownership of all existing domestic, public water supply, irrigation, or commercial wells within one-quarter mile of the perimeter of the buffer zone described in this subsection, indicated by appropriate symbols to differentiate these works from the proposed works;

(7) all elevations shall be referred to mean sea level datum;

(8) any additional information the executive director may require to determine the feasibility of the project.

Adopted December 18, 1996 Effective January 10, 1997

SUBCHAPTER F : MISCELLANEOUS

§295.201. Filing of Instruments.

(a) Received Date. All instruments, correspondence, and material delivered to the executive director shall be stamped or marked "Received" and the date thereof clearly indicated.

(b) Acceptance of Water Use Permit Application for Filing. Any water use permit application requiring commission action shall not be formally accepted for filing by the commission until it is reviewed by the executive director as to form, fees, and data required by law and declared administratively complete under §281.17 of this title (relating to Notice of Receipt of Application and Declaration of Administrative Completeness). No substantive changes may be made after an application has been filed with the chief clerk of the commission by the executive director. Applications for permits to appropriate state water or amendments to permits, certified filings or certificates of adjudication shall not be considered filed as required by the Texas Water Code, §11.141, until declared administratively complete by the executive director and filed by the executive director with the chief clerk of the commission.

§295.202. Reports.

(a) Annual Reports. Every person who takes water from a stream or reservoir during the preceding calendar year shall submit a written report to the commission. Blank forms for recording the information required by the Texas Water Code, §§11.031 and 11.032(a), shall be mailed to all surface water users during January of each year. Water use report forms shall be furnished to anyone on request. In completing the reports, a water user shall fill in the blanks to the best of his ability in accordance with the instructions that accompany each form. The report must be returned to the executive director not later than March 1 of each year to avoid the penalties prescribed by the Texas Water Code §11.031(b). Water users under the jurisdiction of the Rio Grande Watermaster shall return their annual reports to the Rio Grande Watermaster so that office can prepare and submit water use data covering the area of watermaster control. No report is required to be filed by persons who divert water solely for domestic and livestock purposes.

(b) Reports By Temporary Permit Holders. Upon the expiration of the period for which a temporary permit is granted, the appropriator shall cease diverting water and file a written report with the executive director, stating the amount of water and the date of cessation of use.

(c) Report on Time Limitations for Construction. Within 10 days after beginning construction or installation of diversion and distribution facilities, a permittee shall file a statement with the executive director showing that work was begun within the time limit allowed. Immediately upon completion of the project a similar statement must be filed with the executive director showing that the work was completed within the specified time limitations.

(d) Report of contractual sales.

(1) The purchaser under a contract to supply state water shall submit annual written reports to the executive director in accordance with subsection (a) of this section indicating the total amount of water diverted each month and the total amount diverted each week. Purchasers diverting from the perimeter of a reservoir need to report only monthly diversions.

(2) The supplier shall submit annual written reports to the executive director in accordance with subsection (a) of this section indicating the total amount of water diverted and used each month for each purpose and the total amount released downstream each week to each purchaser under the storage water right specified in the contract. A separate reporting of the amount of water estimated for transmission losses shall be made.

(3) These reporting requirements shall apply to all contractual permits and water supply contracts.

(4) For purposes of this subchapter, a "week" is the period from Saturday midnight to Saturday midnight.

(e) Operations Report for Aquifer Storage and Retrieval Projects.

(1) On the five-year anniversary date of the issuance of the permit or permit amendment, and every ten years thereafter or upon a more frequent schedule established by the executive director, the permittee shall provide the executive director with an operations report describing what efforts the permittee has made to:

(A) protect the state water stored in the receiving aquifer from unauthorized withdrawals; and

(B) maximize the retrieval and beneficial use of the stored water without experiencing unreasonable losses of state water.

(2) The operations report shall identify and provide:

(A) any potential or real impacts identified during the operation of the project;

(B) a summary of all data, information and analyses associated with any monitoring during the operation of the project;

(C) a comparison of actual movement of injected state water with the modeling predictions submitted with the application for permit under Chapter 295 of this title (relating to Water Rights, Procedural);

(D) an assessment of the project in terms of the protection of ground water quality; and

(E) any additional information the executive director determines is necessary for the protection of underground sources of drinking water.

(3) The executive director shall review the report described in this subsection. If the executive director determines that the circumstances, under which the permit was granted, have significantly changed, the executive director may pursue an amendment to such permit in accordance with §305.62 of this title (relating to Amendment).

Adopted December 18, 1996 Effective January 10, 1997

Effective: January 10, 1997

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
Permanent Rule Changes

CHAPTER 297 - WATER RIGHTS, SUBSTANTIVE

Subchapter A
§297.1

1. Purpose. This change transmittal provides the pages that reflect changes and additions to the Texas Natural Resource Conservation Commission (TNRCC) Volume of Permanent Rules.

2. Explanation of Change. The TNRCC adopted an amendment to §297.1 concerning permits for the storage of appropriated surface water in aquifers under Texas Water Code §§11.153-11.155. Section 297.1 is adopted without changes and will not be republished. The proposed sections can be found in the October 4, 1996 issue of the *Texas Register* (21 TexReg 9604).

3. Effect of Changes. The adopted amendment to §297.1 will implement recent legislation in House Bill 1989 (Regular Session, 74th Legislature, 1995) which directs the TNRCC to investigate the feasibility of storing appropriated surface water in various aquifers around the state by encouraging the issuance of permits for aquifer storage and retrieval projects, as defined in the amendment to §297.1 of this title (relating to Definitions), which would store appropriated surface water in specific aquifers for subsequent retrieval and beneficial use.

HISTORY PAGE

CHAPTER 297 - WATER RIGHTS, SUBSTANTIVE

Amendment to: §297.1
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Amendment to: §297.1
Date Adopted: December 18, 1996
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INDEX

CHAPTER 297 - WATER RIGHTS, SUBSTANTIVE

SUBCHAPTER A : DEFINITIONS

SUBCHAPTER B : CLASSES OF PERMITS

SUBCHAPTER C : TYPES OF USES

SUBCHAPTER D : DIVERSION FROM UNSPONSORED OR STORAGE-LIMITED RESERVOIRS

§297.31. Use Other Than Domestic or Livestock.
§297.32. Domestic or Livestock Use.

SUBCHAPTER E : ISSUANCE AND CONDITIONS OF WATER PERMIT OR CERTIFICATE OF ADJUDICATION

§297.41. Subject to Prior and Superior Water Rights.
§297.42. Additional Limitations.
§297.43. Requiring Storage Facilities.
§297.44. Acceptance of Permit or Certificate of Adjudication.
§297.45. Return and Surplus Waters.
§297.46. Suppliers of Water for Irrigation.
§297.47. Time Limitations for Commencement or Completion of Construction.
§297.48. Low-Flow Outlets for Dams.
§297.49. Habitat Mitigation.
§297.50. Water Quality Effects.
§297.51. Estuarine Considerations.
§297.52. Instream Uses.
§297.53. Conservation and Beneficial Use.
§297.54. Waste.
§297.55. Consideration of Water Conservation Plans.
§297.56. Conserved Water.

SUBCHAPTER F : AMENDMENTS TO WATER RIGHTS; CORRECTIONS TO WATER RIGHTS

§297.61. Amendments by Executive Director.
§297.62. Corrections of Water Rights by the Commission.

SUBCHAPTER G : CANCELLATION AND REVOCATION OF WATER RIGHTS

§297.71. Cancellation With Consent.
§297.72. Cancellation Under Texas Water Code, §11.146.
§297.73. Cancellation Under Texas Water Code, §§11.171-11.186.
§297.74. Revocation of Authorization To Divert from a Locally Unsponsored or Storage-Limited Reservoir.

SUBCHAPTER H : CONVEYANCES OF LAND AND WATER RIGHTS

§297.81. General Rules of Conveyance.
§297.82. Duty To Inform Executive Director.
§297.83. Recording Conveyances of Water Rights.

SUBCHAPTER I : CONVEYING STORED WATER

§297.91. Use of Bed and Banks.
§297.92. Authorization.
§297.93. Duties of Water Conveyor.
§297.94. Duties of Others Along the Stream.

SUBCHAPTER J : WATER SUPPLY CONTRACTS AND AMENDMENTS

§297.101. General; Exceptions.
§297.102. When Application Required.
§297.103. Special Requirements for Downstream Sales of Water from a Storage Reservoir.
§297.104. Special Requirements for Upstream Sales of Water from Storage.
§297.105. Effective Date of Water Supply Contract Rules.
§297.106. Perfection and Priority of Water Rights.
§297.107. Reports.
§297.108. Effect on Existing Contractual Permits.

SUBCHAPTER A : DEFINITIONS

§297.1. Definitions.

The following words and terms, when used in this chapter and in Chapter 295 of this title (relating to Water Rights Rules, Procedural), shall have the following meanings, unless the context clearly indicates otherwise:

Appropriations - The process or series of operations by which an appropriative right is acquired. A completed appropriation thus results in an appropriative right; the water to which a completed appropriation in good standing relates is appropriated water.

Appropriative right - The right to impound, divert, or use a specific quantity of state water acquired by law.

Aquifer Storage and Retrieval Project - A project with two phases that anticipates the use of a Class V aquifer storage well, as defined in §331.2 of this title (relating to Definitions), for injection into a geologic formation, group of formations, or part of a formation that is capable of underground storage of appropriated surface water for subsequent retrieval and beneficial use. Phase I of the project requires commission authorization by a temporary or term permit to determine feasibility for ultimate storage and retrieval for beneficial use. Phase II of the project requires commission authorization by permit or permit amendment after the commission has determined that Phase I of the project has been successful.

Baseflow or normal flow - The portion of streamflow uninfluenced by recent rainfall or flood runoff and is comprised of springflow, seepage, discharge from artesian wells or other groundwater sources, and the delayed drainage of large lakes and swamps. (Accountable effluent discharges from municipal, industrial, irrigation, or other uses of ground or surface waters may be included at times.)

Beneficial use - Use of the amount of water which is economically necessary for a purpose authorized by law, when reasonable intelligence and reasonable diligence are used in applying the water to that purpose.

Certificate of adjudication - An instrument evidencing a water right issued to each person adjudicated a water right in conformity with the provisions of the Texas Water Code, §11.323, or the final judgment and decree in State of Texas v. Hidalgo Co. Water Control and Imp. Dist. No. 18, 443 S.W.2d 728 (Tex. Civ. App.-- Corpus Christi 1969, writ ref. n.r.e.).

Certified filing - A declaration of appropriation or affidavit which was filed with the State Board of Water Engineers under the provisions of Acts of the Thirty-third Legislature, 1913, General Laws, Chapter 171, §14, as amended.

Claim - A sworn statement filed pursuant to Texas Water Code, §11.303.

Commencement of construction - An actual, visible step beyond planning or land acquisition, which forms the beginning of the on-going (continuous) construction of a project in the manner specified in the approved plans and specifications, where required, for that project. The action must be performed in good faith with the bona fide intent to proceed with the construction.

Commission - The Texas Water Commission.

Conservation - Those practices, techniques, and technologies that will reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water, or increase the recycling and reuse of water so that a water supply is made available for future or alternative uses.

Dam - Any artificial structure, together with any appurtenant works, which impounds water. All structures which are necessary to impound a single body of water shall be considered as one dam. A structure used only for diverting water from a watercourse by gravity is a diversion dam.

Diffused surface water - Water on the surface of the land in places other than watercourses. Diffused water may flow vagrantly over broad areas coming to rest in natural depressions, playa lakes, bogs, or marshes. (An essential characteristic of diffused water is that its flow is short-lived.)

Director or executive director - The executive director, or an acting executive director of the Texas Water Commission, or any authorized individual designated by the executive director to act in his place for the commission unless a direct authorization from the executive director or acting executive director is required by the Texas Water Code or these rules.

District - Any district or authority created by authority of the Texas Constitution, either Article III, §52, Subsection (b), Subdivisions (1) and (2), or Article XVI, §59.

Domestic use - Use of water by an individual or a household for drinking, washing, or culinary purposes; for irrigation of lawns, or of a family garden and/or orchard when the produce is not sold; for watering of domestic animals; and for water recreation for which no consideration is given or received. If the water is diverted, it must be diverted solely through the efforts of the user.

Groundwater - Water under the surface of the ground other than underflow of a stream and underground streams, whatever may be the geologic structure in which it is standing or moving.

Hydropower use - The use of water for hydroelectric and hydromechanical power and for other mechanical devices of like nature.

Industrial use - The use of water in processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, including commercial feedlot operations, commercial fish production and the development of power by means other than hydroelectric.

Instream use - The beneficial use of instream flows for such purposes including, but not limited to, navigation, recreation, hydropower, fisheries, game preserves, stock raising, park purposes, aesthetics, water quality protection, aquatic and riparian wildlife habitat, freshwater inflows for bays and estuaries, and any other instream use recognized by law. An instream use is a beneficial use of water. Water necessary to protect instream uses for water quality, aquatic and riparian wildlife habitat, recreation, navigation, bays and estuaries, and other public purposes may be reserved from appropriation by the commission.

Irrigation use - The use of water for the irrigation of crops, trees, and pastureland, including but not limited to golf courses and parks which do not receive water through a municipal distribution system.

Irrigation water use efficiency - the percentage of that amount of irrigation water which is beneficially used by agriculture crops or other vegetation relative to the amount of water diverted from the source(s) of supply. Beneficial uses of water for irrigation purposes include but are not limited to evapotranspiration needs for vegetative maintenance and growth and salinity management and leaching requirements associated with irrigation.

Livestock use - The use of water for the open-range watering of livestock connected with farming, ranching, or dairy enterprises.

Mariculture - The propagation and rearing of aquatic species, including shrimp, other crustaceans, finfish, mollusks, and other similar creatures in a controlled environment using brackish or marine water.

Mining use - The use of water for mining processes including hydraulic use, drilling, washing sand and gravel, and oil field repressuring.

Municipal per capita water use - The sum total of water diverted into a water supply system for residential, commercial, and public and institutional uses divided by actual population served.

Municipal use - The use of potable water within a community or municipality and its environs for domestic, recreational, commercial, or industrial purposes or for the watering of golf courses, parks and parkways, or the use of reclaimed water in lieu of potable water for the preceding purposes or the application of municipal sewage effluent on land, pursuant to a Texas Water Code, Chapter 26, permit where:

(A) the application site is land owned or leased by the Chapter 26 permit holder; or

(B) the application site is within an area for which the commission has adopted a no-discharge rule.

Navigable stream - By law, Natural Resources Code §21.001(3), any stream or streambed as long as it maintains from its mouth upstream an average width of 30 feet or more, at which point it becomes statutorily nonnavigable.

100-year flood - The flood peak discharge of a stream, based upon statistical data, which would have a 1% chance of occurring in any given year.

Permit - The authorization by the commission to a person whose application for a permit has been granted.

Person - Any individual, corporation, organization, government, or governmental subdivision or agency, business trust, estate, trust, partnership and any other legal entity or association.

Pollution - The alteration of the physical, thermal, chemical, or biological quality of, or the contamination of any water in the state that renders the water harmful or detrimental to humans, animal life, vegetation, or property, or the public health, safety or welfare, or impairs the usefulness of the public enjoyment of the waters for any lawful or reasonable purpose.

Priority - As between appropriators, the first in time is the first in right, Texas Water Code, §11.027, except as provided by the Texas Water Code, §11.028.

Reclaimed water - Municipal wastewater that is under the direct control of the treatment plant owner/operator and which has been treated to a quality suitable for a beneficial use.

Recreational use - The use of water impounded in or diverted or released from a reservoir or watercourse for fishing, swimming, water skiing, boating, hunting, and other forms of water recreation, including aesthetic land enhancement of a subdivision, golf course or similar development.

Register - The Texas Register.

Reservoir system operations - The coordinated operation of reservoirs within a common watershed or river basin or owned or operated by the same entity in order to optimize available water supplies.

Return water or return flow - That portion of state water diverted from a water supply and beneficially used which is not consumed as a consequence of that use and returns to a watercourse. Return flow includes sewage effluent.

Reuse - The authorized use for one or more beneficial purposes of use of water that remains unconsumed after the water is used for the original purpose of use and before that water is either disposed of or discharged or otherwise allowed to flow into a watercourse, lake or other body of state-owned water.

Runoff - That portion of streamflow comprised of surface drainage or rainwater from land or other surfaces during or immediately following a rainfall.

Secondary use - The reuse of state water for a purpose after the original, authorized use.

Sewage or sewage effluent - Water-carried human or animal wastes from residences, buildings, industrial establishments, cities, towns, or other places, together with any groundwater infiltration and surface waters with which it may be commingled.

Spreader dam - A levee-type embankment placed on alluvial fans or within a flood plain of a watercourse, common to land use practices, for the purpose of overland spreading of diffused waters and overbank flows.

State water - The water of the ordinary flow, underflow, and tides of every flowing river, natural stream, and lake, and of every bay or arm of the Gulf of Mexico, and the stormwater, floodwater, and rainwater of every river, natural stream, and watercourse in the state. State water also includes water which is imported from any source outside the boundaries of the state for use in the state and which is transported through the beds and banks of any navigable stream within the state or by utilizing any facilities owned or operated by the state.

Stormwater or floodwater - Water flowing in a watercourse as the result of recent rainfall.

Streamflow - The total water flowing within a watercourse.

Surplus water - For the purposes of Chapter 295 of this title (relating to Water Rights, Procedural) and this chapter, water taken from any source in excess of needs and not used beneficially for the purpose authorized by law.

Underflow of a stream - Water in sand, soil, and gravel below the bed of the watercourse, together with the water in the lateral extensions of the water-bearing material on each side of the surface channel, such that the surface flows are in contact with the subsurface flows, the latter flows being confined within a space reasonably defined and having a direction corresponding to that of the surface flow.

Waste - The diversion of water if the water is not used for a beneficial purpose; the use of that amount of water in excess of that which is economically reasonable for an authorized purpose when reasonable intelligence and reasonable diligence are used in applying the water to that purpose. Waste may include, but not be limited to, the unreasonable loss of water through faulty design or negligent operation of a water delivery, distribution or application system or the diversion or use of water in any manner that causes or threatens to cause pollution of water. Waste does not include the beneficial use of water where the water may become polluted because of the nature of its use, such as domestic or residential use, but is subsequently treated in accordance with all applicable rules and standards prior to its discharge into or adjacent to water in the state so that it may be subsequently beneficially used.

Water conservation plan - a strategy or combination of strategies for reducing the volume of water withdrawn from a water supply source, for preventing or reducing the loss or waste of water, for maintaining or improving the efficiency in the use of water, for increasing the recycling and reuse of water, and for preventing the pollution of water. A water conservation plan may be a separate planning document or may be contained within another water management document(s).

Water or water in the state - Groundwater, percolating or otherwise, lakes, bays, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Gulf of Mexico inside the territorial limits of the state, and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, navigable or nonnavigable, and including the beds and banks of all watercourses and bodies of surface water, that are wholly or partially inside or bordering the state or inside the jurisdiction of the state.

Watercourse - A definite channel of a stream in which water flows within a defined bed and banks, originating from a definite source or sources. (The water may flow continuously or intermittently, and if the latter, with some degree of regularity, depending on the characteristics of the sources.)

Water right - A right acquired under the laws of this state to impound, divert, or use state water.

Watershed - A term used to designate the area drained by a stream and its tributaries, or the drainage area upstream from a specified point on a stream.

Water supply - Any body of water, whether static or moving, either on or under the surface of the ground, available for beneficial use on a reasonably dependable basis.

Adopted December 18, 1996 Effective January 10, 1997

Effective: January 10, 1997

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
Permanent Rule Change

CHAPTER 331 - UNDERGROUND INJECTION CONTROL

Subchapter A
§331.9

Subchapter K
§331.182 and §331.185

1. Purpose. This change transmittal provides the page(s) that reflect changes and additions to the Texas Natural Resource Conservation Commission (TNRCC) Volume of Permanent Rules.

2. Explanation of Change. The TNRCC adopted amendments to §§331.9, 331.182 and 331.185, concerning additional standards and requirements for Class V aquifer storage wells. Sections §§331.9, 331.182 and 331.185 are adopted without changes and will not be republished. The proposed sections can be found in the October 4, 1996 issue of the *Texas Register* (21 TexReg 9605).

3. Effect of Changes. The adopted amendments to §§331.9, 331.182 and 331.185 will implement recent legislation in House Bill 1989 (Regular Session, 74th Legislature, 1995) which directs the TNRCC to investigate the feasibility of storing appropriated surface water in various aquifers around the state by encouraging the issuance of permits for aquifer storage and retrieval projects, as defined in the amendment to §297.1 of this title (relating to Definitions), which would store appropriated surface water in specific aquifers for subsequent retrieval and beneficial use.

HISTORY PAGE

CHAPTER 331 - UNDERGROUND INJECTION CONTROL

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Amendments to: §§331.9, 331.182, 331.185
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INDEX

CHAPTER 331 - UNDERGROUND INJECTION CONTROL

SUBCHAPTER A: GENERAL PROVISIONS

SUBCHAPTER B: JURISDICTION OVER IN-SITU URANIUM MINING

SUBCHAPTER C: GENERAL STANDARDS AND METHODS

§331.41. Applicability.
§331.42. Area of Review.
§331.43. Mechanical Integrity Standards.
§331.44. Corrective Action Standards.
§331.45. Executive Director Approval of Construction and Completion.
§331.46. Closure Standards.
§331.47. Pond Lining.
§331.48. Waiver of Requirements.

SUBCHAPTER D: STANDARDS FOR CLASS I WELLS OTHER THAN SALT CAVERN SOLID WASTE DISPOSAL WELLS

§331.61. Applicability.
§331.62. Construction Standards.
§331.63. Operating Requirements.
§331.64. Monitoring and Testing Requirements.
§331.65. Reporting Requirements.
§331.66. Additional Requirements and Conditions.
§331.67. Record-keeping Requirements.
§331.68. Post-Closure Care.

SUBCHAPTER E: STANDARDS FOR CLASS III WELLS

§331.81. Applicability.
§331.82. Construction Requirements.
§331.83. Operating Requirements.
§331.84. Monitoring Requirements.
§331.85. Reporting Requirements.
§331.86. Closure.

SUBCHAPTER F: STANDARDS FOR CLASS III WELLS PRODUCTION AREA DEVELOPMENT

§331.101. Applicability.
§331.102. Confinement of Mining Solution.
§331.103. Production Area Monitor Wells.
§331.104. Establishment of Baseline and Restoration Values.
§331.105. Monitoring Standards.
§331.106. Remedial Action for Excursion.
§331.107. Restoration.

SUBCHAPTER G: CONSIDERATION PRIOR TO PERMIT ISSUANCE

§331.121. Class I Wells.
§331.122. Class III Wells.

SUBCHAPTER H: STANDARDS FOR CLASS V WELLS

§331.131. Applicability.
§331.132. Construction Standards.
§331.133. Closure Standards.

SUBCHAPTER I: FINANCIAL RESPONSIBILITY

§331.141. Definitions.
§331.142. Financial Responsibility.
§331.143. Cost Estimate for Plugging and Abandonment.
§331.144. Financial Assurance for Plugging and Abandonment.
§331.145. Incapacity of Owners and Operators, Guarantors, or Financial Institutions.
§331.146. State Assumption of Responsibility.
§331.147. Wording of the Instruments.

SUBCHAPTER J: STANDARDS FOR CLASS I SALT CAVERN SOLID WASTE DISPOSAL WELLS

§331.161. Applicability.
§331.162. Performance Standard.
§331.163. Well Construction Standards.
§331.164. Cavern Construction Standards.
§331.165. Waste Disposal Operating Requirements.
§331.166. Monitoring and Testing Requirements.
§331.167. Reporting Requirements.
§331.168. Additional Requirements and Conditions.
§331.169. Record-Keeping Requirements.
§331.170. Cavern Closure.
§331.171. Post-Closure Care.

SUBCHAPTER K: ADDITIONAL REQUIREMENTS FOR CLASS V AQUIFER STORAGE WELLS

SUBCHAPTER A : GENERAL PROVISIONS

§331.1. Purpose, Scope and Applicability.

(a) The purpose of this chapter is to implement the provisions of the Injection Well Act, Texas Water Code, Chapter 27, as it applies to the commission, consistent with the policy of the Act stated in §27.003.

(b) This chapter applies to all injection wells and activities within the commission's jurisdiction.

(c) Variances from the prohibition of injection of hazardous waste authorized by 40 CFR Part 148 are not within the scope of the commission's jurisdiction.

§331.2. Definitions.

The following words and terms, when used in this chapter shall have the following meanings, unless the context clearly indicates otherwise.

Abandoned well - A well whose use has been permanently discontinued or a well for which, after appropriate review and evaluation by the commission, there is no reasonable expectation of a return to service.

Activity - The construction or operation of an injection well or of pre-injection facilities and includes processing, storage and disposal of waste.

Affected person - Any person whose legal rights, duties or privileges may be adversely affected by the proposed injection operation for which a permit is sought.

Annulus - The space in the wellbore between the injection tubing and the long string casing and/or liner.

Annulus pressure differential - The difference between the annulus pressure and the injection pressure in an injection well.

Aquifer - A geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring.

Aquifer restoration - The process of achieving or exceeding the water quality levels established by the commission for a permit/production area.

Aquifer Storage Well - A Class V injection well used for the injection of water into a geologic formation, group of formations, or part of a formation that is capable of underground storage of water for later retrieval and beneficial use.

Area permit - An injection well permit which authorizes the construction and operation of two or more similar injection wells within a specified area.

Artificial liner - The impermeable lining of a pit, lagoon, pond, reservoir, or other impoundment, that is made of a synthetic material such as butyl rubber, chlorosulfonated polyethylene, elasticized polyolefin, polyvinyl chloride (PVC), other manmade materials, or similar materials.

Baseline quality - The parameters and their concentrations that describe the local groundwater quality of an aquifer prior to the beginning of injection activities.

Baseline well - A well from which groundwater is analyzed to define baseline quality in the permit area (regional baseline well) or in the production area (production area baseline well).

Buffer area - The area between any mine area boundary and the permit area boundary.

Caprock - A geologic formation typically overlying the crest and sides of a salt stock. The caprock consists of a complex assemblage of minerals including calcium carbonate ($CaCO_3$), anhydride ($CaSO_4$), and accessory minerals. Caprocks often contain lost circulation zones characterized by rock layers of high porosity and permeability.

Captured facility - A manufacturing or production facility that generates an industrial solid waste or hazardous waste that is routinely stored, processed, or disposed of on a shared basis in an integrated waste management unit owned, operated by, and located within a contiguous manufacturing complex.

Casing - Material lining used to seal off strata at and below the earth's surface.

Cement - A substance generally introduced as a slurry into a wellbore which sets up and hardens between the casing and borehole and/or between casing strings to prevent movement of fluids within or adjacent to a borehole, or a similar substance used in plugging a well.

Cementing - The operation whereby cement is introduced into a wellbore and/or forced behind the casing.

Commercial facility - A Class I permittee who operates one or more commercial injection wells.

Commercial UIC Class I well facility - Any waste management facility that accepts hazardous or nonhazardous industrial solid waste, for disposal in a UIC Class I injection well, for a charge, except a captured facility or a facility that accepts waste only from other facilities owned or effectively controlled by the same person.

Commercial well - A UIC Class I injection well which disposes of hazardous or nonhazardous industrial solid wastes, for a charge, except for a captured facility or a facility that accepts waste only from facilities owned or effectively controlled by the same person.

Conductor casing or conductor pipe - A short string of large-diameter casing used to keep the top of the wellbore open during drilling operations.

Cone of influence - Is the potentiometric surface area around the injection well within which increased injection zone pressures caused by injection of wastes would be sufficient to drive fluids into a USDW or freshwater aquifer.

Confining zone - A part of a formation, a formation, or group of formations between the injection zone and the lowermost Underground Source of Drinking Water (USDW) or freshwater aquifer that acts as a barrier to the movement of fluids out of the injection zone.

Contaminant - Any physical, biological, chemical or radiological substance or matter in water.

Control parameter - Any chemical constituent of groundwater monitored on a routine basis used to detect or confirm the presence of mining solutions in a designated monitor well.

Date of approval - The effective date of Environmental Protection Agency original approval of Texas' underground injection control program: January 6, 1982.

Disposal well - An injection well that is used for the injection of industrial or municipal waste.

Disturbed salt zone - Zone of salt enveloping a salt cavern, typified by increased values of permeability or other induced anomalous conditions relative to undisturbed salt which lies more distant from the salt cavern, and is the result of mining activities during salt cavern development and which may vary in extent through all phases of a cavern including the post-closure phase.

Excursion - The movement of mining solutions into a designated monitor well.

Existing injection well - A Class I well which was authorized prior to August 25, 1988 by an approved State program, or an EPA-administered program or a well which has become a Class I well as a result of a change in the definition of the injected waste which would render the waste hazardous under 31 Texas Administrative Code (TAC) §335.1.

Fluid - Material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state.

Formation - A body of rock characterized by a degree of lithologic homogeneity which is prevailingly, but not necessarily tabular and is mappable on the earth's surface or traceable in the subsurface.

Formation fluid - Fluid present in a formation under natural conditions.

Fresh water - Water having bacteriological, physical, and chemical properties which make it suitable and feasible for beneficial use for any lawful purpose.

(A) For the purposes of this subchapter, it will be presumed that water is suitable and feasible for beneficial use for any lawful purpose only if:

(i) it is used as drinking water for human consumption; or

(ii) the ground water contains fewer than 10,000 mg/l "Total Dissolved Solids"; and,

(iii) it is not an "exempted aquifer".

(B) This presumption may be rebutted upon a showing by the executive director or an affected person that water containing greater than or equal to 10,000 mg/l Total Dissolved Solids can be put to a beneficial use.

Ground water - Water below the land surface in a zone of saturation.

Hazardous industrial waste - Any industrial solid waste or combination of industrial solid wastes identified or listed as a hazardous waste by the Administrator of the United States Environmental Protection Agency pursuant to Section 3001 of the Resource Conservation and Recovery Act of 1976. The administrator has identified the characteristics of hazardous wastes and listed certain wastes as hazardous in Title 40 of the Code of Federal Regulations, Part 261. The executive director will maintain in the offices of the commission a current list of hazardous wastes, a current set of characteristics of hazardous waste, and applicable appendices, as promulgated by the administrator.

Injection interval - That part of the injection zone in which the well is authorized to be screened, perforated, or in which the waste is otherwise authorized to be directly emplaced.

Injection operations - The surface storage or subsurface emplacement of fluids occurring in connection with an injection well or wells, other than that occurring solely for construction or initial testing.

Injection well - A well into which fluids are being injected.

Injection zone - A formation, a group of formations, or part of a formation that receives fluid through a well.

Intermediate casing - A string of casing with diameter intermediate between that of the surface casing and that of the smaller long-string or production casing, and which is set and cemented in a well after installation of the surface casing and prior to installation of the long-string or production casing.

In service - The operational status when an authorized injection well is capable of injecting fluids, including times when the well is shut-in and on standby status.

Liner - An additional casing string typically set and cemented inside the long string casing. Occasionally, used to extend from base of the long string casing to or through the injection zone.

Long string casing or production casing - A string of casing that is set inside the surface casing and usually extending to or through the injection zone.

Lost circulation zone - A term applicable to rotary drilling of wells to indicate a subsurface zone which is penetrated by a wellbore, and which is characterized by rock of high porosity and permeability, into which drilling fluids flow from the wellbore to the degree that the circulation of drilling fluids from the bit back to ground surface, is disrupted or "lost".

Mine area - The area defined by a line through the ring of designated monitor wells installed to monitor the production zone.

Mine plan - A map of proposed mine areas and an estimated schedule indicating the sequence and timetable for mining and any required aquifer restoration.

Monitor well - Any well used for the sampling or measurement of any chemical or physical property of subsurface strata or their contained fluids.

(A) "Designated monitor wells" are those listed in the production area authorization for which routine water quality sampling is required;

(B) "Secondary monitor wells" are those wells in addition to designated monitor wells, used to delineate the horizontal and vertical extent of mining solutions;

(C) "Pond monitor wells" are wells used in the subsurface surveillance system near ponds or other surface facilities.

New injection well - Any well, or group of wells not an existing injection well.

New waste stream - A waste stream not permitted.

Non-commercial facility - A Class I permittee which operates only non-commercial wells.

Non-commercial UIC Class I well facility - A UIC Class I permittee which operates only non-commercial wells.

Non-commercial well - A UIC Class I injection well which disposes of wastes disposes of wastes that are generated on-site, at a captured facility or from other facilities owned or effectively controlled by the same person.

Off-site - Property which cannot be characterized as "on-site".

On-site - The same or geographically contiguous property which may be divided by public or private rights-of-way, provided the entrance and exit between the properties is at a cross-roads intersection, and access is by crossing, as opposed to going along, the right-of-way. Non-contiguous properties owned by the same person but connected by a right-of-way which the owner controls and to which the public does not have access, is also considered on-site property.

Out of service - The operational status when a well is not authorized to inject fluids, or the well itself is incapable of injecting fluids for mechanical reasons, maintenance operations, or well workovers or when injection is prohibited due to the well's inability to comply with the in-service operating standards of this chapter.

Permit - A written document issued by the Texas Water Commission that by its conditions, authorizes the permittee to construct, install, modify, or operate, in accordance with stated limitations, a specified injection well facility.

Permit area - The area owned or under lease by the permittee which may include buffer areas, mine areas, and production areas.

Pollution - The contamination of water or the alteration of the physical, chemical, or biological quality of water:

(A) that makes it harmful, detrimental or injurious:

(i) to humans, animal life, vegetation, or property, or

(ii) to public health, safety or welfare; or,

(B) that impairs the usefulness or the public enjoyment of the water for any lawful and reasonable purpose.

Pre-Injection facilities - The on-site above-ground appurtenances, structures, equipment and other fixtures that are or will be used for storage, processing or in conjunction with an injection operation.

Production area - The area defined by a line generally through the outer perimeter of injection and recovery wells used for mining.

Production area authorization - A document, issued by the Texas Water Commission under the terms of an injection well permit, approving the initiation of mining activities in a specified production area within a permit area.

Production zone - The stratigraphic interval extending vertically from the shallowest to the deepest stratum into which mining solutions are authorized to be introduced.

Radioactive material - A material which is identified as a radioactive material under Article 4590f, Vernon's Texas Civil Statutes, as amended, or the rules adopted by the Texas Board of Health pursuant thereto.

Radioactive waste - A solid waste which is identified as a radioactive waste in and requires special licensing under Article 4590f, Vernon's Texas Civil Statutes, as amended, or the rules adopted by the Texas Board of Health pursuant thereto.

Restoration demonstration - A test or tests conducted by a permittee to simulate production and restoration conditions and verify or modify the fluid handling values submitted in the permit application.

Restored aquifer - An aquifer whose local ground water quality has, by natural or artificial processes, returned to levels consistent with Restoration Table values or better as verified by an approved sampling program.

Salt cavern - A hollowed-out void space that has been purposefully constructed within a salt stock, typically by means of solution mining by circulation of water from a well or wells connected to the surface.

Salt cavern confining zone - A zone between the salt cavern injection zone and all USDWs and freshwater aquifers, that acts as a barrier to movement of waste out of a salt cavern injection zone, and consists of the entirety of the salt stock excluding any portion of the salt stock designated as a UIC Class I salt cavern injection zone or any portion of the salt stock occupied by a UIC Class II or Class III salt cavern or its disturbed salt zone.

Salt cavern injection interval - That part of a salt cavern injection zone consisting of the void space of the salt cavern into which waste is stored or disposed of, or which is capable of receiving waste for storage or disposal.

Salt cavern injection zone - The void space of a salt cavern that receives waste through a well, plus that portion of the salt stock enveloping the salt cavern, and extending from the boundaries of the cavern void outward a sufficient thickness to contain the disturbed salt zone, and an additional thickness of undisturbed salt sufficient to ensure that adequate separation exists between the outer limits of the injection zone and any other activities in the domal area.

Salt cavern solid waste disposal well or salt cavern disposal well - For the purposes of this chapter relating to Underground Injection Control, regulations of the Texas Water Commission, and not to UIC Class II or UIC Class III wells in salt caverns regulated by the Texas Railroad Commission, a salt cavern disposal well is a type of UIC Class I injection well used:

(A) to solution mine a waste storage or disposal cavern in naturally-occurring salt; and/or,

(B) to inject hazardous, industrial, or municipal waste into a salt cavern for the purpose of storage or disposal of the waste.

Salt dome - A geologic structure that includes the caprock, salt stock, and deformed strata surrounding the salt stock.

Salt stock - A geologic formation consisting of a relatively homogeneous mixture of evaporite minerals dominated by halite (NaCl) that has migrated from originally tabular beds into a vertical orientation.

Stratum - A sedimentary bed or layer, regardless of thickness, that consists of generally the same kind of rock or material.

Surface casing - The first string of casing (after the conductor casing, if any) that is set in a well.

Transmissive fault or fracture - A fault or fracture that has sufficient permeability and vertical extent to allow fluids to move between formations.

Underground injection - The subsurface emplacement of fluids through a well.

Underground injection control (UIC) - The program under the federal Safe Drinking Water Act, Part C, including the approved Texas state program.

Underground source of drinking water ("USDW") - An "aquifer" or its portions:

(A) which supplies drinking water for human consumption; or

(B) in which the ground water contains fewer than 10,000 mg/l "Total Dissolved Solids"; and,

(C) which is not an "exempted aquifer".

Upper limit - A parameter value established by the Texas Water Commission in a permit/production area authorization which when exceeded indicates mining solutions may be present in designated monitor wells.

Verifying analysis - A second sampling and analysis of control parameters for the purpose of confirming a routine sample analysis which indicates an increase in any control parameter to a level exceeding the upper limit. Mining solutions are assumed to be present in a designated monitor well if a verifying analysis confirms that any control parameter in a designated monitor well is present in concentration equal to or greater than the upper limit value.

Well - A bored, drilled or driven shaft, or an artificial opening in the ground made by digging, jetting or some other method, where the depth of the opening is greater than its largest surface dimension, but the term does not include any surface pit, surface excavation, or natural depression.

Well monitoring - The measurement by on-site instruments or laboratory methods of any chemical, physical, radiological or biological property of the subsurface strata or their contained fluids penetrated by the wellbore.

Adopted May 29, 1996 Effective June 28, 1996

§331.3. Injection Prohibited.

(a) Unless excluded under subsection (b) of this section, the construction of an injection well, the conversion of a well into an injection well, and the use or operation of an injection well is prohibited unless authorized by an injection well permit, order, or rule of the commission. A RCRA permit applying the standards of Chapter 335.152(14) of this title (relating to Permitting Standards of Owners and Operators of Hazardous Waste Storage Processing or Disposal Facilities) will constitute a Underground Injection Control (UIC) permit for hazardous waste injection wells for which the technical standards of Chapter 331 are not generally appropriate.

(b) The following activities are not within the scope of subsection (a) of this section:

(1) Injection of waste into subsurface strata via a single family residential cesspool or other device that receives waste, which has an open bottom or perforated sides.

(2) Injection of waste into subsurface strata via a septic system well used for single family residential waste disposal.

(c) This rule does not limit the authority of the commission to abate and prevent pollution of fresh water resulting from any injection activity by requiring a permit, by instituting appropriate enforcement action, or by other appropriate action.

§331.4. Mechanical Integrity Required.

Injection is prohibited for Class I and III wells which lack mechanical integrity, the result of which may pollute an underground source of drinking water. Except where excluded in the case of authorization by rule, mechanical integrity pursuant to §331.43 of this title (relating to Mechanical Integrity Standards) must be demonstrated to the satisfaction of the executive director before operation begins. Injection may be prohibited for Class V wells which lack mechanical integrity. The executive director may require a demonstration of mechanical integrity at any time if there is reason to believe mechanical integrity is lacking.

§331.5. Prevention of Pollution.

No permit or authorization by rule shall be allowed where an injection well causes or allows the movement of fluid that would result in the pollution of an underground source of drinking water. A permit or authorization by rule shall include terms and conditions reasonably necessary to protect fresh water from pollution.

§331.6. Prohibition of Class IV Well Injection.

The injection of hazardous fluids or radioactive wastes into or above a formation which within one quarter mile of the well contains an underground source of drinking water is prohibited. Wells used to inject hazardous waste-contaminated ground water that is of acceptable quality to aid remediation and is being reinjected into the same formation from which it was drawn are not prohibited by this section if such injection is approved by the commission pursuant to provisions for cleanup of releases consistent with federal regulations under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 United States Code (U.S.C) 9601-9657, or pursuant to provisions for cleanup of releases consistent with federal regulations under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901 through 6987.

Adopted May 22, 1996 Effective June 13, 1996

§331.7. Permit Required.

(a) Except as provided in §331.9 of this title (relating to Injection Authorized by Rule), all injection wells and activities must be authorized by permit.

(b) For Class III in situ uranium solution mining wells, Frasch sulfur wells, and other Class III operations under commission jurisdiction, an area permit authorizing more than one well may be issued for a defined permit area wherein wells of similar design and operation are proposed. Prior to commencing operation of such wells, the permittee may be required to obtain a production area authorization for separate production or mining areas within the permit area.

§331.8. Application Required for Existing Wells.

The owner or operator of an existing injection well shall complete, sign and submit to the executive director an application for permit in conformance with Chapter 305 of this title (relating to Consolidated Permits). The application shall be submitted according to the following schedule:

(1) for Class I hazardous waste wells, within 6 months from January 1, 1982;

(2) for other Class I and for Class III wells, within 2 years from January 1, 1982.

§331.9. Injection Authorized by Rule.

(a) Injection into any Class I and Class III well or group of Class I and Class III wells for which the commencement of construction began prior to January 1, 1982 is authorized by virtue of this rule, provided compliance with any permit issued before January 1, 1982 is maintained, provided compliance with the following rules of this chapter is achieved within one year from January 1, 1982, and provided mechanical integrity is demonstrated within two years from January 1, 1982 for each individually authorized Class I and III well:

(1) financial responsibility: §§331.141-331.147 of this title (relating to Financial Responsibility);

(2) operating, monitoring and reporting: Class I, §331.63 of this title (relating to Operating Requirements); §331.64 of this title (relating to Monitoring Requirements); and §331.65 of this title (relating to Reporting Requirements); Class III, §331.83 of this title (relating to Operating Requirements); §331.68 of this title (relating to Post-Closure Care); §331.84 of this title (relating to Monitoring Requirements); and §331.85 of this title (relating to Reporting Requirements); or §331.103 of this title (relating to Production Area Monitor Wells); §331.104 of this title (relating to Establishment of Baseline and Restoration Values); §331.105 of this title (relating to Monitoring Standards); §331.106 of this title (relating to Remedial Action for Excursion); §331.107 of this title (relating to Restoration); §331.86 of this title (relating to Closure);

(3) reporting of noncompliance or malfunction: Class I, §331.65(b) of this title (relating to Reporting Requirements); Class III, §331.106(1) of this title (relating to Remedial Action for Excursion) and §331.85(e) of this title (relating to Reporting Requirements);

(4) retention of records: Class I, §331.67(c) of this title (relating to Record Keeping Requirements);

(5) notice of abandonment: §331.46(b) of this title (relating to Closure Standards);

(6) closure plan and standards: §331.46 of this title (relating to Closure Standards); and

(7) post-closure care: §331.68 of this title (relating to Post-Closure Care); and

(8) hazardous waste injection wells: §305.156 of this title (relating to Hazardous Waste).

(b) The authorization and requirements of subsection (a) of this section also apply to the construction or operation commencing after January 1, 1982 of any Class III well that will be part of an existing Class III well field or operation and will represent a continuation of such field or operation, provided a demonstration of mechanical integrity is made and reported to the executive director in accordance with §331.43 of this title (relating to Mechanical Integrity Standards).

(c) Plugging and abandonment of a well authorized by rule at any time after January 1, 1982 shall be accomplished in accordance with the standards of §331.46 of this title (relating to Closure Standards).

(d) Post-Closure Care of a hazardous Class I well authorized by rule at any time after January 1, 1982 shall be accomplished in accordance with the standards of §331.68 of this title (relating to Post-Closure Care).

(e) Authorization under subsections (a) and (b) of this section shall expire:

(1) if an application for permit has not been filed in accordance with §331.8 of this title (relating to Application Required for Existing Wells);

(2) upon the effective date of an injection well permit or denial of an injection well permit application; or,

(3) the date five years after January 1, 1982, unless a complete application for permit is pending.

(f) Injection into Class V Wells, unless otherwise provided herein is authorized by virtue of this rule:

(1) for injection into new Class V wells used for the disposal or storage of over 1,000 gallons per day of wastewater or treated wastewater, a person must submit an application to and obtain a permit from the commission prior to commencement of construction and operations.

(2) for Class V aquifer storage injection wells to be used for underground storage of appropriated surface water, a person must obtain the necessary authorization under §295.21 of this title (relating to Aquifer Storage and Retrieval Projects) from the commission and meet the requirements of this chapter related to aquifer storage injection wells prior to commencement of construction and operation.

(g) The executive director may require the owner or operator of an injection well authorized by rule to apply for and obtain an injection well permit. The owner or operator shall submit a complete application within 90 days after the receipt of a letter from the executive director requesting that the owner or operator of an injection well submit an application for permit. Cases for which a permit may be required include, but are not limited to:

(1) the injection well is no longer within the scope of subsections (a), (b) and (e) of this section;

(2) compliance with standards in addition to those listed in Subsection (a) of this section is required to protect fresh water from pollution; or,

(3) the injection well is not in compliance with the standards required by this section.

(h) For Class III injection wells authorized by rule, the executive director is authorized to waive requirements consistent with the provisions of §331.48 of this title (relating to Waiver of Requirements).

(i) For all permits issued by the state on or before July 26, 1988, the permit terms "injection zone" and "subsurface interval" shall have the same definitional meaning as the term "injection interval", as defined in §331.2 of this title (relating to Definitions). For all permits issued after July 26, 1988, the permit term "injection interval" shall be defined in accordance with §331.2 of this title (relating to Definitions).

(j) Class IV wells injecting hazardous waste-contaminated ground water that is of acceptable quality to aid remediation and is being reinjected into the same formation from which it was drawn, as authorized by §331.6 of this title (relating to Prohibition of Class IV Well Injection), shall be authorized by rule.

Adopted December 18, 1996 Effective January 10, 1997

§331.10. Inventory of Wells Authorized by Rule.

(a) Within one year after January 1, 1982 or prior to construction, the owner, operator, and driller of an injection well facility shall submit to the executive director an inventory for each facility containing:

(1) the name of the facility,

(2) the name and address of legal contact,

(3) the ownership of the facility,

(4) the nature, type and operating status of the injection well(s), and

(5) the location, depth, and construction of each well.

(b) Drillers of injection wells authorized by rule may inventory wells by submission of either a form to be provided by the executive director or the form of the Water Well Drillers Board.

(c) Failure to comply with this section shall constitute grounds for termination of authorization by rule.

§331.11. Classification of Injection Wells.

(a) Injection wells within the jurisdiction of the commission are classified as follows:

(1) Class I.

(A) Wells used by generators of hazardous wastes or owners or operators of hazardous waste management facilities to inject hazardous waste, other than Class IV wells.

(B) Other industrial and municipal waste disposal wells which inject fluids beneath the lower-most formation which within one quarter mile of the wellbore contains an underground source of drinking water.

(2) Class III. Wells which inject for extraction of minerals, including:

(A) mining of sulfur by the Frasch process;

(B) solution mining of minerals which includes sodium sulfate, sulfur, potash, phosphate, copper, uranium, and other minerals which can be mined by this process.

(3) Class IV. Wells used by generators of hazardous wastes or of radioactive wastes, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous wastes or radioactive wastes into or above a formation which within one quarter mile of the wellbore contains an underground source of drinking water.

(4) Class V. Injection wells within the jurisdiction of the commission, but not included in Classes I, III, or IV. Class V wells include, but are not limited to:

(A) air conditioning return flow wells used to return to the supply aquifer the water used for heating or cooling in a heat pump;

(B) cesspools or other devices that receive wastes, which have an open bottom and sometimes have perforated sides;

(C) cooling water return flow wells used to inject water previously used for cooling;

(D) drainage wells used to drain surface fluid, primarily storm runoff, into a subsurface formation;

(E) dry wells used for the injection of wastes into a subsurface formation;

(F) recharge wells used to replenish the water in an aquifer;

(G) salt water intrusion barrier wells used to inject water into a freshwater aquifer to prevent the intrusion of salt water into the fresh water;

(H) sand backfill wells used to inject a mixture of water and sand, mill tailings or other solids into mined out portions of subsurface mines;

(I) septic system wells used:

(i) to inject the waste or effluent from a multiple dwelling, business establishment, community or regional business establishment septic tank; or

(ii) for a multiple dwelling, community or regional cesspool.

(J) Subsidence control wells (not used for the purpose of oil or natural gas production) used to inject fluids into a non-oil or gas producing zone to reduce or eliminate subsidence associated with the overdraft of fresh water.

(K) Aquifer storage wells used for the injection of water for storage and subsequent retrieval for beneficial use.

(b) Class II wells and Class III wells used for brine mining fall within the jurisdiction of the Railroad Commission of Texas.

Adopted May 29, 1996 Effective June 28, 1996

§331.12. Conversion of Wells.

(a) Persons utilizing wells authorized by permit, by rule, or otherwise, who wish to convert the well from its authorized purpose to another purpose or to an additional purpose must first obtain the appropriate approval described in paragraphs (1) through (4):

(1) Persons utilizing injection wells authorized by permit must obtain either a permit amendment pursuant to §305.62 of this title (relating to Amendment), or if appropriate, a permit revocation pursuant to §305.66 of this title (relating to Revocation and Suspension) or §305.67 of this title (relating to Revocation and Suspension Upon Request or Consent).

(2) Persons utilizing injection wells authorized by rule that are to be converted to a purpose that requires authorization by permit must obtain a permit.

(3) Persons utilizing injection wells authorized by rule that are to be converted to a purpose that does not require authorization by permit must obtain the written approval of the executive director.

(4) Disposal of industrial or municipal waste in Class II wells is specifically prohibited unless authorized by permit or by written approval of the executive director and confirmed by Texas Railroad Commission authorization.

(b) Conversions of wells that remain exclusively within the jurisdiction of the Railroad Commission are not affected by this rule. For example, a conversion from a Class II disposal well to a water supply well regulated by the Railroad Commission would neither enter nor exit the jurisdiction of the Texas Water Commission and thus would not be subject to this rule.

§331.13. Exempted Aquifer.

(a) An exempted aquifer is an aquifer or a portion of an aquifer which meets the criteria for fresh water but which has been designated an exempted aquifer by the commission after notice and opportunity for public hearing. Those aquifers or portions of aquifers which were designated for exemption by the Texas Department of Water Resources in its original application for program approval submitted to the Environmental Protection Agency shall be considered to be exempted aquifers.

(b) Except for injection authorized by rule, the commission may require a permit for injection into an exempted aquifer in order to protect fresh water outside the exempted aquifer which may be subject to pollution caused by the injection.

(c) An aquifer or portion of an aquifer may be designated as an exempted aquifer if the following criteria are met:

(1) It does not currently serve as a source of drinking water for human consumption; and

(2) Until exempt status is removed according to procedures in subsection (d) of this section, it will not in the future serve as a source of drinking water for human consumption because:

(A) It is mineral, hydrocarbon or geothermal energy bearing with production capability;

(B) It is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical;

(C) It is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or,

(D) It is located above a Class III well mining area subject to subsidence or catastrophic collapse.

(d) After notice and opportunity for public hearing, the designation of exempted aquifer may be removed thereby eliminating the exempt status, provided restoration has been accomplished if required.

§331.14. Prohibition of Class I Salt Cavern Solid Waste Disposal Wells and Associated Caverns in Geologic Structures or Formations Other Than Salt Stocks of Salt Domes.

Construction and operation of Class I salt cavern solid waste disposal wells and associated caverns in geologic structures or formations other than salt stocks of salt domes is prohibited until such time at which this section is amended to provide for authorization of such facilities and activities, and specific rules for such facilities and activities are promulgated.

§331.15. Financial Assurance Required.

Injection is prohibited for Class I and III wells which lack financial assurance, as required by this chapter.

SUBCHAPTER K : ADDITIONAL REQUIREMENTS FOR CLASS V AQUIFER STORAGE WELLS

§331.181. Applicability.

In addition to the requirements of Subchapter H of this chapter (relating to Standards for Class V Wells), the requirements of this subchapter apply to all Class V aquifer storage wells.

Adopted May 29, 1996 Effective June 28, 1996

§331.182. Area of Review.

The area of review for a Phase I Class V aquifer storage well is the area determined by a radius of ¼ mile from the proposed or existing wellbore. The area of review for a Phase II Class V aquifer storage well is the area determined by a radius of ¼ mile from the perimeter of a buffer zone as described under §295.22(e)(5) of this title (relating to Additional Requirements for the Underground Storage of Surface Water for Subsequent Retrieval and Beneficial Use). In the application for authorization, the applicant shall provide information on the activities within the area of review including the following factors and their adverse impacts, if any, on the injection operation:

(1) location of all artificial penetrations that penetrate the interval to be used for aquifer storage, including but not limited to: water wells and abandoned water wells from TNRCC well files or ground water district files; oil and gas wells and saltwater injection wells from the Railroad commission files; and waste disposal wells/other injection wells from the TNRCC disposal well files;

(2) completion and construction information, where available, for identified artificial penetrations; and

(3) site specific, significant geologic features, such as faults and fractures.

Adopted December 18, 1996 Effective January 10, 1997

§331.183. Construction and Closure Standards.

All Class V aquifer storage wells shall be designed, constructed, completed, and closed to prevent, commingling, through the wellbore and casing, of injection waters with other fluids outside of the authorized injection zone; mixing through the wellbore and casing of fluids from aquifers of substantively different water quality; and infiltration through the wellbore and casing of water from the surface into ground water zones.

(1) Plans and specifications. Except as specifically required in the terms of the Class V aquifer storage well authorization, the drilling and completion of a Class V aquifer storage well shall be done in accordance with the requirements of §331.132 of this title (relating to Construction Standards) and the closure of a Class V aquifer storage well shall be done in accordance with the requirements of §331.133 of this title (relating to Closure Standards).

(A) If the operator proposes to change the injection interval to one not reviewed during the authorization process, the operator shall notify the executive director immediately. The operator may not inject into any unauthorized zone.

(B) The executive director shall be notified immediately of any other changes, including but not limited to, changes in the completion of the well, changes in the setting of screens, and changes in the injection intervals within the authorized injection zone.

(2) Construction materials. Casing materials for Class V aquifer storage wells shall be constructed of materials resistant to corrosion.

(3) Construction and workover supervision. All phases of any aquifer storage well construction, workover or closure shall be supervised by qualified individuals who are knowledgeable and experienced in practical drilling engineering and who are familiar with the special conditions and requirements of injection well and water well construction.

Adopted May 29, 1996 Effective June 28, 1996

§331.184. Operating Requirements.

(a) All Class V aquifer storage wells shall be operated in such a manner that they do not present a hazard to or cause pollution of an underground source of drinking water.

(b) Injection pressure at the wellhead shall not exceed a maximum which shall be calculated so as to assure the pressure in the injection zone does not cause movement of fluid out of the injection zone.

(c) The owner or operator of an aquifer storage well that has ceased operations for more than two years shall notify the executive director 30 days prior to resuming operation of the well.

(d) The owner or operator shall maintain the mechanical integrity of all wells operated under this section.

(e) The quality of water to be injected must meet the quality criteria prescribed by the commission's drinking water standards as provided in Chapter 290 of this title (relating to Water Hygiene).

Adopted May 29, 1996 Effective June 28, 1996

§331.185. Monitoring and Reporting Requirements.

(a) The following must be monitored at the required frequency, and reported to the executive director on a quarterly basis or a schedule to be agreed upon by the executive director:

(1) monthly average injection rates;

(2) monthly injection and retrieval volumes;

(3) monthly average injection pressures;

(4) monthly water quality analyses of injected water; and

(5) other information as determined by the executive director as necessary for the protection of underground sources of drinking water.

(b) A final report for Phase I of an aquifer storage and retrieval project or a feasibility study of any other aquifer storage project must be submitted to the executive director within 45 days of the completion of such projects addressing items in §331.186 of this title (relating to Additional Requirements Necessary for Final Project Authorization).

Adopted December 18, 1996 Effective January 10, 1997

§331.186. Additional Requirements Necessary for Final Project Authorization.

Upon completion of the aquifer storage well, the following information shall be obtained during the first phase of the project and submitted along with the application for final authorization:

(1) as-built drilling and completion data on the well;

(2) all logging and testing data on the well;

(3) formation fluid analyses;

(4) injection fluid analyses;

(5) injectivity and pumping tests determining well capacity and reservoir characteristics;

(6) hydrogeologic modeling, with supporting data, predicting mixing zone characteristics and injection fluid movement and quality; and

(7) other information as determined by the executive director as necessary for the protection of underground sources of drinking water.

Adopted May 29, 1996 Effective June 28, 1996