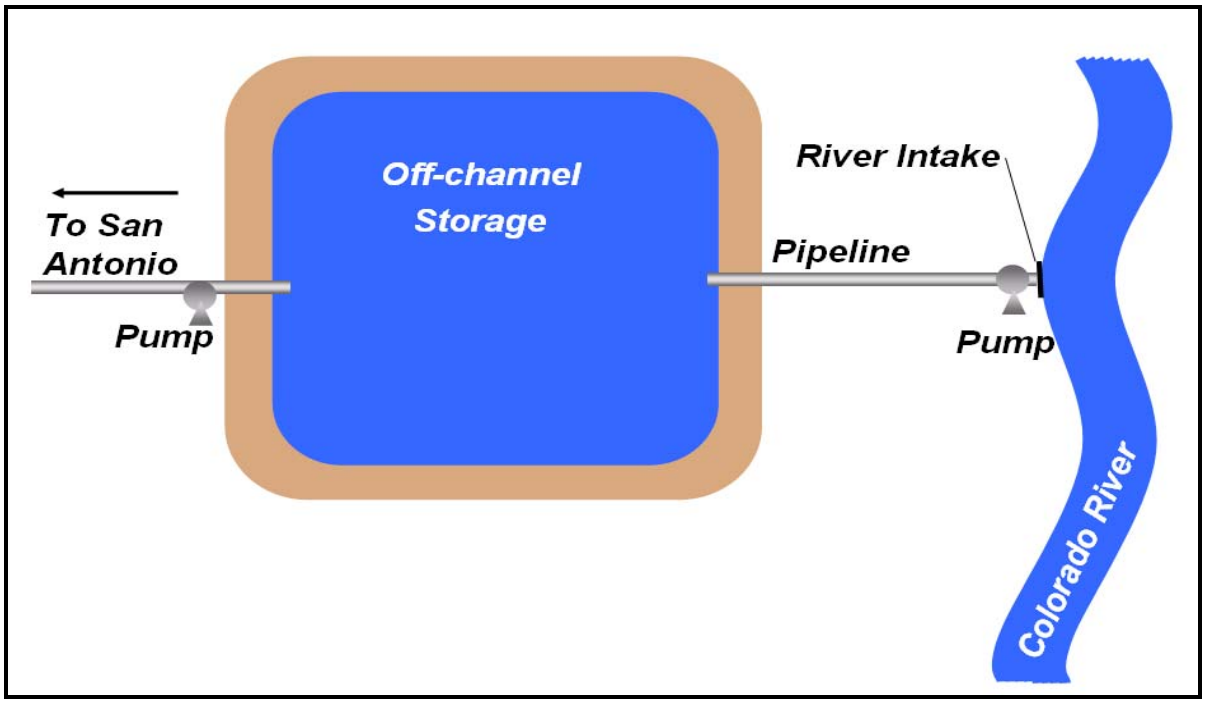
3.0 Study Summary

3.1 Surface Water Availability

Surface water availability studies address how the various sources of water available to LCRA can be used most effectively as a system to meet future water needs within the lower Colorado River basin and to deliver up to 150,000 acre-feet per year to SAWS. These sources (surface water, groundwater used in the LCRA service area, and agricultural water conservation as a "source of supply") would be developed in accordance with the terms of the agreement between LCRA and SAWS. This includes satisfying all the conditions and stipulations in the LCRA-SAWS agreement, as well as other legal and regulatory requirements.

FIGURE 3-1
Off-Channel Storage Facility Operation Schematic
LCRA-SAWS Water Project



Studies continue to refine how the various sources of water available to LCRA can be effectively used as a system to meet future water needs both inside LCRA's water service area and for the project. The results to date continue to indicate river water may be made available to support the project and the transfer of up to 150,000 acre-feet per year to SAWS, pending additional results on environmental flow requirements from other studies. Some highlights of the preliminary results of this ongoing analysis are summarized below. Note that results are based on model simulations of available flow during a repeat of the hydrologic conditions from the 1940-1998 period of record and based on specific

assumptions; these model runs will continue to be updated as new information becomes available. During 2007, scenarios involving various supply and demand amounts were developed to begin exploring an optimum water delivery yield to SAWS.

For purposes of this PVA, specific results regarding the operation of the project were developed for projected 2030, 2060 and 2080 decadal conditions with the delivery of surface water to SAWS set equal to the minimum amount of firm supply that the project is capable of providing for any of the three decadal conditions. In this scenario, the yield to SAWS would be 95,000 acre-feet per year (based on the 2030, 2060 and 2080 conditions) under the assumptions listed above and also assuming that the projected LCRA irrigation demands with the project in operation would be fully satisfied. A second simulation for 2080 conditions also was performed with the firm supply of surface water delivered to SAWS established at 120,000 acre-feet per year. For this second simulation, the available supplies for the LCRA irrigation operations with the project implemented were curtailed by an average of 7.5 percent over the entire period of record (1940-1998) and 20.3 percent during the drought-of-record period (1947-1957) compared to 23.7 percent over the period of record and 54.6 percent during the drought of record conditions without the project.

- **Storage in Off-Channel Storage Facility**. Storage and water levels in the off-channel storage facility are expected to vary considerably in response to pumpage of available river flows, with the facility projected to be full about 20 percent of the time and empty about 7 to 10 percent of the time. "Empty" means that run-of-river flows or water released from the Highland Lakes pumped into storage will be immediately pumped out and sent to San Antonio.

- **River Pumping Rate.** For the 95,000 acre-foot per year scenario, the maximum required river pumping rate for the project appears to be around 2,500 cubic feet per second (cfs) under 2030 demand conditions and decreases to 1,425 cfs under 2080 conditions, as more water is available in the lower segment of the river in 2080 primarily due to reduced irrigation demands compared to 2030. The river pumps for the project are operated only about half of the time (all decades), with the maximum pumping rate required only about 5 percent of the time under 2060 and 2080 conditions and about 4 percent of the time under 2030 conditions. Pumping characteristics are subject to change with factors such as changes in bay and estuary freshwater inflow requirements. For the 120,000 acre-feet per year scenario, the maximum required diversion rate for the project is estimated at approximately 6,000 cfs.

- **Highland Lakes Levels.** In accordance with one of the legislative mandates for the project[1], over the life of the project, the average lake levels of Lakes Buchanan and Travis are projected to be higher compared to corresponding future conditions without the project.

- **Highland Lakes Storage**. The minimum storage amounts in Lakes Buchanan and Travis under 2060 and 2080 critical drought-of-record conditions are projected to increase from near zero without the project in operation to more than 300,000 acre-feet with the project.

1 Texas Special District Local Laws Code: §8503.030, Provision of Water to Municipality Outside Colorado River Basin

- **Highland Lakes Evaporation.** Evaporation losses from Lakes Buchanan and Travis will increase with the project due to higher average lake levels.

- **Irrigation Water Delivery Reliability**. Without the project implemented, projected irrigation water deliveries are expected to become less reliable over time. The percent of time on an annual basis that LCRA's future demands for irrigation water in the lower basin will be fully satisfied is projected to decrease from about 76 percent under 2010 conditions to less than 32 percent under 2080 conditions. However, with the project in operation and delivering 95,000 acre-feet of water per year to SAWS, forecasted irrigation demands (reduced due to conservation) are projected to be fully satisfied 100 percent of the time. With the project in operation and delivering 120,000 acre-feet of water per year to SAWS in 2080, the overall average annual reliability of the irrigation supply is projected to be 92.5 percent.

- **Recommended Subsistence River Instream Environmental Flows**. Based on the scenarios and assumptions modeled, the preliminary results indicate that *subsistence* instream environmental flow criteria for the lower Colorado River (minimum flows necessary during drought conditions to support riverine habitats) in accordance with the river habitat study team's recommendations are engaged all the time and are projected to be satisfied both with and without the project.

- **Recommended Base-dry Instream Environmental Flows**. *Base-dry* instream environmental flow criteria (flows during dry conditions) are satisfied at least 80 percent of the time (with the exception of the Wharton location in 2080 with the project), meeting the compliance goal suggested by the river habitat study team. These results are based on the scenarios and assumptions modeled and should be considered preliminary until the project has been defined.

- **Recommended Base-normal Instream Environmental Flows.** *Base-normal* instream environmental flow criteria (flows during average or typical conditions) are satisfied at least 60 percent of the time (the compliance goal suggested by the aquatic habitat study team) at most locations. Exceptions include the Wharton area (in most decades with or without the project) and the Columbus area (in 2080 with the project). These results are based on the scenarios and assumptions modeled and should be considered preliminary until the project has been defined.

- **Bay Freshwater Inflow Critical Criteria**. Freshwater inflows to Matagorda Bay from the Colorado River would meet 2006 Freshwater Inflow Needs Study *critical* criteria (minimum monthly inflow volume estimated to meet average salinity levels) about the same amount of time, on average, both with and without the project under 2030 and 2060 conditions. The *critical* criteria would be met slightly less of the time under 2080 conditions with the project. The 2006 Freshwater Instream Needs Study freshwater inflow values were used for this analysis because the Matagorda Bay study team's draft freshwater inflow criteria were still under development at the time these analyses were performed. Under the drought of record conditions and based on the scenarios modeled, the criteria are projected to be met less of the time with the project than without it.

- **Bay Freshwater Inflow Intermediate and Target Criteria.** Freshwater inflows to Matagorda Bay from the Colorado River are projected to satisfy *intermediate* and *target* criteria in the 2006 Freshwater Inflow Needs Study more often, on average, with the

project than without it based on the scenarios and assumptions modeled. As with the *critical* criteria, the 2006 Freshwater Instream Needs Study freshwater inflow values were used for this analysis. Under 2060 conditions, *intermediate* criteria (monthly flows in between the *critical* and *target* criteria) at the mouth of river are projected to be met 54 percent on average without the project compared to 60 percent with the project for the 95,000 acre-feet per year yield scenario. Under 2080 conditions for the 120,000 acre-feet per year scenario, *intermediate* criteria are met 62 percent of the time with the project. Similarly, under 2060 conditions for the 95,000 acre-feet per year scenario, *target* criteria (monthly flows estimated to be necessary to optimize productivity in the bay) are projected to be met 7 percent of the time without the project and 13 percent with the project. During drought of record conditions, freshwater inflows to the bay are projected to meet the criteria somewhat more often with the project than without it.

- **SAWS Yield Related to Bay Freshwater Inflows.** Increasing the project's firm delivery to SAWS from 95,000 to 120,000 acre-feet per year under 2080 conditions results in only small reductions in the quantities of river flows reaching Matagorda Bay. Specifically, the average annual flow at the mouth of the Colorado River is projected to be reduced from 1,490,882 acre-feet per year down to 1,477,846 acre-feet per year.

Key risks and potential benefits associated with this aspect of the study include the following:

- **Assumed Hydrology**. The assumptions used for hydrologic modeling to evaluate the water supply capabilities of the project, particularly the drought of record, pose uncertainty, or risk, for the project. The state water availability modeling approach includes using a historical period with actual gauged data "naturalized" to adjust for discharges to and diversions from the river. For this project, the period of record is 1940 through 1998, which includes the driest multi-year period. While the drought of the 1950s certainly is considered an extremely severe drought by all accounts, there is no guarantee that a worse drought could not occur sometime during the life of the project. Should this happen, the yield from the project will be less. This is not unique to this project, as all water development projects face the same possibility. According to state law, in these situations customers are generally required to be curtailed on a pro rata basis according to the terms of their contracts. Under the agreement between LCRA and SAWS, LCRA would use this procedure under drought circumstances. During 2007, the project team will explore potential implications related to the potential for climate change to affect hydrology.

- **Lake Level Requirements.** In keeping with the legislation that allows LCRA to consider this project, the average lake levels are expected to be higher over the life of the project compared to corresponding future conditions without the project. Although lake level requirements are met with the two scenarios studied this year, until the yield to SAWS is finalized, meeting the requirements remains a challenge for the project. Further evaluation of this issue will continue, and an implementation plan consistent with the legislative requirements will be developed.

- **LCRA System Optimization and Operation.** The water availability model assumes that the entire LCRA water rights system will be optimized, providing a more efficient system better able to meet basin needs in the long-term. If the actual operation differs from the simulations, results could be different.

- **Projected Water Demands**. The projected water demands used in this modeling effort are the best available information at this time and are consistent with those being used by water planners in Region K's most recently approved water plan (2006). However, future demands are projections and subject to some level of uncertainty or change due to the regional water planning process and actual future demands. In order to be sufficiently conservative, all non-LCRA water rights were modeled at full water authorization. Demand estimates within the LCRA system were projected for LCRA's existing and future customers.

- **Future Requirements for Environmental Flows**. Future requirements for environmental flows to support both instream river uses and bay resources and related water right permitting are uncertain. The water availability analyses of the project used in this Project Viability Assessment have incorporated the basic environmental flow requirements included in the 2006 Freshwater Instream Need Study, with some modifications to better reflect anticipated future firm demand conditions. While these provide considerable protection to both instream and bay and estuary uses, refinements to these requirements are continually being considered as studies are undertaken that produce new information, including the studies associated with this project.

3.2 Groundwater for Agriculture

The project would use groundwater and surface water conjunctively to meet projected agricultural water supply needs. LCRA will determine the need for groundwater on a real-time basis and pump groundwater when surface water supplies are insufficient to meet its irrigation divisions' needs in Colorado, Wharton, and Matagorda counties. Groundwater will not be delivered to San Antonio as part of this project. LCRA anticipates that the project's well systems will be assembled by leasing existing underutilized wells and, where necessary, installing new wells for the most efficient delivery of groundwater to irrigation customers. If new wells are needed within a particular irrigation division, the preference will be to work with a landowner regarding permitting and use of the groundwater. LCRA would generally construct or upgrade the well facilities and then lease the production of the permitted well for the life of the project from the landowner. When groundwater is pumped from project wells, it will be piped into existing irrigation canals. To help minimize construction costs and environmental impacts, the well system will consist of wells located near the irrigation canals. Since the wells are for irrigation, during those years when groundwater is needed, the wells will operate primarily between April and October.

The groundwater study is designed to help model the potential effect of the project on the various formations in the Gulf Coast Aquifer and to design and locate wells in an optimal manner. Some highlights of this ongoing analysis are summarized below.

- **Literature Search of Subsidence.** Literature regarding land subsidence in the study area was reviewed. Additionally, the team incorporated a land subsidence capability into the historical and predictive groundwater models. Subsidence was calibrated in the historical model using historical data derived from the literature search. Since 1900, the land-surface subsidence caused by groundwater pumping in Colorado, Wharton, and Matagorda counties is estimated to be less than 1 foot.

- **Refined Modeling of Brackish Groundwater Movement.** Refined models were used to improve the flow model calibration and to help evaluate the potential movement of brackish water in the vicinity of proposed project production wells in Matagorda County. The analytical model suggests that for typical project pumping rates, upward movement of brackish groundwater is not expected in Wharton County; however, such movement potentially could be observed in Matagorda County. To provide a "buffer zone" to prevent the upward migration of brackish water in Matagorda County, the bottom of the well screens should be kept approximately 300 feet above brackish groundwater having total dissolved solids values greater than 3,000 parts per million (ppm).

- **Conceptual Well System Update.** The conceptual well system for the project was updated based upon 1) the groundwater needs determined by modeling of water availability, 2) the irrigation canal delivery systems provided by other project teams, 3) provide a "buffer zone" to prevent the possible upward migration of brackish water, and 4) other logistical, physical, and environmental design constraints. The conceptual well system is described in more detail in the "Description of the LSWP Well Network" discussion (Section 4.2) of this PVA. The well locations are preliminary in nature and subject to change as further project information comes available.

- **Modeling Aquifer Recharge.** The project's model estimates recharge to the shallow aquifer of about 2.5 inches per year. This estimate is significantly greater than the deep recharge estimated by the Central Gulf Coast groundwater availability model. The difference is due to the refined model effectively simulating the shallow groundwater system which is dominated by local hydrology, whereas the Central Gulf Coast groundwater availability model only models the deeper aquifer. Only about 13 percent (0.27 inches per year) of total recharge reaches the deeper confined portions of the aquifers. The remainder is discharged through stream baseflow and evapotranspiration. In Colorado, Wharton, and Matagorda counties, agricultural irrigation is estimated to contribute about 0.8 inches per year to recharge to the shallow aquifer.

- **Seasonal Variation in Head.** Regional heads (elevations of measured water level in a well) in the Lissie and Willis formations vary significantly (in the range of 20 to 60 feet) between the growing season and the winter when pumping volumes and rates are reduced. Not only are seasonal variations observed, but also water levels tend to vary in the "downdip" or confined portions of these formations depending on the level of confinement and the depth of the well screens. Drawdown (pressure decline) measured within a pumping irrigation well may exceed 100 feet during the growing season; however the shallow unconfined aquifer water levels (heads) are largely unaffected by larger head declines in the deeper pumped formations.

- **Net Drawdown.** The primary test used for quantifying the potential effects of the project on groundwater resources is net (or incremental) drawdown. Net drawdown is defined as the difference between the drawdown predicted for a "*without project*" simulation and the drawdown predicted by a "*with project*" simulation, for a given simulation pair. As currently modeled, the average maximum net drawdown within the irrigation divisions (as simulated for existing well locations) is estimated to be about 14 feet during a repeat of drought of record conditions during a model simulation of projected demands for 2060.

There are potential risks and benefits associated with the groundwater aspect of the project.

- **Groundwater Model**. Related to assessment of groundwater availability, a risk to the project and the stakeholders in the region lies in the accuracy of groundwater availability predictions and, therefore, under or over estimating project impacts. This risk is partially managed by the development of a detailed groundwater model. The project is using the best modeling tools as well as the best information available to attempt to bracket potential uncertainty in model predictions.

- **Groundwater Permits**. The ability to obtain needed groundwater permits is a regulatory risk for the project. The existing groundwater conservation districts' rules that establish three to five year terms for pumping permits could be a risk for the project due to its long-term duration. Current estimates are that the project requires in the approximate range of 105 to 133 wells. However, for approximately 70 percent of the time during the actual growing season, the project needs to pump from 75 or fewer wells to meet the irrigation needs. To ease the need for new wells in the region, the project will seek to lease existing wells. This approach will benefit those in the study region and reduce the number of wells requiring new permits. A second means of addressing permitting issues is through mitigation. The LCRA is currently developing a mitigation policy that will reflect LCRA's commitment to preserving the Gulf Coast aquifer system as a continuing source of water in the region.

- **New Groundwater Conservation District in Colorado County**. In 2007, a groundwater conservation district was approved by the voters for Colorado County. Due to projected irrigation water needs, the layout of the Garwood and Lakeside irrigation divisions, and the project's groundwater production requirements, 35 to 40 percent of the proposed wells would be in Colorado County. With the formation of the Colorado County district, there are some risks that regulations could limit the capability to obtain permits. LCRA is committed to working with the newly formed district to develop and manage groundwater in a manner that is beneficial to the community, results in minimal impacts and meets water supply needs for irrigation.

- **Desired Future Conditions established by Groundwater Conservation Districts**. House Bill 1763 (2005 Legislative session) has the potential to limit production within the region depending on the determination of "desired future conditions" defined by the districts. December 2007 was the legislative goal for providing a definition of "desired future conditions". Groundwater Management Area 15 (the counties in the project area lie within this area) did not define "desired future conditions" by the end of 2007 and it is not clear when this will be determined. Therefore, the associated risk to the project can not be quantified.

- **Public Opinion.** Through the project stakeholder process, the increased use of groundwater to meet local irrigation needs has been raised as a concern by members of the public. Thus, negative public opinion could be a risk to the project. The project is using good science, public education and outreach, well leasing, and mitigation to address this risk. Further, the project team will continue to work closely with the local districts.

- **Policies and Mitigation.** Although new wells would be placed in compliance with districts' well spacing requirements and production managed to minimize drawdown,

the potential for some effect on existing wells is possible. LCRA is developing policies to address such impacts and minimize or mitigate them.

3.3 Agricultural Conservation

The agricultural conservation study is focused on identifying potential water conservation measures within the canal delivery system and on the individual farms served by LCRA in the irrigation system composed of three divisions: Lakeside, Garwood, and Gulf Coast, as well as individual farms served by Pierce Ranch, a wholesale water customer. The target potential savings are the same as those from 2006:

- Delivery system: 48,000 acre-feet per year
- On-farm best management practices: 40,000 acre-feet per year
- Rice varieties: 30,000 acre-feet per year
- Total: 118,000 acre-feet per year

As with the other studies, the results should be considered preliminary. All field efforts, data collection activities and model development will be completed in 2007 with additional model analyses being completed in early 2008. The final results of this study will be completed by mid-2008, with the exception of the high-yield rice variety research which will continue into 2010. Permitting activities may require additional conservation study beyond 2008. Some highlights of this ongoing analysis are summarized below.

- **On-farm Conservation Measures.** In addition to potential water savings in the delivery system, the agricultural conservation study examines the potential for conserving irrigation water used by rice farmers in the irrigation divisions within Colorado, Wharton and Matagorda counties. Efforts in 2007 were focused on calibrating the web-based Rice Water Conservation Analyzer (RiceWCA) model and integrating the model results with analyses from other teams, specifically the socioeconomic study team. The model was used to determine the extent of implementation required to achieve the target on-farm conservation savings of 70,000 acre-feet per year (40,000 acre-feet per year in on-farm measures, plus 30,000 per year reductions due to switching to the high yield rice variety).

- **On-farm Conservation Measure Costs.** Current estimates for on-farm conservation measures are approximately $140 per acre-foot of water conserved. Cost estimates for on-farm savings do not include contingencies. This value represents a cost of the demand reductions to the project sponsors that does not "take credit" for demand reductions resulting from rice acreage going out of production, the adoption of high yield rice, or increases in the number of acres subjected to conservation tillage. All three of these elements are projected to occur, without requiring subsidies.

- **Conservation Ponds.** Conservation ponds are proposed as a means of regulating the flow in the delivery system. The ponds are used to hold excess water from the canals. They may also be used during dry periods to temporarily store canal water for later release to meet peak demands. LCRA will work with landowners in the irrigation divisions regarding proposed locations of the conservation ponds during 2008.

- **Structural Conservation Measures and Costs.** A more detailed review of estimated structural conservation measures and associated costs was conducted during 2007. The scenarios were evaluated in terms of capital costs as well as operations and maintenance costs, along with the potential savings resulting from the implementation of the measures. Non-cost criteria were also considered.

- **Delivery System Improvement Recommendations.** The following actions are recommended if the agricultural conservation measures are implemented:

    1. Employ a water conservation engineer familiar with practices in South Central Texas specifically dedicated to the project to implement, monitor and evaluate the effectiveness of the various conservation measures;

    2. Implement a program to identify high-loss canal segments:

        – Install flow metering stations within the system to identify areas where delivery system losses are the greatest.
        – Conduct repeated instantaneous measurements at locations suspected of high-losses.
        – Based on information collected by the first two activities, conduct ponding tests to further focus in on high-loss segments.
        – Along segments where losses are indicated, conduct intense on-ground inspection of the canal banks and levees.

    3. Where vegetation is heavy in suspected high-loss areas, remove the vegetation to an extent that is environmentally sound.

    4. Line the River-to-Lake Canal and the River-to-Prairie Relift Canal after conducting preliminary testing to confirm the extent to which each canal is losing water.

    5. Construct conservation ponds.

    6. Remove unused turnouts.

    7. Rehabilitate turnouts and add flow meters, along with automated gate control and SCADA (Supervisory Control and Data Acquisition).

    8. Replace check structures (flow and water level regulators) on major canals.

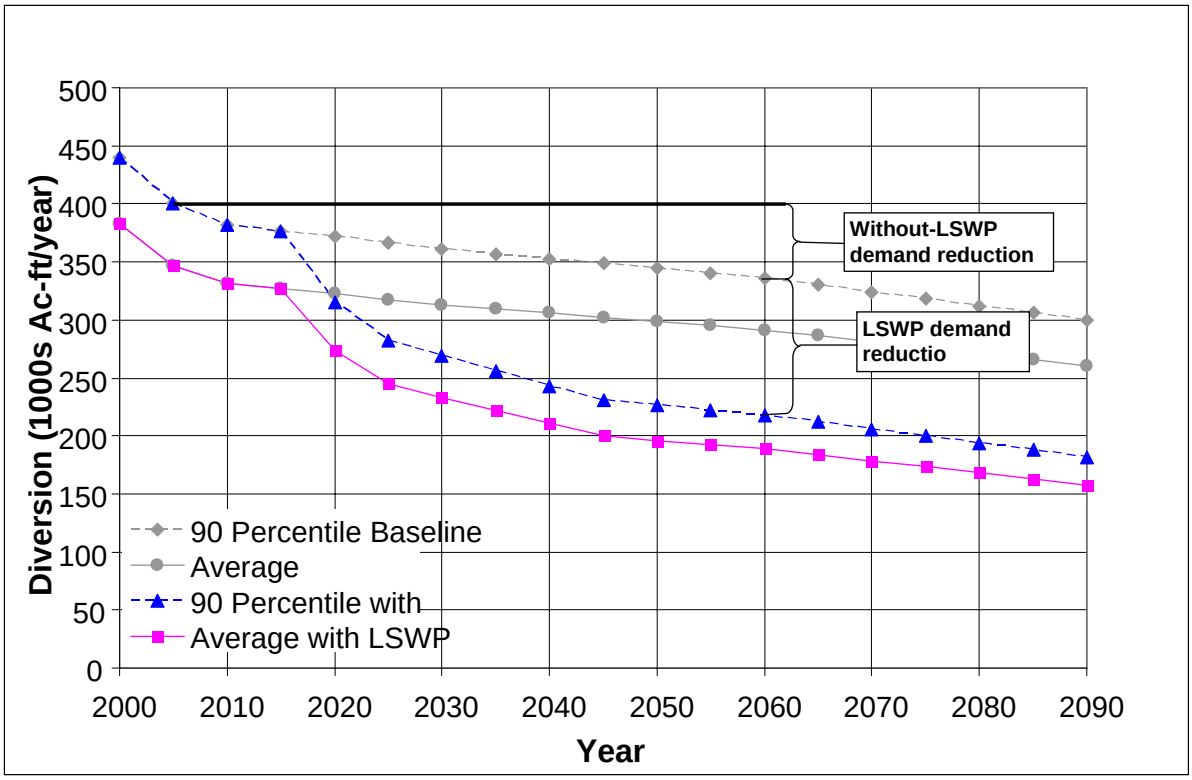
    9. Install a composite geomembrane-concrete liner in high-loss canals to the extent necessary to achieve the savings goal.

- **Delivery System Savings.** The target savings volume for the delivery system is 48,000 acre-feet per year. The combination of actions studied by the team has the potential for saving 65,000 acre-feet of water per year, at an estimated annual cost of $8,500,000 ($130 per acre-foot conserved per year).

The current projected implementation schedule for conservation measures starts in 2015 and shows approximately two-thirds of the measures installed by 2023, with the remaining one-third of the measures implemented by 2045. Figure 3-2 shows the projected irrigation demands over time, with and without the project, based on this schedule. This is a very aggressive schedule and is subject to the availability of workforce and materials. There are also restrictions on when work can be conducted in the canal system imposed by crop

watering requirements. These restrictions could extend the length of the first implementation phase.

FIGURE 3-2
Irrigation Demand Reductions with and without the Project
LCRA-SAWS Water Project



In both on-farm and delivery system scenarios, the risks associated with projecting conservation savings are a factor to be considered in all phases of the project.

- **Delivery System Versus On-farm Measures**. In general, implementing conservation measures in the delivery system may provide fewer risks than implementing measures on-farm, because LCRA has direct control over the delivery system; whereas, on-farm savings will vary among hundreds of farmers with their individual practices, availability of time, or acceptance.
- **Savings Estimates.** Projected savings resulting from recommended practices may not be completely achieved due to differences between the LCRA systems and other systems upon which design criteria were based. For example, data projecting water savings from practices such as installing meters at all turnouts was derived from other irrigation systems while actual savings in this system could vary either higher or lower than the projections. Conducting pilot studies to confirm projected savings resulting from the implementation of a particular conservation strategy in the LCRA irrigation systems is one method of confirming the expected savings.

- **System Operation Differing From Modeled.** Conservation savings are calculated using efficiency figures that can be achieved using SCADA (Supervisory Control and Data Acquisition) in a manner that helps to control water loss from the delivery system. If actual operation differs, then the savings may not equal the calculated savings. System monitoring, personnel training and implementation of best management practices will help ensure system operations achieve desired efficiency.
- **Reduction of Return Flows to the Bay**. Increased system efficiency may reduce return flows to parts of East and West Matagorda Bays. This is being studied by the Matagorda Bay health evaluation study team to identify and quantify potential effects of such system changes.
- **Implementation by Farmers.** Farmers may not implement new conservation practices for a number of reasons including:
    - Tenants who choose not to invest in improvements on land they do not own.
    - Tenants satisfied with their current operations may be unwilling to implement the new practices.
- **Farm Income Maximization Model.** The farm income maximization model is under development to help understand and predict implementation rates for the various conservation strategies so that expected water savings resulting from the project can be better refined. As with any model, however, its estimates have limitations.
- **Global Economy.** Global economic forces could change the value of rice crops resulting in more or less fields being brought into production.

3.4 Facility Siting

Facilities such as off-channel storage facilities, pipelines, intakes, and pump stations within the lower Colorado River basin are needed to implement the project. Beginning in 2004, the team has gathered increasingly detailed information on various potential sites for the project components. The 2007 work effort focused on refining potential locations for the various project components and beginning detailed field analyses.

Some highlights of this ongoing study are summarized below.

- **Public Outreach.** In May 2006, the LSWP initiated its public outreach program to present the proposed off-channel storage sites through a series of meetings and workshops. The project team held several advisory group meetings and public meetings in Matagorda, Wharton, and Colorado counties with the objective of communicating with the public, including potentially affected landowners, the possible off-channel storage site locations along with the criteria used for their selection.
- **Public Outreach Meetings and Additional Sites.** The meetings provided the public an opportunity to talk individually with the project team. Interested parties provided additional information on the component sites and expressed concerns or interests they had in the land being considered for off-channel storage sites or other components. Additionally, the goals and status of the project, the permitting process, and the project schedule were shared with attendees. Based on landowner input at these meetings,

additional off-channel storage sites were identified for consideration. The additional sites were located in Colorado, Wharton, and Matagorda counties.

- **Constraints Maps**. Constraints maps, that help to identify areas where facilities might be compatible with existing land uses, were prepared to guide the siting process. Geographic Information System (GIS) data maps were overlaid with existing land uses, threatened and endangered species habitat, existing utilities, wetlands, known cultural and historical resources, oil and gas wells and pipelines, floodplains, parks, etc. to help locate potentially feasible sites.
- **Size of Off-Channel Storage Facility Sites.** The sites studied for the off-channel storage facilities ranged in size from approximately 1,000 acres to 8,000 acres.
- **Conceptual Facility Sizes and Designs.** Conceptual facility sizes and designs were developed working with the surface water availability portion of the study, which defined diversion rate characteristics and storage volume scenarios for costing purposes.
- **Additional Off-Channel Storage Facility Sites Considered**. The team originally developed eight preliminary conceptual alternative projects from the selected off-channel storage sites. Members of the public provided potential additional or modified locations for the facilities which were analyzed in the study. The additional and modified off-channel storage facility sites resulted in the development of seven additional conceptual alternative projects, three of which were carried forward for comparison with the original eight conceptual alternative projects.
- **Siting Factors of Greatest Importance**. After extensive screening based on a variety of factors, the three factors of greatest importance for selecting the alternative project within the LCRA area appeared to be:
  - Potential jurisdictional waters/wetlands of the U.S.;
  - Estimated capital costs for facilities within LCRA boundary; and
  - Estimated annual unit costs for facilities within LCRA boundary.
- **Preferred Alternative**. A preferred location for the off-channel storage location was identified on the Pierce Ranch in Wharton County. This site will be further evaluated as the preferred alternative project.
- **Limited Field Investigations.** During 2007, the facility team began limited field investigations for the portions of the conceptual project within the Pierce Ranch site (conceptual alternative project 8A). Two potential river diversion structures, two intake pipeline routes (carrying water from the river to storage facilities) and the off-channel storage site are being studied.
- **2008 Field Investigations.** Cultural resources, geotechnical and other civil and environmental field work will be performed in early 2008 in these same areas. Field investigations for the transmission main route from the storage facility to the county line will also occur in early 2008.
- **Transmission Facilities to Deliver Water to San Antonio**. The project team developed conceptual designs for the raw water transmission pipelines, terminal storage

facility(ies), and integration system pipelines and pump stations, and water treatment facility(ies) associated with the project.

- **Potential Transmission Pipelines.** Three conceptual raw water pipeline alignments to deliver water from the Wharton County line to San Antonio have been identified. These will be further studied.
- **Terminal Storage.** Design criteria have been established for either two storage facilities with approximately 10,000 acre-feet of capacity or one facility with approximately 20,000 acre-feet of capacity. This terminal storage would be located in the San Antonio area near the water treatment plant to help meet peak seasonal water demands in the SAWS service area.
- **Water Treatment**. SAWS is studying five water treatment processes that could be used to treat the raw water delivered from the project. All of the treatment processes would meet drinking water standards and ensure compatibility with the existing high-quality drinking water in their delivery system. The capacity of the treatment plant will be determined based on the yield of the project.
- **Integration into SAWS Distribution System.** Conceptual designs have been developed for the integration system, consisting of pump stations and pipelines, which connect the water treatment facility to the SAWS distribution supply system. This includes the integration pumping stations which transfer treated drinking water from the water treatment plant site(s) to alternative integration points within the SAWS system. Sizing of the finished water integration system is dependent on the distribution system demands and the peak delivery capacity of the treatment facilities.

There are potential risks and benefits associated with facility siting and construction aspects of the project.

- **Land Ownership and Field Data.** Many of the risks such as identifying a feasible site for the storage facility that were identified in previous PVAs have been addressed as the facilities' study has progressed. Issues associated with land ownership for the storage facility and field data that would change the recommendation regarding location and other similar factors are being resolved. More extensive assessments of pipeline alignments are required. Because pipeline locations can be adjusted, however, this poses less risk that siting the off-channel storage facility.
- **Project Costs.** Final costs associated with the project construction appear to be one of the most significant risks associated with potential facilities for the project. This includes capital, anticipated operating and maintenance, and potential environmental mitigation costs.

3.5 River Water Quality

The primary objective of the water quality study is to evaluate how water management related to the project may affect existing and future water quality in the Colorado River below Longhorn Dam. River water quality may be affected by the project due to changes in the timing and volume of flow in the river, especially during summer months. The team has reviewed and synthesized previous studies and data on existing conditions in the river and

has developed models and methods to help assess possible changes in future water quality due to the project. The focus has been on dissolved oxygen (DO), although the team has also evaluated other constituents in the river, such as nutrients.

Some highlights of the ongoing analyses are summarized below.

- **Low-flow, Summer Condition.** The primary focus of the water quality study is on the low-flow, warmer summer condition. If the water quality of the river is shown to maintain acceptable levels of DO under this condition, then one can assume that the water quality (i.e., dissolved oxygen) will be acceptable under more average or normal flow and temperature conditions.

- **DO Results.** The minimum dissolved oxygen concentrations with the project for 2030 and 2060 also are at or above the current dissolved oxygen standard for discharge permits. For one month out of the year (September) in 2080, the model predicts a dissolved oxygen minimum for the "*with project*" scenario of 5.9 milligrams per liter (mg/L), which is 0.1 mg/L below the 6 mg/L standard in the segment of the river between the cities of Austin and La Grange. The model predictions are based on a combination of conservative assumptions for flow, water temperature, and discharge quantities and concentrations that may or may not all occur simultaneously in the future.

- **Other Water Quality Results.** Results from the analyses of other constituents indicate the project would have minimal, if any, effect on toxics, metals, bacteria, conservative materials, pH, and water temperature. For some constituents (such as water temperature and bacteria), it is expected that, if the project were implemented, other factors such as urban growth in the lower basin, changes in wastewater treatment plant discharge concentrations and/or return flows, and climate change would potentially affect river water quality more than changes in flow regime due to modifications in the timing and quantity of releases over Longhorn Dam.

- **Water Quality in the Off-Channel Storage Facility.** Model results related to potential water quality in the off-channel storage facility highlight the importance of water depth in the BATHTUB model's prediction of the frequency of algal blooms, which affect the taste and odor of the water. When the facility is more than half-full, algal blooms are projected to occur less than 5 percent of the time. At low water levels, however, conditions are more conducive to the growth of algae. Based on the frequency distribution of water storage in the off-channel storage facility under historical conditions (1940-1998), algal levels exceeding 40 micro grams per liter (µg/L) are projected to occur approximately 4.5 percent of the time, or 16 days per year.

Potential risks (and benefits) related to water quality include the following:

- **Lower Summer River Flows.** Because operation of the project may result in less water released from the Highland Lakes to meet downstream irrigation needs during the summer months, low-flow conditions could exist when water temperatures are higher. While this is a more natural condition in rivers without upstream reservoirs, it could result in decreased levels of dissolved oxygen in the river and potentially increased levels of nutrients resulting from treated wastewater discharges during such low-flow condition.

- **Increases in River Water Temperature.** Increases in water temperature due to climate change could affect the dissolved oxygen capacity of the river and cause the overall average dissolved oxygen concentration in the river to decline irrespective of whether or not the project is implemented. Analyses of the potential impacts of climate change using the QUAL-TX model will be performed in 2008 to assess the impact this potential temperature change may have on the river dissolved oxygen concentrations.
- **Off-Channel Storage Facility Water Quality.** Off-channel storage facility water quality is dependent on the operation of the facilities. Off-channel storage facility design configurations and operation approaches that frequently result in shallow water could result in taste and odor issues in the water supplied to SAWS' water treatment facilities. In most cases, however, these issues can be addressed by engineering solutions during design and operation.

3.6 River Habitat

The project has the potential to alter the flows in the lower Colorado River from current flow patterns. In particular, reduced water deliveries down the river for agriculture from spring through October are anticipated. A low weir could potentially be used to create a pool for pumping water to the proposed off-channel storage facility. These types of changes on a regulated river system have the potential to affect the ecology of the river. The river habitat team has therefore developed ecologically-based tools and models to help evaluate these issues using data from existing studies and additional information from specific field activities. The tools developed will help predict the effects of a range of flows on the ecology of the lower Colorado River system.

Some highlights of this ongoing analysis are summarized below.

- **Blue Sucker Tracking.** Since October 2004 when the project team radio-tagged numerous adult blue suckers, tracking data has provided valuable information on the movement of blue suckers in the lower Colorado River. Tagged fish led the project team to spawning areas each year and detailed habitat measurements were taken at these areas to describe spawning conditions. In 2007 alone, five spawning sites were documented.
- **Use of Collected Data in Modeling.** Data collected over the last several years has been incorporated into several analytical tools to evaluate flow needs to support various aquatic habitats in the Colorado River below Austin. Hydraulic and habitat modeling, sediment transport analysis, and water quality modeling were used to support the development of subsistence and base flow guidelines.
- **Development of Preliminary Instream Flow Recommendations.** Preliminary instream flow recommendations are provided at Austin, Bastrop, Columbus, and Wharton. The subsistence and base flow recommendations are applied on a monthly basis. The pulse flows, channel maintenance, and overbanking flows have associated magnitude, duration, frequency, and timing associated with each event. The final instream flow recommendations for the lower Colorado River will be published in early 2008.

- **Integration of Instream Flow Recommendations into Flow Regime**. Once the specific flow recommendations were developed, an integration of those flow recommendations into a proposed flow regime was needed. Table 3-1 provides an overview of the integration of analysis tools used in developing specific flow recommendations.

TABLE 3-1
Analytical Component Integration Overview for Instream Flow Guidelines
LCRA-SAWS Water Project

	Hydrology and Hydraulics	Biology	Geomorphology	Water Quality
Subsistence Flows	Hydrologic analysis Hydraulic modeling	Habitat Modeling X^{th} percent exceedance level Base flows		Dissolved oxygen modeling
Base Flows	Hydrologic analysis Hydraulic modeling	Habitat Modeling X^{th} percent Habitat exceedance level(s) Base flows	Sediment transport modeling Base flow Particle movement	Dissolved oxygen modeling
High Flow Pulses	Hydrologic analysis Pulse Flows	Riparian assessment	Sediment transport modeling Particle movement Effective discharge	
Overbank Flows	Hydrologic analysis Flood events	Riparian assessment Active floodplain connectivity	Sediment transport modeling Effective discharge	

Many of the potential risks identified regarding the potential effects of the project on river habitat earlier in the study period and in previous PVAs have been addressed through additional study and the development of recommended instream flow criteria.

- **Approach for Instream Flow Guidelines Addressed Many Risks.** In the development of the draft instream flow guidelines, the objective was to provide a protective flow regime that promotes natural variability. Thus, if successfully implemented and achieved, the aquatic health of the lower Colorado River would be maintained. As such, the potential risks discussed in the 2006 PVA relative to aquatic habitat (such as severe reductions in available aquatic habitat, streambank erosion, increased sediment deposition in key habitats, decreased water quality [reduced dissolved oxygen], and decreased recreation) are not a concern based on the data analyses and modeling to date.

- **Potential Vegetation Growth**. Long-term monitoring is advisable to evaluate the potential effects of the summertime subsistence flow recommendations on exotic aquatic vegetation establishment. Natural conditions include low summertime flows; however, the difference today is the additional nutrient load that the river carries. During future low-flow summertime conditions, clear warm water coupled with higher nutrient concentrations could promote an increase in native aquatic plants and/or possibly invasive exotic plants such as hydrilla. In a natural flow regime, excessive vegetation growth is controlled by scouring during high flow pulses and overbanking events.

- **Juvenile Blue Suckers.** While blue sucker spawning was documented on several occasions, eggs were confirmed in 2006, and hatching was observed in 2007, no juvenile blue suckers were collected during the study. Lack of juveniles in recent collections elicits concern regarding recruitment success of this state-threatened species in the lower Colorado River. Therefore, given potential recruitment concerns, recommendations include continued evaluation of spawning habitat during the early spring months and the maintenance of adequate amounts of spawning habitat in early spring months as proposed in the instream flow guidelines.
- **Potential Climate Change.** Climate change is another factor that has environmental implications for the lower Colorado River. Implications could include increasing water temperatures and further altered flows over time. These scenarios are scheduled for evaluation in 2008 using the tools created for the river habitat study relative to the aquatic species response and available habitat area.
- **Coordination with Facility Siting Addresses Potential Risks**. Additional potential risks highlighted in the 2006 PVA (obstruction of fish migration, and increased impingement and entrainment of certain fish species) have also been addressed via specific studies and on-site evaluation of proposed intake locations. The project team will continue to coordinate with the facility siting team so facilities are designed that protect fish passage and limit impingement and entrainment of fish.
- **Detailed Assessment of Riverine Health.** As part of the final alternatives analysis a detailed assessment of riverine health will be conducted relative to the achievement of instream flow guidelines as well as differences between the "*with*" and "*without*" project scenarios. In conjunction with the long-term monitoring, adaptive management will be a vital component of the success of the environmental principles associated with the project and goals of the Texas Instream Flow Program.
- **Long-term Monitoring and Adaptive Management.** A long-term monitoring plan specific to the lower Colorado River is under development for completion in 2008. An adaptive management plan for the project is also being developed in conjunction with all LSWP study teams.

3.7 Waterfowl and Wildlife

During the LSWP study period, members of the public raised the issue of the project's potential effect on wildlife, particularly waterfowl, and how changes in waterfowl habitat might affect the local economies of Colorado, Wharton, and Matagorda counties. The science review panel also listed waterfowl as a key concern. Therefore, during 2007, the Waterfowl and Wildlife study was added to evaluate potential waterfowl/wildlife effects associated with the project. This study involves:

- establishing existing conditions with respect to land use and wildlife utilization;
- determining socioeconomic contributions related to waterfowl and wildlife;
- evaluating off-channel storage facilities and conservation ponds; and
- evaluating LSWP agricultural strategies that could affect waterfowl.

- **Waterfowl Populations and Habitat.** A key component of this study completed in 2007 was the documentation of historic and current waterfowl populations and habitat within the project area. Waterfowl population data are readily available on a large scale basis for total populations in North America or a particular migration flyway. However, population data becomes much more limited when attempting to document waterfowl species on a county basis or within a specific locality. Much of this lack of data is attributed to working with highly mobile avian species that are capable of migrating thousands of miles to preferred habitat and for most species, seasonal residents in the project study area.
- **Waterfowl Migration Data.** Waterfowl migration chronology data is relatively limited at a local level. As such, the migration chronology defined in the Gulf Coast Joint Venture Texas mid-coast initiative was used. The migration chronology from the mid-coast initiative suggests that ducks arrive in the project study area in late August, peak in numbers in December and are present through March. Geese, however, arrive in October, peak in December and also depart near the end of February (with the exception of a few Lesser Snow Geese that remain through March).
- **Changes Expected in LCRA Irrigation Divisions.** Coastal marshes, coastal prairies and agricultural land outside the LCRA irrigation divisions are not expected to change due to agriculture management strategies proposed to conserve water as part of the project. Therefore, the only changes expected to occur as a direct result of the proposed agriculture management strategies would be within the LCRA irrigation divisions.
- **Off-Channel Storage Facility and Conservation Ponds.** The project team is also addressing potential impacts of off-channel storage facilities and conservation ponds being proposed by the project. This assessment focuses on the relative location of these new facilities to existing waterfowl habitat and roost sites and the design and operation of such facilities.
- **Preliminary Model Results.** Preliminary model results indicate that under current agricultural practices, available energy (food) exceeds the needs of geese throughout winter season, while exceeding the needs of ducks until late in the season. The project team is currently focusing on the differences, if any, with respect to available energy to geese and ducks relative to potential agricultural practices expected to result from the project.

The assessment of the effect of the project on waterfowl/wildlife centers on how potential agricultural practice changes and facilities placement and design may influence waterfowl/wildlife habitat and populations within the lower three county area. Specific potential risks include:

- Reduction in available habitat (wetted area) for ducks and geese;
- Reduction in available food (energy) for ducks and geese: and
- Disruption of existing roost sites via placement and operation of new facilities.

3.8 Matagorda Bay Health

The principal charge for the Matagorda Bay health evaluation team is to establish a method or methods that will: (1) estimate changes in bay health and productivity due to changes in freshwater inflow and determine if that level of change is acceptable as defined within the legislation authorizing the project; and (2) provide freshwater inflow criteria for consideration by resource agencies and use by the surface water availability study team to guide their analysis of project design alternatives and system operating guidelines.

Some highlights of this ongoing analysis are summarized below.

- **Bay Health Measures.** The study depends significantly on characterizing existing bay health and productivity to provide a benchmark against which to evaluate maintenance of acceptable conditions. To this end, several bay measures such as salinity, plant productivity and benthic conditions (among others discussed in more detail in Section 6) have been selected to characterize bay health and productivity.

- **Completion of Models and Data Analyses.** During 2007, the Matagorda Bay health evaluation team substantially completed the development work of the various models and data analyses noted above, allowing estimation of responses in bay condition resulting from changes in the driving mechanisms. Particular emphasis was placed on understanding the response of salinity in the bay system to various inflow regimes, as salinity levels are often used as a surrogate for inflows.

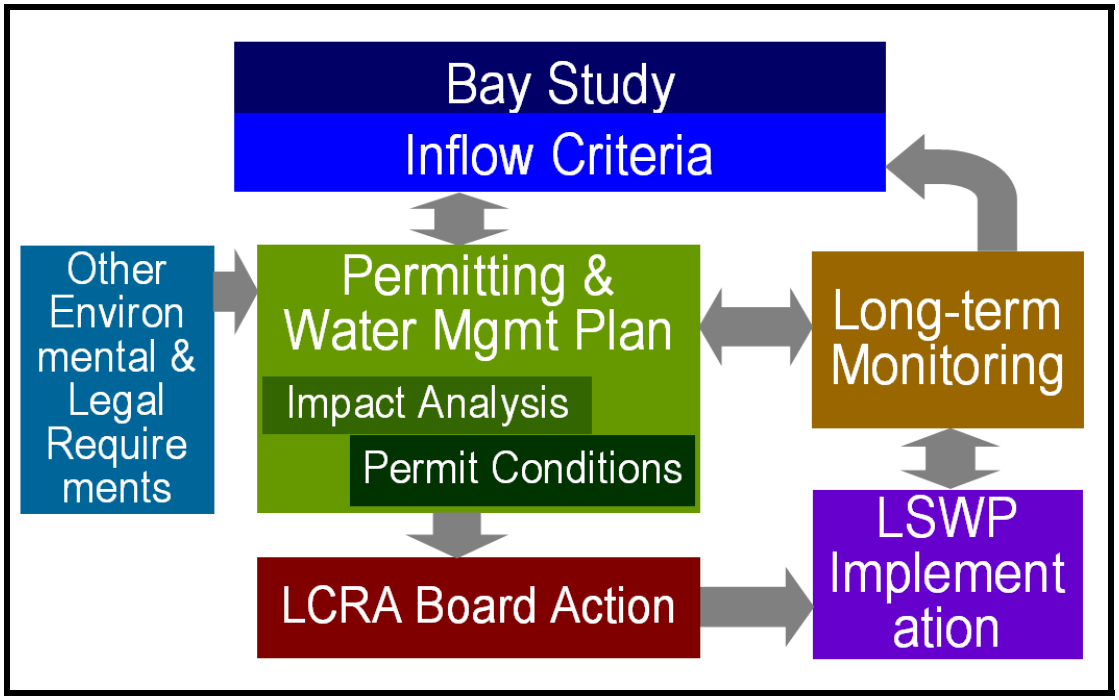
- **Nutrient Loads and Trophic Levels.** Nutrient loading to the bay was further analyzed to assess its relation to inflow conditions. The overall trophic level (e.g. food chain or food web) approach to bay health and productivity continued to provide the framework for the assessment of bay health.

- **Resource Agency Interaction.** Opportunities for interacting with the resource agencies and interested environmental representatives were developed during 2006 and continued in 2007. A series of full-day workshops was conducted as the habitat and oyster modeling approaches were under development. Other meetings were scheduled to discuss hydrodynamic and salinity models and their application to the study results. The bio-statistical analysis of the Texas Parks and Wildlife Department coastal fisheries database was the subject of both large group and smaller group detailed technical discussions. Late in the year, the bay health evaluation team presented a summary of study results, and presented the draft recommendations for inflow criteria for the Colorado River to a meeting of the bay health sub-advisory group made up of agency representatives, environmental advocates, and other parties interested in the project.

- **Development of Freshwater Inflow Criteria.** Each of the measures of bay health and the attendant models and data analyses that underlie the measures has been employed to provide results for use in developing a proposed comprehensive set of inflow criteria. When applied to the future inflows from the Colorado River, the inflow criteria are intended to protect the health and productivity of the bay. The various measures, which reflect differing aspects of bay health, contribute to development of the proposed criteria in different ways. In some cases, direct relationships between freshwater inflow and bay health measure have been developed. In other cases, the connection is indirect; however, supported by the analyses. Both historical bay conditions, and description of the

complexities of the existing and historical ecological "character" of the bay, have been used to lay the groundwork for the inflow criteria.

FIGURE 3-3
Freshwater Inflow Criteria in the Larger Context
LCRA-SAWS Water Project



- **Application of Models to Develop Inflow Criteria.** Application of the various models developed for the study has resulted in a set of numerical inflow criteria with an associated guideline for achievement of the various flow conditions. All of the criteria would be employed simultaneously, allowing the achievement guidelines to result in the desired variability in conditions. The *threshold* levels would maintain a floor on monthly inflows during the most dire conditions of extreme drought and provide for pulse releases from environmental storage. *Base-low* and *base-moderate* criteria would provide seasonal flow pulses to the bay which are important to many species, while also providing a level of flow in the intervening months. Finally, maintenance of long-term average flow volume and flow variability would ensure maintenance of adequate bay food supply to protect primary productivity (e.g. algae growth) levels in the bay.

- **Preliminary Draft Inflow Criteria.** Inflow criteria were presented as preliminary to the resource agencies and other interested stakeholders for their review and comment in November 2007. They will be refined as the review process progresses.

There are risks and opportunities associated with Matagorda Bay related to the implementation of the project.

- **Model Limitations.** There exist inherent limitations in all of the models developed by the Matagorda Bay health evaluation team to assess bay health and productivity. Many of these limitations and the variability in model results have already been reported in the final reports on development of the individual models.
- **Multiple Approaches and Need for Consensus.** The multiple ways to characterize bay health and productivity will necessitate development of a consensus if significant project induced changes in various bay health measures are identified. This outcome would require a heightened level of engagement with regulatory decision makers and resource agencies.
- **Agency Review and Endorsement of New Approaches Needed.** The new methodology for determining bay inflow criteria will require agency review and endorsement as part of permitting for the project. Further, operationalizing these recommended criteria will be challenging.
- **Long-term Monitoring**. Given the natural complexities of coastal estuarine systems, long-term monitoring and adaptive management may be necessary to maximize resource utilization while meeting the water needs of the environment, in particular the Matagorda Bay system.

3.9 Net Environmental Benefit Analysis

A net environmental benefit analysis is a way to quantify the ecological services provided by natural resources and account for them so that both beneficial and negative impacts as well as mitigation strategies can be evaluated. Its purpose is to identify and evaluate the environmental effects of a project.

- **Focus on Key Studies.** For the LSWP, the net environmental benefit analysis will rely heavily on the Matagorda Bay health evaluation, aquatic habitat, and the facility siting studies for information relating to potential impacts on affected resources such as wetlands and other habitat. This analysis will evaluate ecological services not easily measured in monetary terms, and will contribute to the benefit-cost analysis conducted for the project.
- **Same Theory as a Benefit-Cost Analysis.** Essentially, this analysis is an accounting framework with the same theoretical foundation as a conventional benefit-cost analysis; however, it assesses ecological benefits and costs rather than monetary effects of a project. Such analyses are frequently used to support decision-making regarding the relative ecological consequences of alternative projects, environmental mitigation, findings of "no significant impact" as well as other natural resource management decisions.
- **Workshop and Field Work.** A workshop with a number of resource agencies was held to explore the various models and data available for those habitats most likely to be affected by the project's facilities; processes for collecting the appropriate field information were also discussed. The initial field work and data collection effort to evaluate potential impacts commenced in October 2007 and additional field work as

well as data collection and management activities are expected to continue through July 2008 for the proposed facilities locations.

- **Scheduled for Completion in 2008**. In addition to the analysis to be conducted for environmental effects related to facilities, a net environmental benefit analysis is planned to measure potential impacts of the project, including enhancement measures on Matagorda Bay. Final outputs from models developed and used in the Matagorda Bay health evaluation study (biostatistics of identified species; benthic model; habitat models i.e., marsh nursery habitat; and nutrient/food supply models) will provide the basis for this evaluation and are scheduled for completion in 2008.

3.10 Permitting Requirements

During the development of the agreement between LCRA and SAWS and the resulting study period plan, certain essential permits were identified as critical to the viability of the project. The project team evaluated the requirements for the permits and shaped the studies to meet those requirements whenever possible. The major permits for the project include:

- **US Army Corps of Engineers.** Permits, licenses or authorization are likely required by the United States Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act and Section 10 of the River and Harbors Act for the project components. These permits, licenses and/or authorizations are referred to in this document as the Section 404/10 permit and are granted by the USACE. The USACE has permitting authority over discharge of dredged or fill materials into navigable waters, including wetlands and streams ("jurisdictional waters of the United States"). Such permits require compliance with the National Environmental Policy Act (NEPA) and a water quality certification (Section 401) by the Texas Commission on Environmental Quality (TCEQ).

- **Texas Commission on Environmental Quality.** Water rights and/or amendments to water rights are necessary for the project. Water rights permits (including amendments and interbasin transfer authorizations) are granted by the TCEQ. TCEQ approvals include amendments to existing LCRA water rights to add interbasin transfer authorization, new purposes of use and diversion locations as may be necessary for the project; an unappropriated flows permit; and construction of off-channel storage facilities.

- **Groundwater Conservation Districts.** Permits, licenses, or authorizations as necessary are needed to develop and use groundwater resources. Groundwater conservation district permits for production wells are required from the Coastal Bend, Coastal Plains and Colorado County groundwater conservation districts.

Some highlights of the ongoing permitting activities are summarized as follows:

- The permitting team is working closely with the various study teams to ensure the data needed will be available and presented in a consistent format.

- Descriptions of the project components are under development, including agricultural conservation measures, groundwater wells, facilities within the LCRA basin as well as those delivering, storing, and treating the water for the San Antonio area.

- The current project schedule targets late 2009 for filing of various essential permit applications with the exception of the groundwater conservation district permits. The schedule for applying for permits from the groundwater districts has not yet been established.

Potential risks exist for permitting a project of this magnitude and complexity. Some of the risks include:

- **Water Rights Permitting**. Water rights permitting could be delayed for a variety of reasons including: pending water rights application processes in the basin; substantial legislative changes to the Texas Water Code; potential protests to the LCRA applications; potentially, statewide water rights issues including on-going uncertainty regarding environmental flows, water rights amendments and return flows treatment in permitting; and obtaining simultaneous review and decisions regarding the multiple, complex permit requests associated with this unique project.
- **USACE Permitting.** The federal permit issuance process could be affected by availability of agency staff to conduct necessary National Environmental Policy Act (NEPA) processes and 404 permit reviews and by potential comments on the permit application related to the project.
- **Groundwater Conservation Districts' Permitting.** Statutory changes or changes in groundwater conservation district rules or management plans could affect permitting of the groundwater system associated with the project. The limited term of groundwater production permits and the determination of "desired future conditions" by the districts also could be risks.

3.11 Socioeconomic Study

The socioeconomic analysis is designed to help address the overarching questions regarding the social and economic benefits and costs of the project as well as the distribution of those benefits and costs among the regions and sub-groups within the regions affected by the project. This study will support permitting efforts at both the state and federal level. Because the study relies heavily on the results of the other project studies, a majority of the study is scheduled for 2008 with completion in 2009.

Following are some preliminary findings as a result of the limited initial analyses:

- **Municipal and Industrial Sector Analysis in Region K**. The "Municipal and Industrial Sector Within Region K Analysis" focuses on municipal and industrial water users within the lower Colorado River basin. This analysis examines the expected benefits and costs, if any, to cities and industries as a result of the project. One possible way that entities within this sector could be affected would be if changes in the river flow patterns or water quality led to higher treatment costs for wastewater discharges. Using results produced by the water quality team to simulate possible future conditions, the preliminary findings indicate that while more robust wastewater treatment would be expected as discharge volumes increase over time, minimal impacts are anticipated for major wastewater dischargers in the region.

- **Municipal and Industrial Demands in Region L.** A primary driver for the project is to meet the future need for municipal water in the San Antonio and greater Bexar County region as described in SAWS 2005 Water Resources Plan (SAWS 2005). In order to value the economic benefit to SAWS' customers of the water provided by the LSWP, economists ask the question: What quantity of water would be obtainable for the typical SAWS customer if the water from the LSWP were not available and how does this compare to their desired quantity? Absent the LSWP there would be a shortage because the quantity demanded would be greater than the quantity available. This shortage would be larger during the very hot and dry years because water demands go up when temperatures are relatively high and precipitation is relatively low. In economics, the concept of a benefit is the amount the rational consumer is willing to give up rather than forego consumption. Usually, this "willingness to pay" is measured in dollars. Many factors are considered in such an analysis including project yield, consumption patterns, expected population, etc.

3.12 Other Studies

The project's study period plan identified studies required to determine the feasibility of the project and support permitting requirements. While comprehensive, the plan was also designed to be flexible to allow for new studies based on results of the programmed studies as well as those recommended through the public and scientific review processes. During 2006, two additional studies were added to the suite of assessments for the project including additional water quality analysis near the mouth of the river and a waterfowl and wildlife evaluation. Two additional studies are planned for 2008.

- **Wildlife and Waterfowl Study**. The wildlife and waterfowl study is discussed in Section 6.3 of this PVA.
- **Water Quality Study of Tidally Influenced Reach of the Colorado River with Respect to Impacts to the South Texas Project Diversion Study.** This study is investigating the potential changes in water quality (i.e., salinity) due to changes in the timing and amount of flow coming over the Bay City Dam that the South Texas Project may be able to divert in the future, if the LSWP were to be implemented. Water available to the plant includes diversions of both run-of-river water rights and stored water releases from LCRA.
    - **Study Focus in 2007.** The focus of the LSWP's South Texas Plant study was to understand the daily availability of water to the plant both with and without the project in place, given a combination of restrictions and other guidelines. The analysis did not consider on-site reservoir operations; rather, water availability from the river was the focus.
    - **Preliminary Results.** Based on the water availability simulations for the 95,000 acre-feet per year yield scenario, the preliminary results indicate that if the South Texas Project's current operational protocols and limitations are used, the plant would be able to divert water (from both sources of water previously identified) about 1 percent less often with 2030 demands and a little over 3 percent less often with 2080 demands, during the entire period of historical record. During the drought of record conditions, the model predicted that the South Texas Project's pumping

would potentially be reduced by 11.5 percent with 2080 demands, considering all restrictions and the guidelines that aid the South Texas Project in diverting low saline water. If the plant's operational guideline that aids diversion of lower saline water is not applied more water is potentially available to the South Texas Project during the period of record and only slightly lower (about 1 percent less water is available) during the drought of record with 2080 demands. The second phase of the study will assess potential changes in salinity during lower flow periods that could result from the project.

- **New Studies for 2008.** Through the public input processes, additional studies were suggested by the public and the science review panel. These include an evaluation of the potential implications of climate change on the project as well as an assessment of uncertainty associated with the various studies. The two studies are planned to begin in earnest during 2008.

3.13 Additional Detailed Study Results

This report summarizes key aspects of the various studies including methodologies, accomplishments to date and highlights of the results and findings. More information and detailed reports and technical memoranda can be found at the following Web site locations.

www.lcra.org/lswp

www.saws.org