8.0 POTENTIAL GROUND WATER RESOURCES

8.1 Development of New Ground Water Supplies

Some quantities of ground water can still be developed within the Sabine Basin. However, due to the limitations in aquifer transmissivities and deteriorating water quality with aquifer depth, large volumes of water typically cannot be obtained from a localized area. The groundwater availability reported for each aquifer and county was determined for the entire aquifer area within the county. The amount of water that can be obtained from a well field is limited to the well field's area of influence, which is commonly only a portion of the available ground water within the county. In light of these considerations, it is not reasonable to expect to fully develop all ground water resources within the Basin to meet large demand centers. However, new ground water developments are viable resources for small local supplies.

The Carrizo-Wilcox aquifer is the most important ground water resource in the Sabine Basin and has the greatest potential for future development. Based on a TWDB evaluation, an additional amount of ground water could be obtained from the aquifer with proper development. However, in some areas of the Basin ground water recharged to the Carrizo-Wilcox moves into the adjacent Neches River Basin. Also, the variability of the transmissivity in portions of the Carrizo-Wilcox can limit movement of recharge through the aquifer. This effectively reduces the potential to develop this aquifer as a regional water supply source.

A large amount of good quality water from the Gulf Coast aquifer is available in Jasper, Newton, and Orange counties. Most wells in the Gulf Coast aquifer system produce from the shallowest aquifer available that contains the amount of water necessary to meet intended needs. Additional ground water from lower aquifers is often also available. For example, the Jasper is largely underdeveloped because it lies beneath the Evangeline and Chicot aquifers, both of which are heavily used in the region. Most wells producing from the Jasper are located in the outcrop area or close to it and there are very few downdip wells. Although a large amount of ground water can be developed from the Gulf Coast aquifer, it is not likely to be developed because the Gulf Coast region already has adequate water supply.

The Nacatoch is only valuable as a local ground water resource, but is available as a backup source for temporary use by the City of Commerce. Water-quality deterioration limits its use in the downdip direction.

The utilization of the Queen City aquifer is fairly small since the amount of water potentially recoverable from this aquifer is limited. Most of the water recharged to the aquifer is later discharged as spring flow, before it can be captured by wells. Where the Queen City is overlain by the Sparta, wells can be drilled and completed in both aquifers to increase productivity. For some areas it is particularly important that wells within the Queen City be adequately spaced due to limitations of aquifer transmissivity. Wells spaced too closely and over pumping will result in water level decline and possible water quality deterioration.

The Sparta aquifer is similar to the Queen City in that its outcrop area and saturated thickness are limited, and much of the water that enters the aquifer as recharge is quickly discharged as spring flow. The aquifer will likely continue to be used primarily for light demands. However, if properly constructed and spaced, wells can yield as much as 300 to 500 gallons per minute (gpm). Additionally, production can be increased considerably by drilling and completing wells in both the Sparta and Queen City aquifers.

The Yegua aquifer is limited to Sabine County and therefore represents only a small percent of ground water availability in the Sabine Basin. Although the aquifer is limited in extent, the formation does attain sufficient thickness to potentially allow for moderately high yields in downdip locations.

8.1.1 Ground Water Availability

Section 4.2 of this report details the methodology by which ground water availability was determined. Tables 4.4 and 4.5 show that availability. To determine how much of the available ground water is likely to be developed, future shortages and their location need to be identified. Based on the comparison of current supply to year 2050 demand, four counties in the Sabine Basin showed a shortage. All of these counties are in the Upper Basin. The potential ground water availability and supply shortage amounts for those counties is listed in Table 8.1

Table 8.1: Potential New Ground Water Supply
(all values are in acre-feet per year)

County	Aquifer	Year 2000 Projected Pumpage	Annual Availability	Potential New Ground Water Supply	Projected 2050 Shortage
Harrison	Carrizo-Wilcox	2,606	4,958	2,352	83,959
	Queen City	0	2,756	2,756	
Hopkins	Carrizo-Wilcox	557	2,066	1,509	2,098
	Nacatoch	319	29	-290	
Rusk	Carrizo-Wilcox	3,256	4,130	874	10,323
	Queen City	137	2,756	2,619	
Wood	Carrizo-Wilcox	3,950	7,437	3,487	9,359
	Queen City	2,601	10,920	8,319	

When looking at the projected need in Harrison County, almost all of the future shortage is due to increased manufacturing use. As explained above, aquifer development will need to take place by smaller users on a very localized level. Large demands in one area (like manufacturing) cannot expect to develop all of the county's potential future ground water supply. For these reasons, manufacturing users will probably not use groundwater. Therefore, it is likely that only very little of the potential future groundwater supply in Harrison County will be developed.

In Hopkins County, it is conceivable that the additional 1,200 acre-feet per year (1,509 minus 290) could be developed on local levels because most of the growth in the county is in municipal use (small towns) and livestock use.

In Rusk County, over the 50-year planning period, there is an increase of only 700 acre-feet per year for municipal use, which would generally be in smaller towns. The remainder of the increase in need (16,700 acre-feet per year) is for steam electric use. Steam electric power plants generally do not use groundwater for their operations. They almost always have on-site surface reservoirs. Therefore, it is likely that only about 700 acre-feet of groundwater can expect to be developed.

In Wood County, total water use is expected to increase by 21,000 acre-feet per year from 1990 to 2050. Almost 13,000 acre-feet per year of this demand is in the mining use category. As with manufacturing use in Harrison County, these mining operations would have large localized demands, which cannot be supported by local well fields. Reported water level declines in the Carrizo-Wilcox and lower transmissivities in the Queen City Aquifer indicate large-scale ground water development in this county is unlikely. In addition, through the meetings with water providers some ground water quality problems were identified in Wood County. Bright Star-Salem Water Supply Corporation, who has wells in Wood and Rains Counties, has requested to buy surface water from SRA due to the deteriorating quality of their ground water. Given the reasons above, only a small portion of the 11,700 acre-feet per year of potential supply is likely to be developed.

Summary

With proper well location and construction, and conservative pumping rates, the aquifers located in the Sabine Basin can continue to be a water source for the region. As noted in Section 4, historical water-level declines are mostly the result of overpumpage from individual wells or well fields and generally have not resulted in regional declines. Water quality problems do exist in portions of the Basin's aquifers, but these problems can sometimes be remedied or avoided by proper well placement and construction. When local entities are considering development of ground water resources, in-depth studies should be performed. At that time down-hole surveys could be conducted to identify potential water quality problem zones. Once identified these zones can be avoided for future wells by proper location of screened intervals when setting the well casing.

Proper development of an aquifer may also significantly increase the amount of recharge to the aquifer by increasing the hydraulic gradient downdip of the outcrop areas and reducing the amount of recharge that is locally rejected. However, this additional recharge cannot be counted on nor can it be estimated.

Good quality water should be obtainable from many sections of the Carrizo-Wilcox aquifer in the study area. Whether these supplies will be developed depends heavily on the location, amount, and concentration of the future demands. Evaluation of water quality in different zones should be performed to identify potential bad quality zones. To limit significant declines in water levels, the location of well fields, spacing of production wells, and the pumping rates must also be considered. Further studies are necessary to fully evaluate the potential of the Carrizo-Wilcox aquifer in the Sabine Basin area, and to determine the best way to properly develop this water resource.

8.1.2 Costs

The costs associated with developing future ground water supplies can vary significantly based on several factors. These costs can generally be grouped into two categories:1) costs associated with a feasibility analysis, and 2) costs associated with installation of the well or wells and the infrastructure necessary to get the water to the end user. The cost of a feasibility study is only a small component of the cost of developing a well or well field. The majority of the costs are in the drilling and installation of the well(s) and the installation of a distribution and treatment system. Desired yields of less than 200 gpm can generally be achieved with wells completed at moderately shallow depths for relatively low costs. Significantly higher costs are required for high production wells (greater than 1,000 gpm). In addition, wells of this size require greater saturated thickness and are limited to the Carrizo-Wilcox aquifer in the Sabine Basin. While high capacity wells are relatively expensive to construct as compared to small capacity wells, the overall cost is often less expensive than a new surface water alternative.

8.2 Aquifer Storage and Recovery

Artificial recharge is a method of augmenting the natural recharge that occurs to an aquifer system. The injection of water into an aquifer as an artificial recharge technique has been practiced in the United States for several decades. Aquifer Storage and Recovery (ASR) is a term that has been developed to describe recharge of an aquifer and the subsequent recovery of the water for a beneficial use. ASR is a method to inject treated surface water into the aquifer during periods of low water demand, which normally occurs during the winter months. The water would subsequently be available for withdrawal using existing or new wells during months of high water demand. If feasible, ASR could relieve peak demands on the water treatment system and delay the need for the construction of additional surface water treatment facilities.

For this study, the geology of the Basin was examined to identify geologic formations that would be conducive to the ASR process. The formations must be capable of storing volumes of water without transferring them to other areas in the aquifer. A number of counties in the Upper Basin fit this first criteria. The next criteria for selection was selecting entities that already had both existing surface water and ground water facilities. Cities that utilize ground water and surface water within Rains, Smith, Van Zandt, and Wood counties were considered as potential candidates for artificial recharge. Discussions with the staff of the Sabine River Authority also provided information on cities that may be interested in artificial recharge as a water supply option. Kilgore in Smith County, Emory in Rains County, Canton and Grand Saline in Van Zandt County and Quitman in Wood County were considered as candidates. The City of Kilgore was considered a viable option for further study because of its well field in the Carrizo-Wilcox aquifer, the water-level decline(about 70 to 100 feet since 1952) that has occurred in the well field due to past pumping, and the availability of treated surface water from the City's system. The City of Canton in Van Zandt County also was considered a viable candidate because of the combined surface water and ground water supply and the increase in water demand that is occurring in the City due to growth and the commercial and reselling market served by the City's water supply system. Representatives of Canton and Kilgore also expressed an interest in the feasibility of artificial recharge to help provide additional water supply.

Quitman in Wood County has an adequate surface water supply and does not have the projected increase in demand as other cities. Grand Saline was not selected because treated surface water to the City would have to be provided via pipeline from another city in the area. Emory in Rains County is a town with 963 people and does not represent a large enough potential project to warrant further consideration.

The cities of Kilgore and Canton were selected also because they would represent a study of artificial recharge for a larger city of about 11,000 and the study of artificial recharge of a smaller city with a population of about 3,000. The aquifer conditions for the Kilgore well field in Smith County and for the water wells utilized by Canton indicate that it should be possible to store the water in the aquifer and have it retained there for utilization by the cities. There is very limited pumpage in proximity to Canton and the City of Kilgore well field.

Water usage by the City of Kilgore was 2,950 and 3,095 acre-feet per year (af/y) in 1996 and 1997, respectively. The municipal water demand for Kilgore is projected to be 2,794 af/y, 2,854 af/y, and 2,940 af/y by 2010, 2020, and 2030, respectively. In addition, Kilgore supplies approximately 700 af/y to wholesale municipal and industrial customers. Data for the City of Canton show that water usage was about 649 acre-feet in 1996 compared to 484 acre-feet in 1986. Municipal water demand is projected to be 681 af/y, 679 af/y, and 658 af/y by 2010, 2020, and 2030, respectively. In addition, Canton supplies approximately 100 af/y to wholesale municipal customers.

8.2.1 Kilgore Site

The City of Kilgore's well field is located about 9 to 11 miles southwest of the City. Currently, there are nine producing wells screened in the Carizzo-Wilcox formation that provide part of the City's water supply (see Table 8.2 at the end of this section). The remaining portion of the City's supply is provided by treated surface water from the City's water treatment plant. The ground water wells have a combined pumping rate capacity of 3,100 gallons per minute (gpm) or about 4.4 million gallons per day (MGD). Average daily well pumpage in 1997 was about 1.67 MGD. Total water use by the City for 1997 averaged 2.75 MGD, with peak month usage averaging 3.66 MGD.

The existing surface water treatment plant has a capacity of about 3.5 MGD, and the City is considering increasing the capacity to about 7 MGD in the future to meet needs during heavy demand periods. To delay the need to increase surface supply and treatment, an artificial recharge project can augment the ground water supply during the high demand summer months. In concept, an ASR project would route excess treated water in the winter (when total demand is less than the capacity of the water treatment plant) to the well field for injection via the production wells for storage. This water would raise the water levels in the wells and would then be used to help supply peak demands in the summertime. It would also reduce the demand on the treatment plant during the summer months. The water also might be used by other water supply entities located in proximity to the City's well field if the City wanted to sell water to them. When the City expands its surface water treatment plant capacity to 7 MGD, there should be additional water that could be routed to the well field for artificial recharge and short-term or long-term storage.

The City of Kilgore well field is located in an area with limited pumpage and a Lowered aquifer piezometric head (about 95 feet of decline), both of which contribute to a favorable storage area for injected water. Another advantage of the well field as an artificial recharge site is that the Carrizo Sand permeability is relatively high which helps increase the likelihood of wells accepting water during injection operations and not plugging. It is estimated that about 1 MGD could be available for injection based on data provided by the City of Kilgore Water Department.

Using available well capacity data, injection at two wells would be sufficient for this rate of recharge. Initial reviews indicate that Wells 1,3,7 and 9 may be the best candidate wells for artificial recharge.

City of Kilgore - Aquifer Parameters

Values of transmissivity, permeability and storage coefficient of the aquifer at the City of Kilgore well field have been calculated based on available data. Production Wells No. 1 through No. 9 in the well field screen sands in the Carrizo Sand or in the Carrizo Sand and underlying Wilcox aquifer and at the time of the tests, the aquifers were under artesian conditions. Pumping tests in the well field provide a coefficient of transmissivity that ranges from about 19,000 to 38,000 gallons per day per foot (gpd/ft) with the range in transmissivity values caused by the differences in thickness and permeability of sands screened by the wells. In general, the permeability of sands in the Carrizo Sand is higher than the permeability of the sands in the Wilcox aquifer. The test results show this to be the case and the data indicate an average value of permeability of about 152 gallons per day per square foot (gpd/ft^2) for the sands. Interference drawdown tests indicate an average coefficient of storage of about 0.0002 which is in line with the coefficient of storage values for unconsolidated sand aquifers under artesian conditions.

The specific capacities of the City of Kilgore Wells Nos. 1 through 9 range from 6.4 to 37.4 gallons per minute per foot of drawdown (gpm/ft) and average 19.9 gpm/ft. The specific capacities indicate that the sands screened have good permeability and could be less susceptible to clogging during injection than wells with lower specific capacities.

City of Kilgore - Two-Dimensional Modeling of Recharge Effects

An aquifer model code was used to estimate the amount of water-level rise that would occur in the recharge wells as a result of artificial recharge. The results are based on 347 gpm (0.5 mgd) being injected through two wells for a period of five months followed by a non-injection period of one day. The two wells selected for the example are Wells 1 and 3 located about 1,700 feet apart in the well field. The aquifer was assumed to have a transmissivity of 18,000 gpd/ft and a storage coefficient of 0.0002. These values are in line with those obtained from pumping tests in the well field with the value of transmissivity being on the conservative side. Based on these assumptions, it was estimated that the water-level rise in the two wells would range from 20 to 30 feet at the end of five months of injection followed by one day of non-injection. During the injection period, the water-level rise in the wells could be in the range of 50 to 100 feet. With the static water level of the wells in the range of 250 to 320 feet, the well water levels during injection periods should remain 150 to 200 feet below land surface.

8.2.2 Canton Site

The City of Canton began drilling water wells as early as 1957. Currently, there is one producing well screened in the Wilcox formation (Well No. 4) that provides about 0.25 MGD (see Table 8.2). This water is used to supplement treated surface water for the City's water supply. In 1997, the total City water usage averaged 0.77 MGD, with a peak month usage of 1.15 MGD. The City's water treatment plant has a capacity of 2 MGD, which is adequate for existing demands. The City is considering expanding the treatment plant to meet demands that occur on the weekends and First Monday Trade Days, which attract a large number of people to Canton and creates very high peak demands. A proposed ASR project may delay this need for plant expansion and maximize the use of its surface water supply.

Similar to the ASR project proposed for Kilgore, excess treated water would be routed to the existing well field during low demand months and injected for storage to be used during high demand periods. The water could be injected directly through Well No. 4 or a new well. Currently, water from Well No. 4 is obtained from the Wilcox aquifer at a depth of approximately 250 to 500 feet. The static water level is about 150 feet below ground surface, representing about 50 feet of decline. Based on an average permeability of 5.2 feet per day, it is estimated that the treated water could be injected at a rate of 100 to 140 gpm. This would cause the water level to rise during injections periods, but should be at least 40 feet below land surface. To ensure controlled water level rise, a high level cut-off switch could be installed in the well casing.

There is adequate treated surface water available for injection based on data from the City of Canton Water Department. Pilot testing should occur to assess the injection rate for the well and the overall feasibility of ASR. Periodic maintenance will probably be required due to plugging of the formation sands by the injection water. If water is injected at a rate of 120 gpm for 150 days (five months), this equates to approximately 80 acre-feet of water stored. If injection through one well is proven successful, then possibly an additional injection well would increase the amount of water available for peaking purposes.

City of Canton- Aquifer Parameters

Limited data are available on the transmissivity, permeability, and storage coefficient values for the Wilcox aquifer in the vicinity of Canton. Pumping tests have been performed on a number of wells in Rains and Van Zandt that screen the Wilcox aquifer with results provided in Texas Water Development Board Report 169 "Ground-Water Resources of Rains and Van Zandt Counties, Texas". The report gives values of permeability that range from 13.4 to 89.7 gpd/ft^2 and average 38.9 gpd/ft^2. Using an estimated value of permeability of 38.9 gpd/ft^2 and a screened interval for City of Canton Well No. 4 of 107 feet, results in an estimated value of transmissivity of 4,062 gpd/ft. The one-half hour specific capacity of Well No. 4 was measured at 3.3 gpm/ft in 1987. The value of specific capacity is consistent with the estimated transmissivity for the aquifers screened by the well. It is estimated that the coefficient of storage for the sands screened by City of Canton Well No. 4 is in the range of 0.00025 to 0.0004. A pumping test has not been performed on the well with an accompanying observation well to obtain an coefficient of storage based on empirical data. A coefficient of storage of 0.00038 was calculated from an interference drawdown test of wells for the town of Grand Saline which is located about 11 miles from Canton and has wells that screen sands of the Wilcox aquifer.

City of Canton - Two-Dimensional Modeling forWell No. 4

An aquifer model code was used to estimate the amount of water-level rise that could occur in Well No. 4 as the result of artificial recharge. The results are based on 120 gpm being injected through the well for a period of five months followed by a non-injection period of one day. The aquifer is assumed to have a transmissivity of 4,000 gpd/ft and a storage coefficient of 0.00025. These values are estimated are based on pumping test data from wells in Rains and van Zandt counties and on the estimate of transmissivity for Well No. 4. Based on theses assumptions, it is estimated that the water-level rise would range from 15 to 20 feet during five months of injection followed by one day with no injection. During the injection period, the water-level rise in the well could range from about 70 to 110 feet and with a static water level in the well of about 150 feet the wells water level during injection could remain 40 to 80 feet below land surface.

8.2.3 Preliminary Cost Estimates for ASR

Preliminary Cost Estimate for the City of Kilgore

Further studies and pilot testing of ASR are the next steps in assessing the feasibility of a recharge project. The chemical compatibility of the aquifer water and of the treated surface water should be studied and geochemical models used to help determine if chemical plugging of the well and aquifer may occur as the result of artificial recharge. The estimated cost is about $4,000 to $5,000 for collecting samples from the well and surface water supply, performing chemical analyses, and geochemical modeling. Pilot testing should be performed using probably Well No. 3 (34-48-202) to evaluate the aquifer response and well response to the injection of water.

At the ground storage facilities located in Kilgore, it is estimated that a small 500 gpm pump station would be required to pump surface water to the well field ground storage tank. It is estimated that the pump and motor, electrical equipment and piping modifications required at the ground storage tank in Kilgore could cost in the range of $40,000 to $50,000.

Piping and valving modifications and possibly a booster pump and motor and electrical controls would be required at the ground storage tank in the well field to route water back to Well No. 3. Minor piping modifications should be required at Well No. 3, along with installation of a filter or strainer, to route water down the well using the existing discharge piping and pump column assembly. It is estimated that the piping modifications, pump and motor and electrical costs in the well field could be about $40,000.

With the water delivery modifications completed at the ground storage facilities in Kilgore and in the well field and with the piping modifications performed at probably Well No. 3, pilot testing in the well field could begin. Pilot testing would help assess the rate at which the well will accept water and the response of the aquifer to the injection. The pilot testing would include injecting water and subsequently pumping it from the well and possibly repeating the sequence a number of times. It is estimated that the cost of pilot testing could be in the range of about $15,000. If the results of the pilot testing are satisfactory, Well No. 3 could be permanently equipped for ASR and additional booster pump and piping modifications could be completed to help automate the injection of water. Other wells in the well field also could be pilot tested as candidates for ASR. Considering all the above items, the total capital and pilot testing costs for ASR in Kilgore would range form $99,000 to $110,000.

Operating and maintenance costs are estimated as follows:

1. Electric power cost to pump water from Kilgore to well field for 175 feet of lift (500 gpm flow rate).	6.6¢ per 1,000 gallons
2. Labor cost at 4 hours per day at $20 per hour for 720,000 gallons of injection per day.	11.1¢ per 1,000 gallons
3. Treated surface water cost estimate from City of Kilgore	$1.32 per 1,000 gallons
4. Electric power cost for 375 feet of lift to pump water from well.	14.2¢ per 1,000 gallons
5. Well Maintenance/Cleaning ($15,000/two years with 5 months of injection per year at 500 gpm or 0.72 mgd.	6.6¢ per 1,000 gallons
Total O&M Cost	$1.71 per 1,000 gallons

If successful results are obtained during pilot testing and the artificial recharge system is enlarged to inject more than 500 gpm, then the booster pump facilities in Kilgore and at the well field would be expanded along with piping and monitoring modifications at additional wells. To increase the size of the system to handle about 1,050 gpm, it is estimated that it could cost an additional $150,000 to $200,000. The expenditure would be about evenly divided between facilities at the ground storage tanks in Kilgore and facilities modifications and additions in the well field. Utilization of an artificial recharge program would delay the construction of the next surface water treatment module of 3.5 million gallons per day. The estimated cost of that additional capacity is about $2.8 to $3.5 million.

The preliminary cost estimates are for a conceptual design of an ASR project. Pilot testing is required to help assess if ASR is a feasible water supply option. An economic comparison between a conceptual ASR project and other water supply options that may be considered by Kilgore is beyond the present scope of the study.

Preliminary Cost Estimate for the City of Canton

Further studies and pilot testing of ASR are needed to help assess the feasibility of a recharge project. The chemical compatibility of the treated surface water and the aquifer water should be studied and geochemical models used to help determine if chemical plugging of the well and aquifer may occur as the result of artificial recharge. It is estimated that it could cost about $4,000 to $5,000 for collecting samples from the well and surface water supply, performing chemical analyses, and for geochemical modeling. Pilot testing should be performed using Well No. 4 (37-26-407) to evaluate the aquifer response and well response to the injection of water.

Piping and pump modifications will be required at Well No. 4 to facilitate the injection of surface water. The well pump should be removed and small diameter injection tubes, probably no greater than 2 inches in diameter would be installed to extend below the static water level. The injection tubes would be connected to the well discharge piping and valves and a filter or strainer installed so that water could be routed from the distribution system to the injection tubes. Pump foundation and discharge head modifications may be required to perform the piping modifications. Safety equipment such as a high water-level cut off switch may be required to help insure that the water level does not rise too high in the well. It is estimated that the pump removal and reinstallation, injection tube installation, piping modifications, strainer, and electrical modification at Well No. 4 could cost about $30,000.

Following completion of the geochemical studies and the equipping and modifications at Well No. 4, pilot testing could begin. Pilot testing would help evaluate the rate at which the well will accept water and the response of the aquifer to the injection. Several cycles of injecting water and subsequently pumping it from the well could be required during the pilot testing phase. It is estimated that the cost of the pilot testing could range from about $10,000 to $15,000. If the pilot testing provides satisfactory results, Well No. 4 could be equipped on a permanent basis for ASR. Considering all the above items, the total capital and pilot testing costs for ASR in Kilgore would range form $44,000 to $55,000.

Operating and maintenance costs are estimated as follows:

1.	Electric power cost for 270 feet of lift to pump water from well.	10.2¢ per 1,000 gallons
2.	Labor cost at 2 hours per day at $20 per hour for 144,000 gallons of injection per day.	27.7¢ per 1,000 gallons
3.	Treated surface water.	$1.30 per 1,000 gallons
4.	Well Maintenance/Cleaning ($10,000/two years with 5 months of injection per year at 100 gpm or 0.144 mgd.	22.6¢ per 1,000 gallons
	Total O&M Cost	$1.91 per 1,000 gallons

The study of the feasibility of artificial recharge would include, as mentioned previously, performing pilot studies, followed by artificial recharge using Well No. 4. Assuming artificial recharge using Well No. 4 is successful, the City could consider drilling additional wells at locations compatible with its distribution system to inject water into the Wilcox aquifer.

Utilization of artificial recharge to provide water to meet peak demands should help delay the expansion of the existing surface water treatment plant that is rated to provide 2 million gallons per day. Expansion of the plant, which could occur within the next 5 years, would be to a capacity of 4 million gallons per day. The estimated cost for expansion is about $1.6 to $2.0 million.

The preliminary cost estimates are for a conceptual design of an ASR project. Pilot testing, as stated previously, is required to evaluate the feasibility of the ASR option. An economic comparison between a conceptual ASR project and other water supply options that may be considered by Canton is beyond the present scope of the study.

Table 8.2: Water Supply Well Data for the Cities of Canton and Kilgore

State Well Number	City Well Number	Date Completed	Drilling Firm	Aquifer (1)	Well Elev. (feet) (2)	Depth of Well (feet)	Screened Interval (feet)	Well Diameters (inches)	Specific Capacity (gpm/ft)	Pumping Rate (gpm)	Static Water Level (feet) (3)	Date	Use of Water (4)
City of Canton													
34-26-401	Well No. 2	1964		Wc	500	505	300-505	--	--	--	90	1964	P(U)
34-26-404	Well No. 3	1969		Wc	480	461	--	--	--	--	97	7/25/1969	P(U)
34-26-407	Well No. 4	1971		Wc	505	521	259-496	10, 7	--	--	149	6/25/1984	P
City of Kilgore													
34-48-202	Well No. 3	1952	Texas Water Wells	Cz/Wc	510	534	313-524	20, 12	11.0	508	180	8/27/1952	P
34-48-203	Well No. 1	1952	Texas Water Wells	Cz/Wc	540	760	350-750	14, 12	26.0	1,120	230	5/12/1952	P
34-48-204	Well No. 4-R	1978	Layne-Texas Co.	Cz/Wc	530	748	353-724	20, 14			226.7	10/1/1952	P
34-48-303	Well No. 7	1963	Texas Water Wells	Cz/Wc	470	646	290-638	20, 12	25.4	942	200	5/20/1963	P
34-48-304	Well No. 9	1967	Katy Drilling, Inc.	Cz/Wc	527	698	330-688	20, 12	33.3	1,200	273	3/7/67	P
34-48-501	Well No. 2	1952	Texas Water Wells	Cz/Wc	563	508	374-499	20, 12	7.4	408	240	7/17/1952	P
34-48-502	Well No. 5	1957	Montgomery Drilling	Cz/Wc	560	476	340-470	24, 12	10.7	556	258	2/8/1957	P
34-48-503	Well No. 6	1957	Texas Water Wells	Cz/Wc	548	470	340-460	16, 8	7.1	307	244	9/11/1957	P
34-48-604	Well No. 8	1965	Katy Drilling Inc.	Cz/Wc	530	569	226-575	20, 12		784		7/8/1965	P

EXPLANATION:

(1) Aquifer:
Cz = Carrizo aquifer
Wc = Wilcox aquifer

(2) Approximate well elevations from U.S. Geological Survey (USGS) and/or Texas Water Development Board (TWDB) data and/or maps. USGS and/or TWDB reported well elevations are not the same for some wells.

(3) Static water level depths shown are reported depths to water below the measuring point datums for the wells, which are generally about 2 to 3 feet above the land surface elevation. USGS, TWDB and other reported water-level data may not be the same as shown if the water-level datums are different
.

(4) Use of Water: P = Public water supply
(U) = Unused
.