

## **4B.8 Aquifer Storage and Recovery (ASR)**

In the development of Brazos G water management strategies, Aquifer Storage and Recovery (ASR) is considered for (1) the Seymour Aquifer in Knox and Haskell Counties where the aquifer is recharged with water from the Salt Fork Brazos River by infiltration and recovered with existing irrigation wells, and (2) the Trinity Aquifer in Johnson County where new, dual-purpose wells are used to inject potable water from the SWATS water treatment plant on Lake Granbury into the aquifer for storage and recovery by public supply wells.

The ASR management strategy is useful to water suppliers who periodically have surplus water and water shortages. For example, ASR can be used to inject and store water in aquifers during the fall, winter, and spring when demands are low and to recover the water during the summer when demands are high. This strategy better utilizes the available capacity of the water treatment plant and supply and transmission system, and commonly delays the need for expanding water treatment and distribution facilities. In most all cases, the water utility's operating plan would call for balancing injection and recovery or possibly recovering slightly less than the amount injected.

### **4B.8.1 Seymour Aquifer in Knox and Haskell Counties**

#### **4B.8.1.1 Description of Option**

A proposed ASR water management option for irrigation water supplies in Knox and Haskell Counties is based on diverting a portion of runoff during relatively high flow conditions from the Salt Fork Brazos River to an off-channel reservoir for temporary storage, transporting the stored water to spreading basins in the target recharge area in the Seymour Aquifer, and recovering the water with existing irrigation wells. The project area was selected on the basis of the local proximity to a potentially suitable surface water reservoir for temporary storage, the Salt Fork Brazos River, and areas of the Seymour where the aquifer is rather thick and productive, water level declines are significant, and there is extensive agricultural irrigation with groundwater. The selected ASR area of the Seymour Aquifer is in a region along the Haskell-Knox County line and between the towns of Munday and Knox City; the selected off-channel reservoir is Lake Davis, which is located about 10 miles north of the ASR area. The Salt Fork Brazos River is between the off-channel reservoir and the target ASR area. The strategy is intended to supplement the natural recharge to the Seymour and benefit irrigated agriculture. This area is shown in Figure 4B.8.1-1.

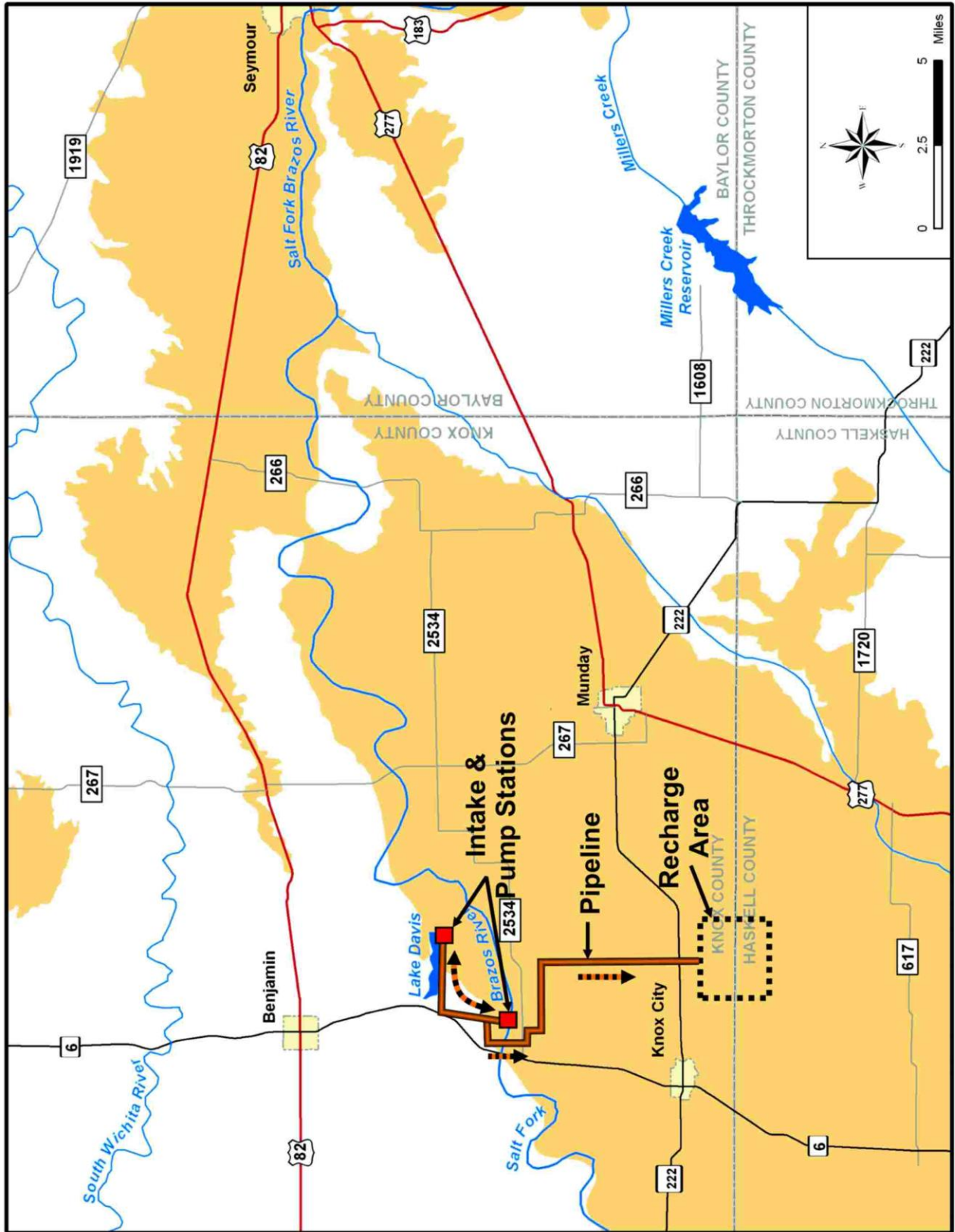


Figure 4B.8.1-1. Location and Features of Seymour ASR Project

#### **4B.8.1.2 Available Yield**

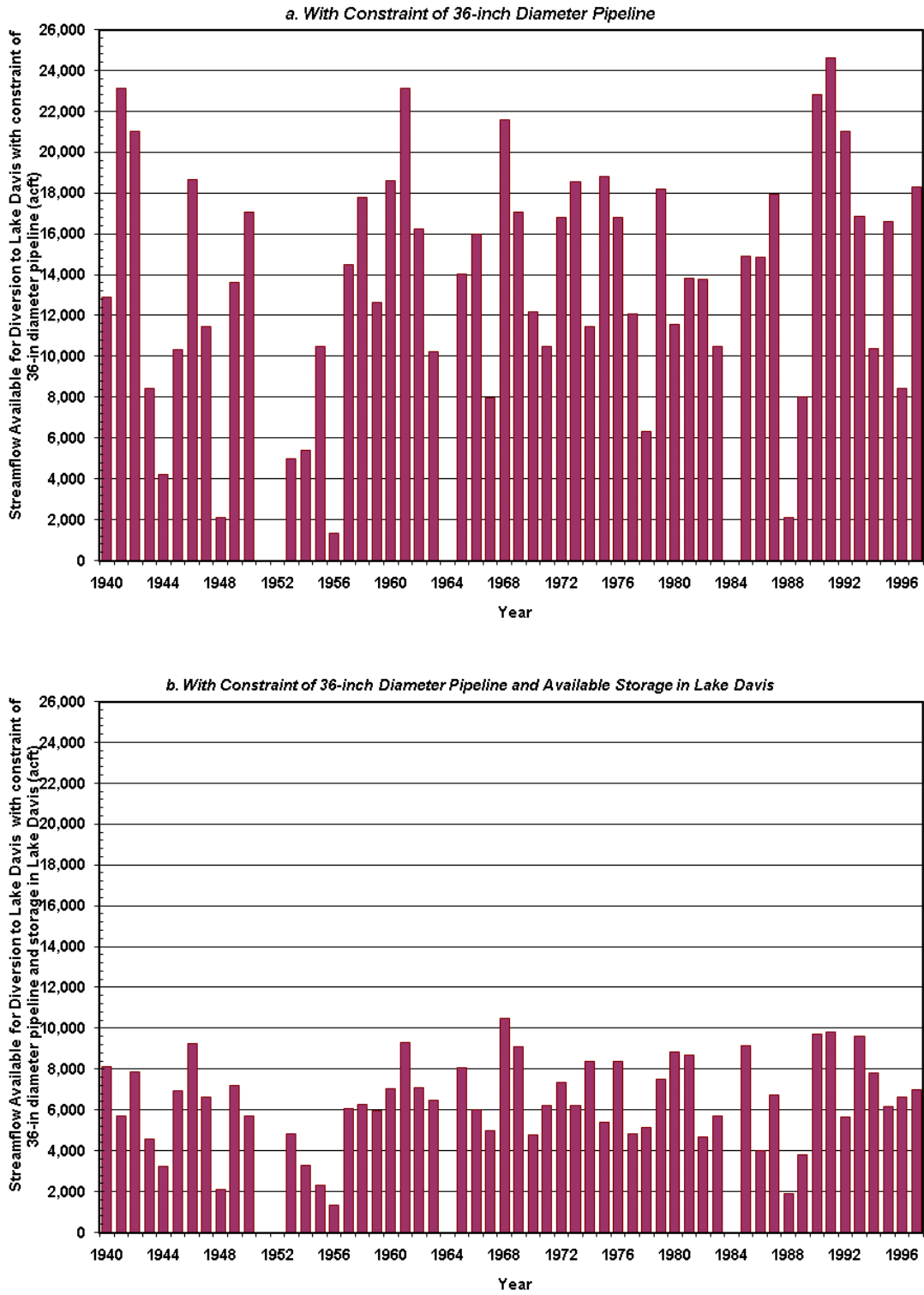
##### **4B.8.1.2.1 Source and Supply of Surface Water**

The source of water for the Seymour ASR project is the Salt Fork Brazos River. During seasons of high flow available water from the Salt Fork would be diverted to Lake Davis. During the September-April period, available water from Lake Davis would be delivered to the target area for recharging the Seymour Aquifer. The recharged water would be recovered from May through August for irrigation of crops.

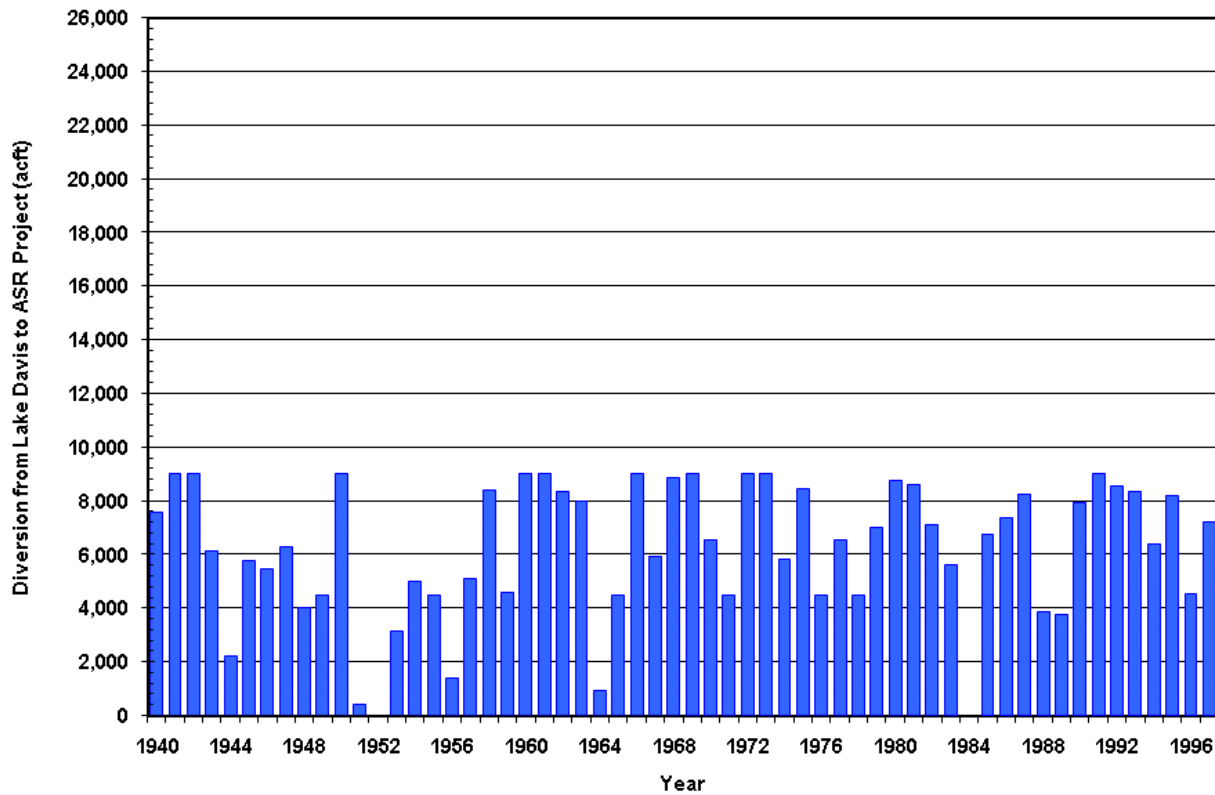
The Brazos G WAM was used to evaluate the availability of water in the Salt Fork and potential operation of Lake Davis. Operational settings to the Brazos G WAM included:

- Possum Kingdom Lake is subordinated to Salt Fork Brazos River and Lake Davis;
- No diversions are made to ASR when there is less than 575 acft of storage in Lake Davis to protect irrigation uses from the reservoir;
- Adjustment of the water diversion patterns from Lake Davis to allow existing irrigation water rights to continue from May through August and ASR diversions from September through April;
- When water in the Salt Fork is available and needed by the ASR project, the filling rate of Lake Davis is 2,100 acft/month (equivalent of a 36-inch pipe transporting water at a velocity of 5 feet per second (fps) from the Salt Fork to Lake Davis);
- ASR diversions are limited to 1,125 acft/mo (9,000 acft/yr); and
- Lake Davis storage is considered to be under 2060 sedimentation conditions.

Figure 4B.8.1-2a shows the annual available flow from the Salt Fork to Lake Davis that is constrained by the capacity of the 36-inch pipeline, and Figure 4B.8.1-2b shows an additional constraint that is attributed to the available storage capacity of Lake Davis. The diversions shown in Figure 4B.8.2b represent the supply of water that is available from the Salt Fork, which averages about 5,980 acft/yr. The greatest annual diversion occurs in 1968 and is about 10,490 acft. For 3 years, no water was available for diversion to Lake Davis. Figure 4B.8.1-3 shows the annual diversions from Lake Davis to the ASR area. This chart shows that the average annual recharge was about 6,208 acft/yr, which is about 230 acft/yr greater than the diversions from the Salt Fork. This increase is attributed to runoff into Lake Davis.



**Figure 4B.8.1-2. Potential Annual Diversions from Salt Fork Brazos River for Storage in Lake Davis**



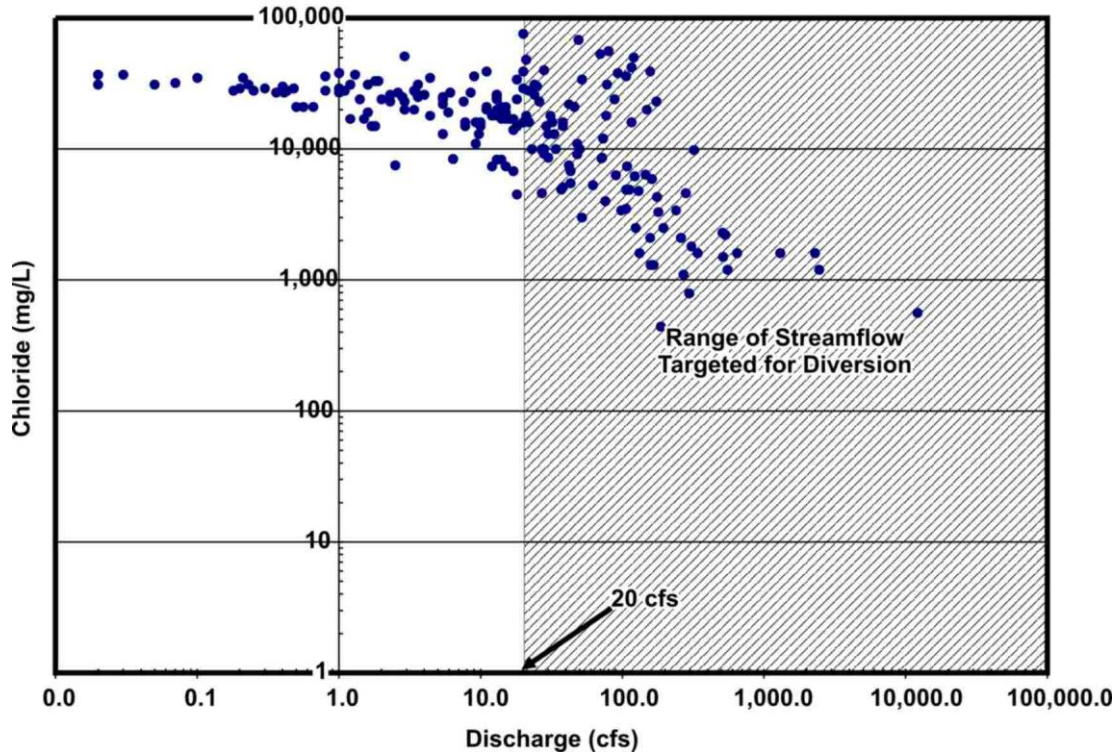
**Figure 4B.8.1-3. Annual Availability of Water from Lake Davis for ASR Recharge**

Water quality in the Salt Fork was considered in the study of the ASR system. For this analysis, chloride concentrations and streamflow records at USGS gaging station 08082000 Salt Fork Brazos River near Aspermont, Texas, were analyzed. Figure 4B.8.1-4 shows the concentration of chloride versus streamflow. The shaded area indicates the range of discharges at which the most scalping of high flows in the Salt Fork would occur. The chart shows that chloride concentration decreases significantly as discharge increases.

**4B.8.1.2.2 Seymour Aquifer**

The Seymour Aquifer is composed of alluvial clay, silt, sand, and gravel deposited during the Pleistocene era and can be up to several tens of feet thick. Originally, the geologic material was laid down as a continuous unit; however, natural erosion has dissected the geologic material into several disconnected “pods.” The targeted ASR area is in a relatively large and hydraulically transmissive pod of the Seymour Aquifer and has been utilized for irrigation and local municipal supplies during the last several decades. Unconfined (water table) conditions exist throughout the

aquifer. Infiltration of precipitation and excess irrigated water serve as the primary sources of recharge.



**Figure 4B.8.1-4. Relation of Chloride Concentrations to Streamflow at 08082000 Salt Fork Brazos at Aspermont**

Historical water level data in the vicinity of the target recharge area show significant declines in saturated thickness during the last 20 years. For example, a decline of about 30 feet was recorded between 1987 and 2003 at TWDB’s monitoring well 2134902, which is near Knox City. This is about a 70 percent reduction in saturated thickness. These declines suggest that well yields from this area have declined in the past and, if the historical trend in declining water levels persists, well yield declines will continue. The reductions in saturated thickness also indicate that storage space for ASR recharge exists within the aquifer. Because the Seymour is an unconfined aquifer, any surplus recharge added through ASR must be contained within the sediment pore spaces.

**4B.8.1.2.3 Potential Seymour ASR Design**

The proposed method of recharge is using spreading basins instead of wells. The spreading basins are expected to be shallow swales in the more permeable areas, aligned along

topographic contours. The spreading basins have the advantage of allowing the use of recharge water with some sediment concentrations, high application rates, and limited maintenance. It has the disadvantage of some water loss. This probably will be overcome with the retention of rainfall that may otherwise runoff. Site-specific information on soil infiltration characteristics and aquifer properties would be needed to design the recharge system and to identify the prime recovery wells.

#### **4B.8.1.2.4 Important Seymour ASR Assumptions**

Important issues relating to the applicability of a Seymour ASR project include seasonal recharge and recovery cycles and suitable quality and quantity of surface water for aquifer compatibility and local groundwater use.

The recovery cycle must soon follow the injection cycle, or the recharge may dissipate into the regional aquifer system. While benefiting the aquifer on a more regional basis, specific project benefits for participants may be minimal. Additional studies concerning water quality from the Salt Fork would need to be conducted if the project appears feasible from cost/benefit studies.

#### **4B.8.1.3 Environmental Issues**

Diversion facilities on the Salt Fork with a pump station and pipeline to Lake Davis and then to the recharge area, which would cover a relatively small surface area of 57 acres, would probably result in:

- Negligible impacts on environmental water needs, instream flows, and bays and estuaries;
- Improved fish and wildlife habitat conditions in Lake Davis;
- Low to moderate impacts to wildlife habitat along pipeline crossing of Salt Fork;
- Low to moderate impacts to fish and wildlife, including endangered species; and
- Low impacts on cultural resources.

#### **4B.8.1.4 Engineering and Costing**

The engineering facilities for the ASR project consist of an intake and pump station on the Salt Fork Brazos River, a 36-in pipeline to Lake Davis, an intake and pump station at Lake Davis, a 24-in pipeline from the river to the ASR recharge area, distribution pipelines to several delivery points, and swales in the fields. The 36-inch diameter pipeline from the Salt Fork to

Lake Davis would be used for filling the lake. The 24-inch diameter pipeline would be used to divert water from Lake Davis to the recharge area. The river intake and pump station would be located near State Hwy 6. The Lake Davis discharge, intake and pump station facilities would be located near the dam. The conceptual location of these facilities are shown in Figure 4B.8.1-1. The major facilities required for this option is:

- River Diversion to Off-Channel Storage:
  - River intake;
  - Pump station;
  - Pipeline; and
  - Outlet works.
- Lake Diversion to Recharge Area:
  - Lake intake;
  - Pump station;
  - Pipeline;
  - Outlet works; and
  - Terraces or swales.

Estimates were prepared for capital costs, annual debt service, operation and maintenance, water purchases, power, land, and environmental mitigation. These costs are summarized in Table 4B.8.1-1. Estimated costs do not include an annual payment to BRA for potential impacts to Possum Kingdom Reservoir yields. The project costs, including capital, are estimated to be \$38,625,000. The annual costs, including debt service, operation and maintenance, and power are estimated to be \$4,352,000. This water management option produces water at estimated costs of \$701 per acft/yr for a long-term average delivery of 6,208 acft/yr. Because of the relatively large fixed cost, unit rates would be less for relatively wet conditions and more for relatively dry conditions.

#### **4B.8.1.5 Implementation**

Implementation of the described ASR water management strategy for the Seymour Aquifer includes the following issues:

- Availability of suitable water quantities and water quality from the Salt Fork Brazos River;
- Contractual arrangements can be made with owner of Lake Davis or another nearby reservoir for use of the unused storage capacity of the reservoir;
- Contractual arrangements with land owners where the infiltration basins are to be constructed;

**Table 4B.8.1-1.  
Cost Estimate Summary  
Seymour Aquifer ASR Water Supply Project Option  
September 2008 Prices**

<i>Item</i>	<i>Estimated Costs for Facilities</i>
<b>Capital Costs</b>	
Intake and Pump Station (Salt Fork of the Brazos to Lake Davis)	\$5,208,000
Intake and Pump Station (Lake Davis to Recharge Area)	\$8,227,000
Transmission Pipeline (36 in dia., Salt Fork to Lake Davis )	\$4,605,000
Transmission Pipeline (24 in dia., Lake Davis to Recharge Area)	\$8,699,000
Recharge Area Preparations	<u>\$400,000</u>
<b>Total Capital Cost</b>	<b>\$27,139,000</b>
Engineering, Legal Costs and Contingencies	\$8,833,000
Environmental & Archaeology Studies and Mitigation	\$490,000
Land Acquisition and Surveying (72 acres)	\$677,000
Interest During Construction (1 years)	<u>\$1,486,000</u>
<b>Total Project Cost</b>	<b>\$38,625,000</b>
<b>Annual Costs</b>	
Debt Service (6 percent, 20 years)	\$3,368,000
Operation and Maintenance	
Intake, Pipeline, Pump Station	\$469,000
Pumping Energy Costs (5719276 kW-hr @ 0.09 \$/kW-hr)	\$515,000
Purchase of Water ( acft/yr @ 0 \$/acft)	<u>\$0</u>
<b>Total Annual Cost</b>	<b>\$4,352,000</b>
<b>Available Project Yield (acft/yr)</b>	6,208
<b>Annual Cost of Water (\$ per acft)</b>	\$701
<b>Annual Cost of Water (\$ per 1,000 gallons)</b>	\$2.15

- Pipeline right-of-way from Salt Fork diversion to Lake Davis, and from Lake Davis to ASR site;
- Entity who is willing and capable of funding and operating the facilities and capable of developing and administering a management plan to efficiently use the facilities and to balance injection and recovery cycles;
- Controlling the loss of the injected water by the participants in the project;
- Initial cost; and/or
- Experience in operating water facilities.

It will be necessary to obtain these permits:

- TCEQ water rights permit to divert from the Salt Fork Brazos River;
- U.S. Army Corps of Engineers Sections 10 and 404 dredge and fill permits for stream crossings;
- General Land Office Sand and Gravel Removal Permits; and
- Texas Parks and Wildlife Department Sand, Gravel and Marl permit for river crossings.

The impacts of the ASR option for the Seymour Aquifer in Knox and Haskell Counties has been compared to the plan development criteria, as shown in Table 4B.8.1-2.

**Table 4B.8.1-2.  
Comparison of ASR –Seymour Option in Knox and Haskell Counties  
to Plan Development Criteria**

<i>Impact Category</i>	<i>Comment(s)</i>
A. Water Supply 1. Quantity 2. Reliability 3. Cost	1. Sufficient in most years 2. Low 3. Moderate to expensive for irrigation use
B. Environmental factors 1. Environmental Water Needs 2. Habitat 3. Cultural Resources 4. Bays and Estuaries 5. Threatened and Endangered Species 6. Wetlands	1. Low impact 2. Low impact 3. Low impact 4. None 5. Low impact 6. Low impact
C. Impact on Other State Water Resources	• Potential negative impacts on water quality of Seymour; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None
E. Equitable Comparison of Strategies Deemed Feasible	• Option is an attempt to meet agricultural irrigation needs
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• None

## **4B.8.2 Trinity Aquifer in Johnson County**

### **4B.8.2.1 Description of Option**

For purposes of this option, the ASR project of the Trinity Aquifer in Johnson County considers the use of dual-purpose (ASR) wells to inject potable water into the aquifer for storage and recovery of the water at a later date. This strategy takes advantage of the unused capacity of the SWATS desalination water treatment plant during the fall, winter and spring. During these times, some or all the SWATS excess capacity is utilized and the treated water is transported by the existing pipeline to the ASR wells for storage. During summer when the demand exceeds supplies, the water is recovered. The location of the project facilities is shown in Figure 4B.8.2-1. New facilities required for this option are the ASR wells, well field collection pipelines and an interconnect between the pipeline and ASR well field.

The strategy is designed for Johnson County SUD (JCSUD), which now includes Johnson County FWSD#1. SWATS has a treatment capacity of 10.5 MGD, which is planned to be increased to 15.54 MGD by 2020. Of this supply, JCSUD currently has 5.90 MGD of capacity. With the 2020 expansion, JCSUD's share would be 8.73 MGD. The capacity of the water transmission pump station and pipeline is about 10.1 MGD. The customers on the transmission pipeline include JCSUD and the City of Keene. Keene's share of SWATS is 0.68 MGD for the current capacity and 1.00 MGD for the expansion. They lease 1.00 MGD of capacity in the pipeline and pump stations. In addition to SWATS, JCSUD also has a supply of water from the Trinity Aquifer. For planning purposes, the groundwater supply is 1,995 acft/yr.

The projected water demands for JCSUD increases from 8,036 acft/yr in 2010 to 24,506 acft/yr in 2060. A comparison of this demand and the groundwater and SWATS supplies are shown in Figure 4B.8.2-2. This illustrates that annual supplies are adequate to meet the annual demand through 2020. However, when considering the limitations on seasonal (monthly) supplies, the analyses suggest that the supplies are not adequate during June to September for 2010 and 2020, as shown in Figures 4B.8.2-3a and b, respectively. The available supplies from SWATS for JCSUD in 2010 and 2020 are shown in Figure 4B.8.2-4. However, this assumes a uniform monthly pattern of groundwater pumpage. During peak summer monthly demand periods, Trinity Aquifer pumping rates could be increased to meet the seasonal deficit, or water

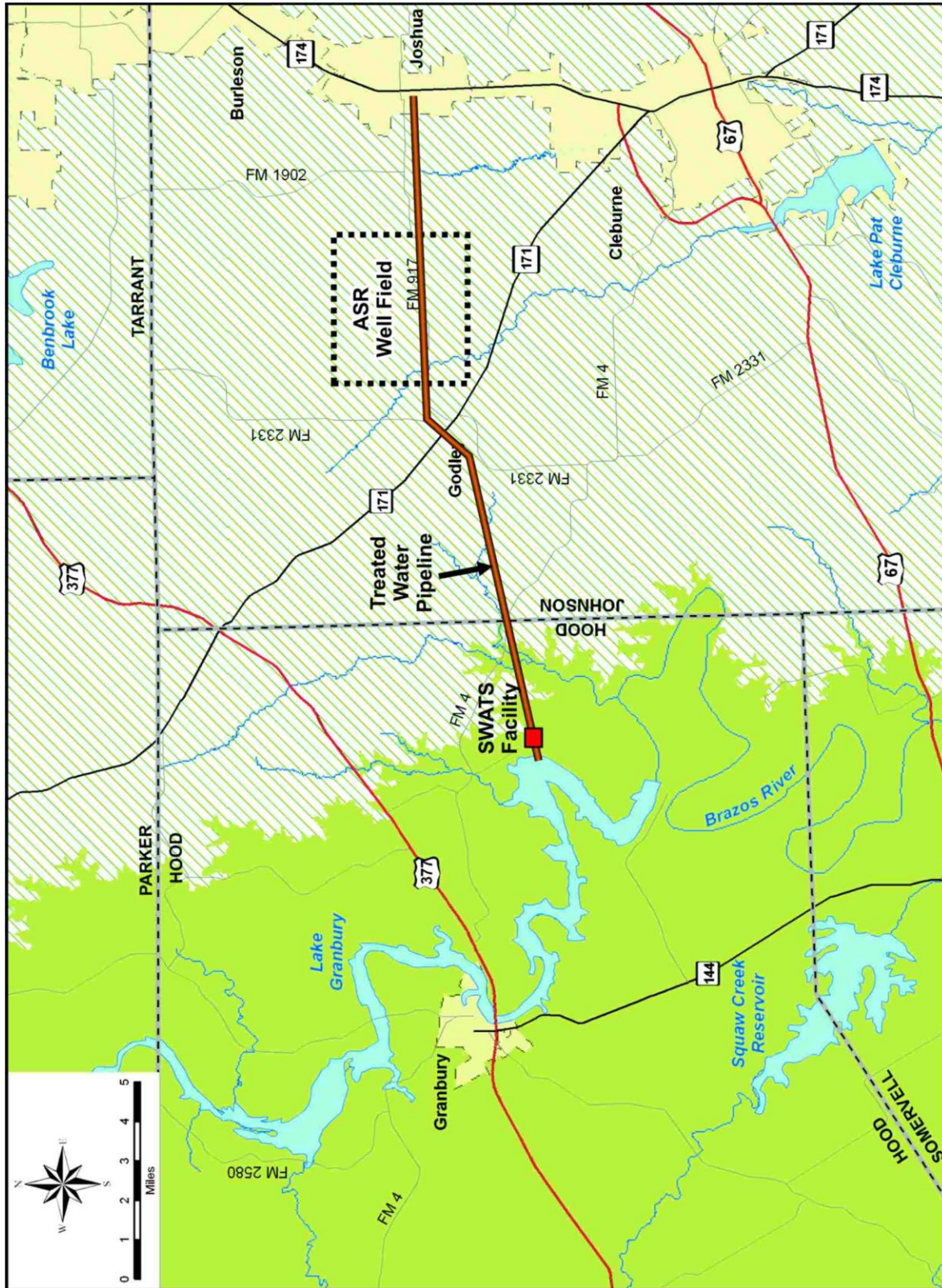
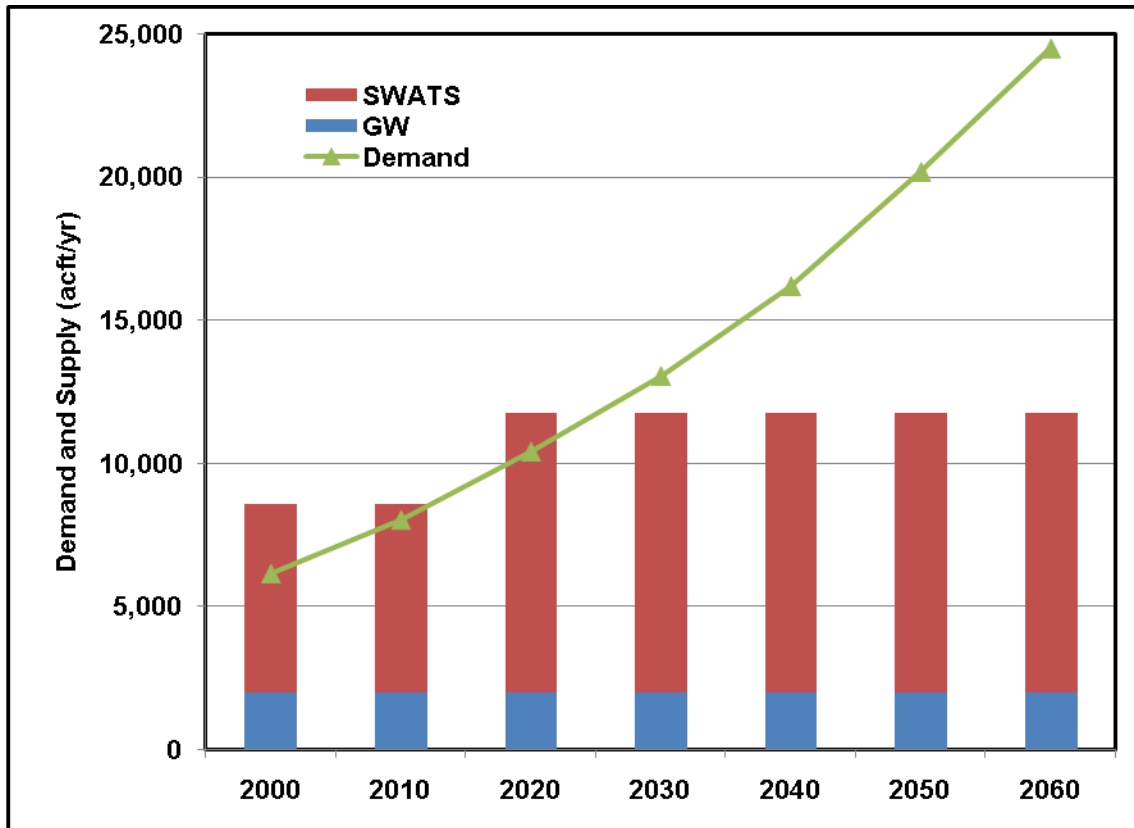
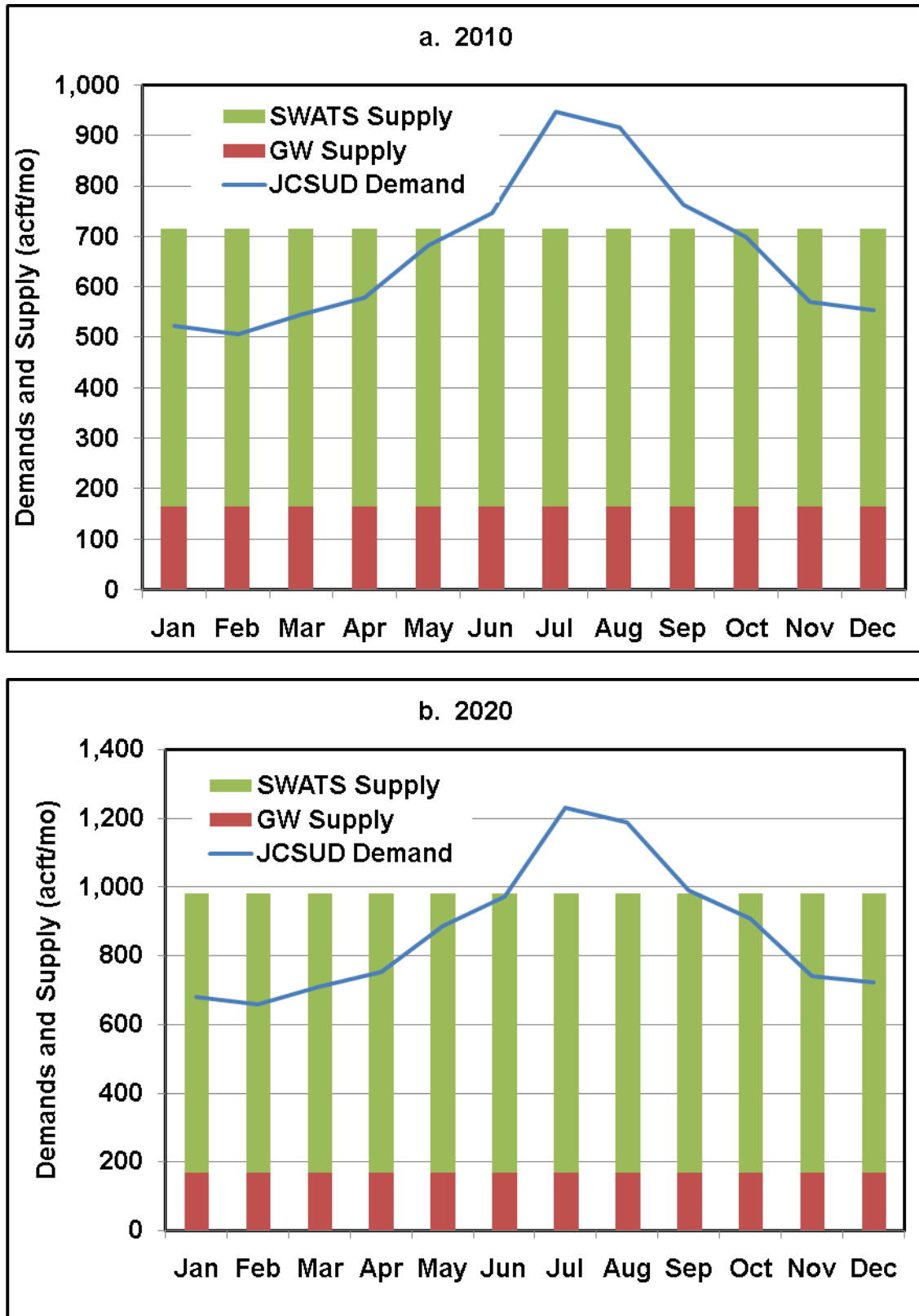


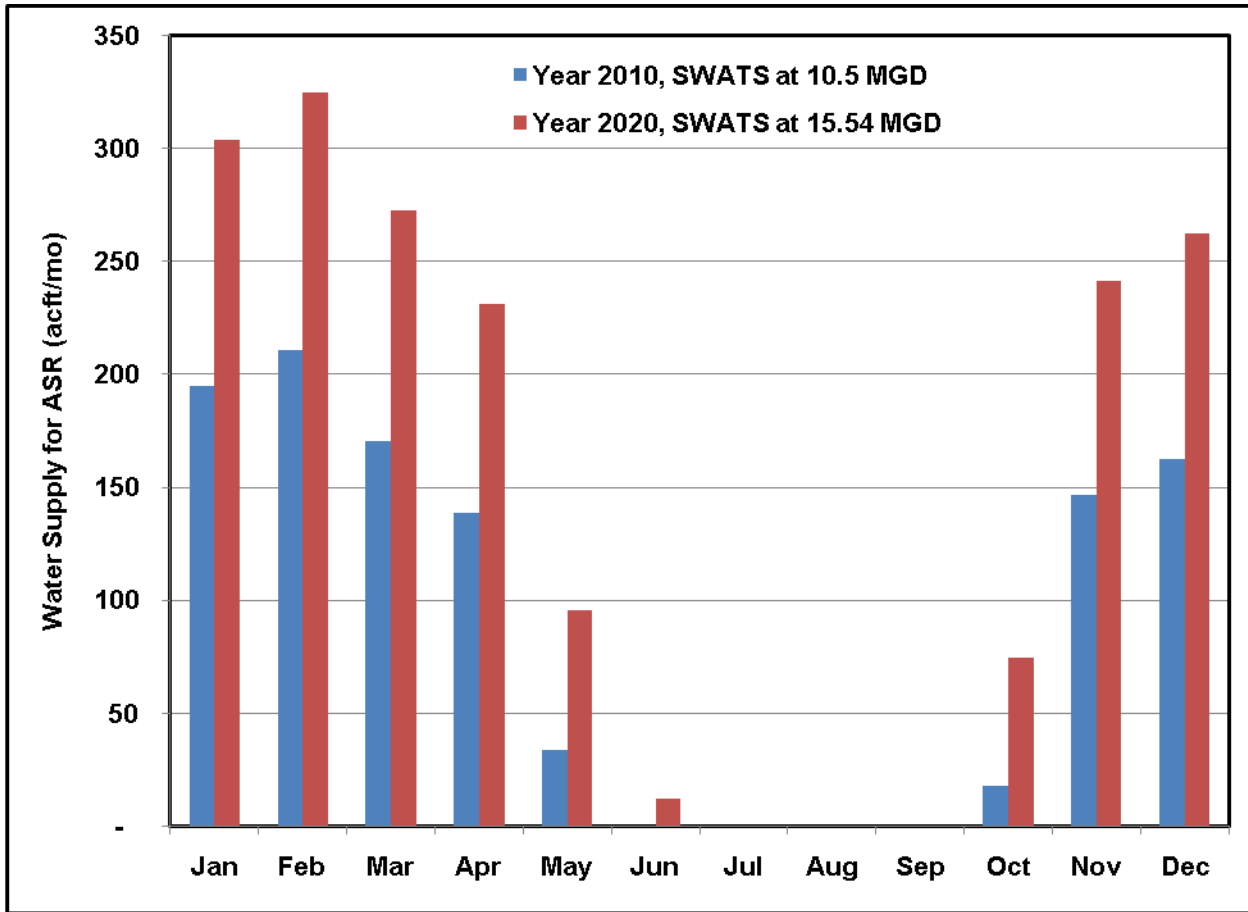
Figure 4B.8.2-1. Location of Johnson County ASR Project



**Figure 4B.8.2-2. Comparison of Johnson County SUD's Long-Term Water Demand and Existing Supplies**



**Figure 4B.8.2-3. Comparison of Johnson County SUD's Monthly Water Demand and Existing Supplies**



**Figure 4B.8.2-4. Water Supply Availability for ASR in 2010 and 2020**

recharged pursuant to this ASR project could be used. This analysis shows the total excess capacity of SWATS for JCSUD is 1,073 acft in 2010 and 1,815 acft in 2020. For operational purposes, the supply is limited to the minimum monthly supply from November-April. However, as shown in Figure 4B.8.2, the growth in annual water demands exceeds annual supplies before 2030.

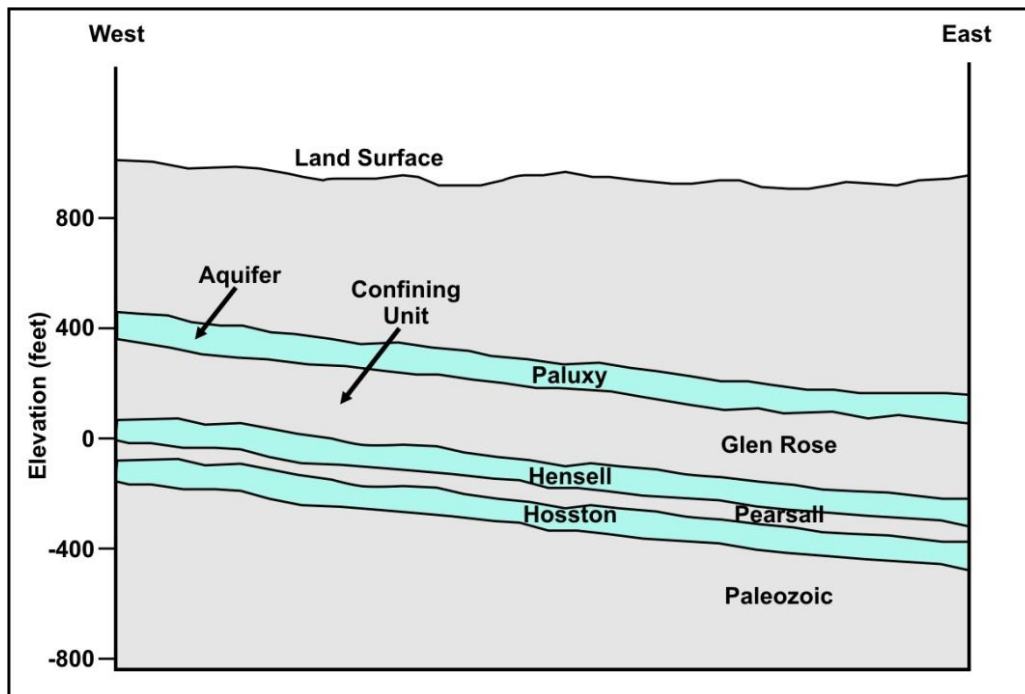
The strategy is evaluated for two options. One is for 2010 conditions; and, the other is for 2020 conditions. The area selected for an ASR well field is located in the northeast part of the county between the towns of Godley and Joshua. For purposes of this study, it is assumed that SWATS water is chemically compatible with the Trinity Aquifer and native Trinity water.

**4B.8.2.2 Available Yield**

**4B.8.2.2.1 Trinity Aquifer System**

In Johnson County, the Trinity Aquifer system is composed of three sandy aquifer units that are confined and separated by relatively impermeable clay units. These aquifer units include, from youngest to oldest: the Paluxy, Hensell, and Hosston (Figure 4B.8.2-5). In the proposed ASR well field, the water-bearing units are confined with artesian pressures generally rising several hundred feet above the top of the aquifer(s). The geometry and hydraulic properties of the hydrogeologic units of the Trinity Aquifer units vary throughout Johnson County. In general, the most hydraulically transmissive (i.e., sand-rich) portions of the units vary from 50 to 100 feet in thickness. High-capacity production wells typically yield from 150 to 250 gallons per minute (gpm).

The long-term impact on the Trinity Aquifer will be insignificant because the strategy for this project is to balance the injection and recovery of water stored from SWATS. In the short-term, the impact will be a noticeable, but temporary, rise in groundwater levels during the injection cycle and a similar decline during the recovery cycle.



**Figure 4B.8.2-5. Hydrogeologic Profile in ASR Well Field**

#### ***4B.8.2.2.2 Potential Trinity ASR Well Field Design***

The actual number of wells and land required for the well field is dependent upon local depth to water, and the thickness and character of sands present at each well field site. This site-specific information would need to be acquired through a test drilling and field testing program prior to implementation of an ASR system in the region.

Available records indicate that wells constructed in the area will average between 1,100 and 1,200 feet in depth. Based on existing wells in the area, the maximum injection and recovery rate of a well is about 250 gpm. Given these conditions, it is estimated that 8 wells, with a 10 percent contingency, is needed for the 2010 project, and 14 wells for the 2020 project. The ASR wells would be used for injection from November through April and for recovery from June through September. The wells would be idle for May and September. The well field design for the 2010 strategy has the wells spaced about 0.5 miles apart and parallel to the SWATS water transmission pipeline. For the 2020 strategy, the design divides the wells into two rows, one on each side of the pipeline and about 0.5 miles from the pipeline.

#### ***4B.8.2.2.3 Important Assumptions***

Important issues relating to the applicability of a Johnson County ASR project include: (1) balanced annual injection and recovery cycles, (2) availability of suitable quality and quantity of water from SWATS, (3) the native aquifer water and imported water are chemically compatible, and (4) limited local groundwater use. Additional studies concerning compatibility of SWATS water and the Trinity Aquifer would need to be conducted to determine if the project is feasible.

#### ***4B.8.2.3 Environmental Issues***

The development of ASR facilities in the Johnson County includes the construction of wells, collector pipelines, and water treatment facilities would involve relatively low environmental impacts:

- Operation of ASR wells is expected to have no effect on streams in the area; and
- Construction of wells, collector pipelines and pump station would have little or no effect on wildlife habitat or in disturbed areas. No streams or wetlands are expected to be encountered.

#### **4B.8.2.4 Engineering and Costing**

The ASR well field would be developed by constructing water wells capable of injection and recovery, well field pipelines for distribution and collection of water, terminal storage, and an interconnection. The well field is about midway between the towns of Godley and Joshua and is parallel to the SWATS pipeline, as shown earlier in Figure 4B.8.2-1. During the injection cycle, a terminal storage reservoir is needed to provide balancing storage between the pipeline and wells. The ASR (dual-purpose) wells would have to be constructed to public water supply standards. The wells would be spaced about 0.5 miles apart. Well pumps will be large enough to produce sufficient head to force the recovered water directly into the SWATS pipeline. The major facilities required for these options are:

- Well Field and interconnect to the SWATS pipeline along State FM 917:
  - Wells,
  - Pipelines,
  - Terminal Storage, and
  - Interconnect.

The project consists of two options. One is for the existing water treatment capacity of 10.5 MGD SWATS water plant, and the other is the expanded SWATS water plant with a capacity of 15.54 MGD, which is being considered for 2020. Considering the JCSUD water demands and the SWATS water treatment capacity, a system with a capacity to store and recovery 967 acft/yr for 2010 and 1,614 acft/yr for 2020 is planned. Water from the SWATS plant will only require operation and maintenance cost, which are estimated to be \$1.15 per 1,000 gallons, because the debt service and raw water costs are part of existing contracts. There is sufficient existing capacity in the water transmission system from SWATS to JCSUD; thus, the only additional cost will be for power.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in Table 4B.8.2-1 for the 2010 and 2020 options. The annual costs, including debt service, operation and maintenance, and power, are estimated to be \$1,500 per acft for the 2010 project and \$1,512 per acft for the 2020 project. Later, as the JCSUD demand exceeds SWATS excess capacity, which will cause the amount of water available for ASR to decrease, the unit cost will increase.

**Table 4B.8.2-1.**  
**Cost Estimate Summary**  
**Water Supply Project Option (Sept 2008 Prices)**  
**Johnson County ASR Water Supply Project Option**

<i>Item</i>	<i>2010 Project</i>	<i>2020 Project</i>
<b>Capital Costs</b>		
ASR Well Field (250 gpm, 1,200 ft deep wells)	\$4,974,000	\$8,705,000
Well Field Collector Pipelines (8-12 inch)	\$882,000	\$1,559,000
System Storage and Interconnections	\$1,027,000	\$1,454,000
<b>Total Capital Cost</b>	<b>\$6,883,000</b>	<b>\$11,718,000</b>
Engineering, Legal Costs and Contingencies	\$2,409,000	\$4,101,000
Environmental & Archaeology Studies and Mitigation	\$302,000	\$523,000
Land Acquisition and Surveying	\$360,000	\$623,000
Interest During Construction (1 years)	<u>\$399,000</u>	\$679,000
<b>Total Project Cost</b>	<b>\$10,353,000</b>	<b>\$17,644,000</b>
<b>Annual Costs</b>		
Debt Service (6 percent, 20 years)	\$903,000	\$1,538,000
Operation and Maintenance		
Intake, Pipeline, Pump Station	\$69,000	\$117,000
SWATS Water Treatment Plant	\$311,000	\$519,750
Pumping Energy Costs	\$168,000	\$266,000
Purchase of Raw Water	\$0	\$0
<b>Total Annual Cost</b>	<b>\$1,451,000</b>	<b>\$2,440,750</b>
<b>Available Project Yield (acft/yr)</b>	<b>967</b>	<b>1,614</b>
<b>Annual Cost of Water (\$ per acft)</b>	<b>\$1,500</b>	<b>\$1,512</b>
<b>Annual Cost of Water (\$ per 1,000 gallons)</b>	<b>\$4.60</b>	<b>\$4.64</b>

**4B.8.2.5 Implementation**

The ASR water management strategy described above has been compared to the plan development criteria, as shown in Table 4B.8.2-2, and the strategy meets each criterion. Implementation of the ASR water management strategy for Johnson County includes the following issues:

- Contractual arrangements can be made with the Brazos River Authority for an expansion of the SWAT facility;
- Permits from TCEQ for ASR operations and for storage of surface water in the Trinity Aquifer can be obtained;
- Lack of experience to develop confidence in the ability to inject and recover water from an aquifer, which includes the uncertainty about the compatibility of the injected water with native groundwater and aquifer materials;
- Controlling the loss of the injected water to others;
- Initial cost;
- Experience in operating the facilities; and
- Development of a management plan to efficiently use the ASR wells with a balance of injection and recovery cycles.

**Table 4B.8.2-2.  
Comparison of Johnson County ASR-Trinity Water Supply Project  
to Plan Development Criteria**

<b>Impact Category</b>	<b>Comment(s)</b>
A. Water Supply	
1. Quantity	1. Improves balance of winter and summer demands
2. Reliability	2. High
3. Cost	3. Moderately expensive
B. Environmental factors	
1. Environmental Water Needs	1. Low impact
2. Habitat	2. Low impact
3. Cultural Resources	3. Low impact
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. Low impact
6. Wetlands	6. Low impact
C. Impact on Other State Water Resources	<ul style="list-style-type: none"> <li>• No apparent negative impacts on state water resources; no effect on navigation</li> </ul>
D. Threats to Agriculture and Natural Resources	<ul style="list-style-type: none"> <li>• Low to none</li> </ul>
E. Equitable Comparison of Strategies Deemed Feasible	<ul style="list-style-type: none"> <li>• Option is considered to meet municipal and "County-Other" shortages</li> </ul>
F. Requirements for Interbasin Transfers	<ul style="list-style-type: none"> <li>• Not applicable</li> </ul>
G. Third Party Social and Economic Impacts from Voluntary Redistribution	<ul style="list-style-type: none"> <li>• None</li> </ul>

(This page intentionally left blank.)