

Chapter 18

**Programmatic Evaluation of a
Groundwater Banking/Exchange Component
to the Freeport Regional Water Project**

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Background

As fully documented in Volume 2, Appendix B, “Alternatives Screening Report,” groundwater banking and exchange in the Sacramento area does not constitute a feasible stand-alone alternative. To implement such a program, facilities such as those contemplated as part of the FRWP or similar facilities would be required to allow the surface water diversions needed to make such a program physically capable of being implemented. As also fully documented in the Alternatives Screening Report, there are major institutional and legal issues that must be resolved before it would be feasible to implement a groundwater banking and exchange program within Sacramento County. These issues make the addition of a groundwater banking or exchange component to the FRWP infeasible at this time.

As discussed in the Alternatives Screening Report, over the past several years, Sacramento-area interests have been undertaking various investigations as to the feasibility of implementing groundwater banking and exchange programs. One groundwater banking program has been placed into limited service north of the Lower American River. The purposes of these processes are varied and each of the efforts is in very preliminary stages at this point.

In addition, FRWA received a small number of comments during the scoping process suggesting that a groundwater banking program be addressed in the EIR/EIS process (Volume 2, Appendix E, “Public Scoping Report”). The primary focus of these comments was to suggest that FRWA determine whether implementation of a groundwater banking element or program would meaningfully reduce water supply and water quality changes to downstream waterways and water users (see Chapters 3 and 4) that may result from implementation of the FRWP.

Based on this information, FRWA has determined that, although groundwater banking and exchange is not a feasible alternative to the FRWP, some further discussion of groundwater banking and its potential benefits and impacts is

appropriate for inclusion in this EIR/EIS. The discussion below is drawn from information contained in Volume 2, Appendix F, “Wet Year/Groundwater Storage Conceptual Alternative—Programmatic Evaluation.” As also documented in the Alternatives Screening Report, groundwater banking in San Joaquin County is clearly not a feasible alternative to the FRWP. Therefore, this discussion focuses on Sacramento County groundwater basins.

Groundwater Basins for Potential Storage and Recovery

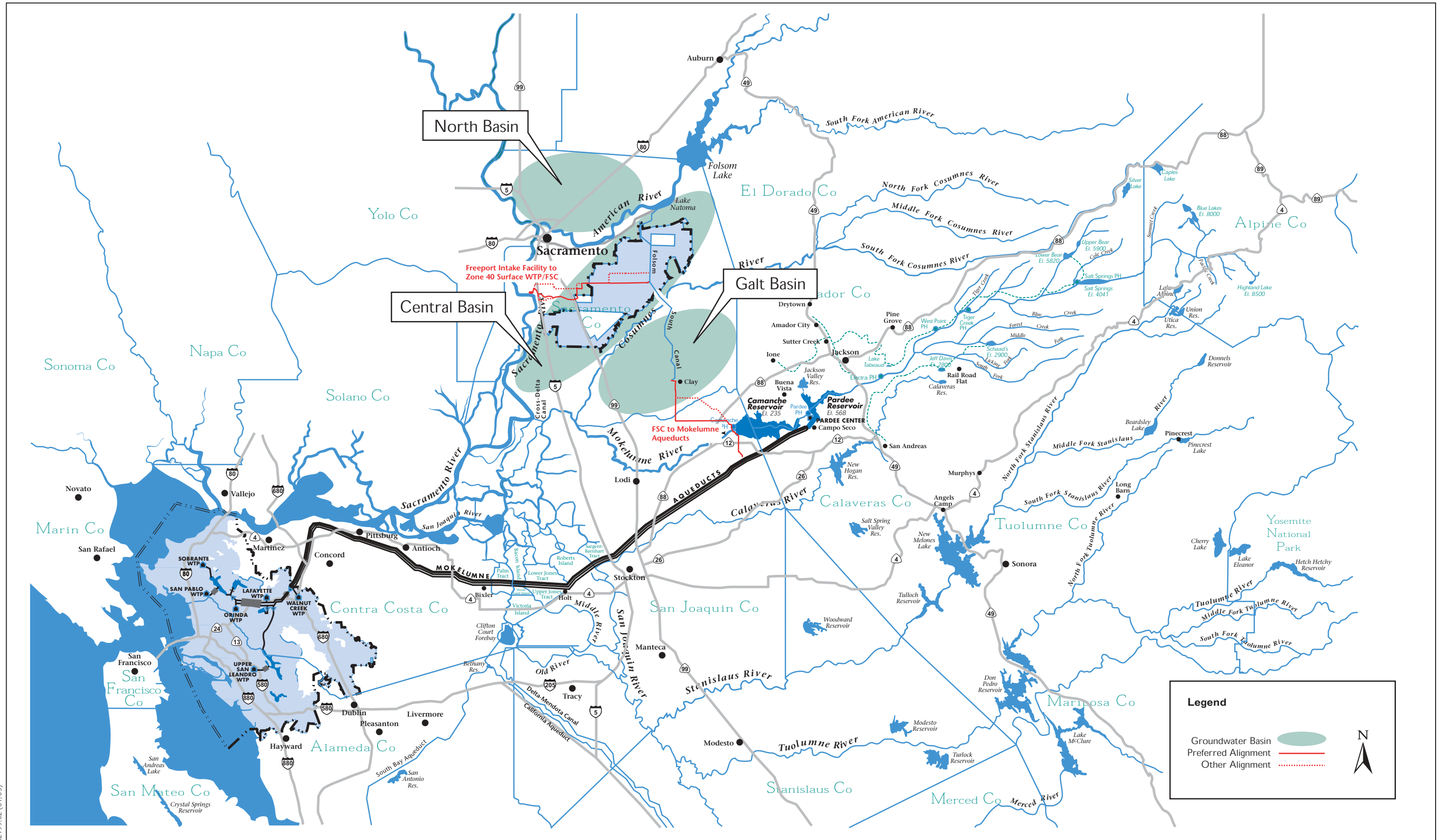
There are three groundwater basins in Sacramento County being considered within the context of the Water Forum for the long-term storage of surface water identified in this alternative: the North, Central, and Galt Basins. A brief summary of the available information for each basin is provided below. A map of each basin is presented in Figure 18-1. For purposes of this analysis, the areas being investigated within these groundwater basins will be as defined by the Water Forum in its 2001 Annual Report. Several key factors apply to these each of these basins because of their specific location.

North Basin

Within Sacramento County, the North Basin is generally bounded by the American River to the south and east, the Sacramento River to the west, and the county line to the north. The basin itself extends into Placer County where it is bounded by the Feather River on the west, the Bear River on the north, and the edge of the Sierra Nevada foothills on the east. DWR characterizes the groundwater quality as marginal in some portions of this basin. In the southern part of the basin, the groundwater is generally of good quality with moderate mineral content and low disinfection by-product concentrations, though some areas have elevated levels of minerals. The North Basin has three major known groundwater contamination sites: McClellan Air Force Base, the United Pacific Roseville Rail Yard, and the Aerojet Superfund site. The Aerojet site is located in the Central Basin, but its contamination plume extends into the North Basin.

Historical extractions from this basin have greatly exceeded natural and artificial recharge. DWR estimated the natural recharge to be 83,800 AFA, and artificial recharge of 29,800 AFA. Annual extraction was estimated to be 399,000 AFA for urban and agricultural uses. The Water Forum has estimated the sustainable yield of this of the North Basin to be 131,000 AFA. The North basin is in an overdraft condition. The North Basin has existing groundwater banking programs in place with the Placer County Water Agency and two local water districts. The quantity of water banked in the North Basin through this artificial recharge totals 29,800 AFA.

The Sacramento North Area Groundwater Management Authority (recently renamed Sacramento Groundwater Authority [SGA]) was created in 1998. This



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Figure 18-1
Groundwater Basins

joint powers authority is responsible for the protection of the regional groundwater basin, and is comprised of sixteen public and private water agencies, including the City of Sacramento and SCWA.

Central Basin

The Central Basin underlies the area from the Lower American River to the north, the edge of the Sierra Nevada foothills to the east, Cosumnes River to the south, and the Sacramento River to the West. Groundwater is typically a calcium magnesium bicarbonate or magnesium calcium bicarbonate groundwater. TDS ranges from 24-581 mg/L, with an average of 221 mg/L.

There are seven major known groundwater contamination sites in the Central Basin Area. They include three Superfund sites: Aerojet, Mather Field, and the Sacramento Army Depot. The other sites include the Kiefer Boulevard Landfill, an abandoned PG&E site in Old Sacramento, the inactive Rancho Cordova Test Site located just south of Aerojet, and the Southern Pacific and Union Pacific Rail Yards near downtown Sacramento. Central Basin inflows historically total approximately 257,000 AFA. Extraction rates have been estimated to be approximately 230,000 AFA for urban and agricultural uses. The Water Forum has estimated the Central Basin annual sustainable yield to be 273,000 AFA.

The Water Forum has formed the Central Sacramento County Groundwater Forum in partnership with DWR and the California Center for Public Dispute Resolution. This forum was assembled to develop a management plan to protect available groundwater supplies and quality. Most recent estimates by the Central Sacramento County Groundwater Forum for completion of the Negotiation Phase, including deciding on an Action Plan for Implementation, is June 2004.

There are no known artificial banking programs in the Central Basin. The basin is not generally considered to be in an overdraft condition, but portions of the Basin (e.g., Elk Grove area) have significant cones of depression in the groundwater table.

Galt Basin

The Galt Basin Area lies to the South of the Central Basin, and generally extends from the Cosumnes River south to the County line. The basin itself extends into San Joaquin County to the south and Amador County to the east. Available information about the Galt Basin is limited. Groundwater level trends since the 1980s have shown declines followed by recoveries in groundwater levels, except in the eastern portion of this basin. TDS levels in the 20 water supply wells ranged from 140–438 mg/L, with an average of 218 mg/L. There appear to be no known major contamination sites.

Basin inflows have historically exceeded extraction rates. Natural and applied water recharge rates have totaled approximately 269,000 AFA. Urban and agricultural extractions have totaled approximately 129,000 AFA. The difference indicates the quantity of subsurface outflows to surface water and to other groundwater basins. The sustainable yield of the Galt Basin has been estimated to be 115,000 AFA.

There are 13 separate water agencies actively involved in utilizing groundwater in the Galt Basin. The Sacramento Metropolitan Water Authority filed a Notice of Intent in 1994 to adopt an AB 3030 plan for the Omochumne–Hartnell, Galt Irrigation District (ID), Clay Water District (WD), and the City of Galt. These agencies subsequently drafted a joint powers agreement (not including the City) to work cooperatively on water resources issues. However, a formal AB 3030 plan was never prepared. During 2002, these agencies decided to create the Southeast Sacramento County Agricultural Water Authority (Authority), and formally organize their activities. This Authority has the ability to manage water resources within the three agencies service areas, but not throughout the basin. The ability of the Authority to implement a groundwater banking project is unknown, due to their very recent creation; and the lack of a collaborative stakeholder process, as proscribed in the Water Forum Agreement, has limited the potential implementation of a banking and exchange program. This process would have to be undertaken in order to clearly define the parameters within which such a program could be developed.

Regulation of Groundwater Storage and Recovery

Three state regulatory agencies have authority over groundwater banking and exchange programs. They are the RWQCB, the SWRCB, and the Department of Health Services (DHS). The State Resources Agency (including DWR) is also an important source of information. The agency roles, responsibilities, and potential involvement are further described below. Various other permits would likely also be required from other jurisdictions or agencies, depending on the specific program.

Regional Water Quality Control Board

The Central Valley Region RWQCB is responsible for the preparation and adoption of Basin Plans, enforcement of the Clean Water Act and the California Water Code. The Basin Plans designate beneficial uses for the waters within the basin, their water quality objectives, and identify strategies to attain these objectives. All groundwater in Sacramento County is considered to be suitable for a municipal or domestic water supply, agricultural supply, industrial service supply, and industrial process supply.

Each Basin Plan in Sacramento County incorporated the maximum contaminant level water quality objectives as defined in Title 22 of the California Code of

Regulations. These objectives include limiting coliform concentrations to below 2.2 most probable number (MPN)/100 ml, and waters free from taste- or odor-producing substances, and radioactivity. The RWQCB also has a nondegradation policy, such that any new supply of water recharged into the basin must not degrade the existing groundwater basin. Any project proposing to store surface waters in the groundwater basins will be required to obtain a permit from the RWQCB for the design, operation, and construction of all facilities.

State Water Resources Control Board

The SWRCB has jurisdiction over the RWQCBs. In addition, the SWRCB has jurisdiction over the surface water rights that would be an essential element of any groundwater storage program. The SWRCB would be responsible for approving any changes in places of use, purposes of use, or points of diversion that would be required to implement a groundwater banking program.

Department of Health Services

The DHS regulates the operation of potable and recycled water systems; issues operating permits for these facilities; reviews plans and specifications for new facilities; enforces existing laws and regulations, including the Safe Drinking Water Act; and reviews water quality monitoring results. Furthermore, the DHS also conducts source water assessments, and evaluates projects utilizing injection and extraction into potable groundwater basins.

For any groundwater storage concept, the DHS would be heavily involved in the conceptual design and planning of all water treatment facilities. The DHS would primarily defer to other regulators for all nontreatment-related issues, except those related to the impact of long-term storage of treated surface waters in the groundwater basin. These issues include the following:

- “Bubble” formation: how close does the injected water “bubble” come to impacting the surface, and where does it migrate?
- Would the extracted water be retreated?
- What is the proximity of the stored water to known contamination sites?
- The impact of long-term storage on existing groundwater, e.g. presence of THMs.

These issues would need to be resolved with DHS prior to the approval to operate any groundwater program. The DHS would also need to approve the design of any treatment facilities. Water quality requirements for injected and extracted water would likely be addressed by a combination of the DHS and RWQCB.

The Department of Water Resources (State Resources Agency)

The State Resources Agency includes DFG, the Coastal Conservancy, and other resource-oriented departments, including the DWR. DWR prepares the State Water Plan (Bulletin 160); manages and operates the State Water Project; assists in monitoring the State's water resources; and protects, restores, and enhances the natural and human environments. In relation to groundwater, the DWR prepares the Bulletin 118 report, which defines the existing conditions of each basin.

The DWR monitors groundwater levels in approximately 2,000 wells in central California. This tracking has shown that groundwater levels in the North Basin are steadily decreasing. Water levels in the Galt Basin have largely recovered to their 1980 levels, and there is no consistent pattern in the Central Basin, although some decreases have been measured and the Elk Grove area has experienced significant groundwater level declines. The DWR is studying several areas in the lower Sacramento Valley where conjunctive use operations may be possible. It appears that the State Resources Agency is an interested party, but not a permitting agency with respect to water transfer, exchange, or conveyance, with the exception of construction permits such as Streambed Alteration Agreements with the DFG.

Other Agency Jurisdiction

At this time, there are no additional agencies with known jurisdiction or permitting authority over a groundwater banking program, other than those already having jurisdiction over the FRWP.

Institutional Issues

Several institutional issues would need to be resolved prior to implementation of any groundwater banking program. These questions include:

1. Is there a legislative or legal framework for groundwater storage and recovery of stored groundwater?
2. Can a groundwater bank be implemented?
3. What is the level of control over groundwater overpumping by overlying agencies and pumps?
4. Would EBMUD be allowed to export stored groundwater out of Sacramento County?
5. Is there a strong local authority with clear boundaries and sufficient powers to partner?

6. Does local/regional consensus desire exist for implementation of a groundwater storage project?
7. What is the ability to avoid potential injury to existing groundwater users?

These questions are addressed in Table 18-1. This institutional analysis describes the institutional feasibility of the FRWP along with possible groundwater banking programs in the North, Central, and Galt Areas.

Table 18-1. Institutional Analysis—Degree of Feasibility for FRWP and Alternative Concepts for Groundwater Storage

Issue	FRWP	North Area	Central Basin	Galt Basin
1. Legislative/legal framework for groundwater storage and recovery of stored groundwater	YES. Zone 40 Master Plan is consistent with water forum solution.	YES. Appendix 66 of State Water Code allows it in Sacramento County.	YES. Appendix 66 of Water Code allows it in Sacramento County.	YES. Appendix 66 of State Water Code allows it in Sacramento County.
2. Implement-ability of a groundwater bank	YES. Zone 40 Master Plan is consistent with Water Forum solution.	YES. Pilot water banking projects demonstrate potential feasibility of establishing long-term project.	YES. Conjunctive use of groundwater basin in Zone 40 contemplated in Water Forum solution; banking and exchange (B/E) not explicitly stated; Groundwater Forum is vehicle to address B/E in Central Basin.	Not Yet Clear. Joint Powers Authority formed, but not bank. Pilot projects needed. Will take three years to determine.
3. Control of groundwater overpumping by overlying agencies and pumpers	YES (incomplete). Sacramento County has legal authority to establish regulatory controls over pumping in all basins, including Zone 40 area, but has not yet exercised or delegated that authority.	YES (partial). Although basin not adjudicated, Sacramento Groundwater Authority (JPA) has some authority, but expressly provided that it will control only with economic incentives.	YES (incomplete). Although basin not adjudicated, Sacramento County has clear authority in Zone 40, but has not exercised or delegated that authority. EBMUD's stored water could be protected if there were an allocation of groundwater storage to existing users and a mechanism for enforcing those limitations (not yet in place).	YES (incomplete). Groundwater Management Plan established at a preliminary level. Full Basin Management Plan not yet in place. Sacramento County has authority but not yet delegated that authority.

Issue	FRWP	North Area	Central Basin	Galt Basin
4. Ability to export stored groundwater out of Sacramento County to EBMUD	N/A	Not yet clear. AB 3030 plan not yet in place (required for export per Water Code Section 1220). No known political obstacles. Pilot to export not yet done. Two to five years to establish necessary framework.	NO. No AB 3030 Plan in place (required for export, per Water Code Section 1220). Political support for exports uncertain. Central Groundwater Forum started. County Ordinance passed in 2000, Title 3, Chapter 3.40.090 authorizes Director of Water Resources to issue permit to export groundwater and surface water. Probably will take 5 to 10 years to establish necessary framework to implement groundwater export.	NO. Groundwater Management Plan established at preliminary level, but no AB 3030 specific authority for exports (required for groundwater export per Water Code 1220). Collaborative stakeholder process not yet begun to extent contemplated in Water Forum. Probably will take 5 to 10 years to establish necessary framework to implement groundwater export.
5. Presence of strong local authority with clear boundaries and sufficient powers to partner	N/A	Not Likely. Can partner but does not yet have enforceable program acceptable internally to JPA to make partnering likely.	Partial YES. SCWA is strong local authority, has established service area. Has powers to partner. Deferring to Groundwater Forum (GWF) process for comprehensive plan for governance. FRWA not yet a formal stakeholder.	Not Yet Clear. JPA formed. Partially staffed. Clear boundaries. No collaborative process yet started.
6. Local/regional consensus that groundwater storage project is desirable	YES. Consistent with Water Forum solution.	YES	NO. Not yet explored within County. Due to large number of farmers and other institutions affected, probably will take one to two years to determine with full time vetting; validation through GWF process (two to five years).	NO. Preliminary exploration in 1998. Not yet explored within community. Due to large number of farmers within three districts, probably one to two years with full-time vetting. Collaborative stakeholder process still needed.
7. Ability to avoid potential injury to existing groundwater users	YES. Zone 40 Master Plan developed to accomplish this objective.	Not Clear. Basin is relatively small (131,000 af); may not be sufficient to do additional banking.	Not Clear. Basin may be large enough to bank SCWA water during wet year diversions, but detailed modeling needed to verify. Basin not large enough to bank both agencies water through injection and extraction without large water level fluctuations (50 feet or more).	Not Clear. Basin may be large enough to bank EBMUD water during wet year diversions, but detailed modeling needed to verify.

Feasibility of Banking/Exchange in North Area

Banking in the North Area is already established institutionally and several pilot projects have been undertaken. Staff at SGA have indicated that FRWA could buy up to 40,000 AFA from SGA. However, FRWA is not part of SGA, and there are significant institutional obstacles to implementation of a reliable water supply project dependent on banking and exchange with the north area, summarized as follows:

- SGA has not yet set a baseline for groundwater pumping for its member agencies in the basin, so there is not a reliable baseline for existing and future conditions of the baseline upon which FRWA could depend.
- SGA is composed of 15 independent agencies, and the JPA for the North Area expressly identifies that local control of groundwater resources will remain in the hands of the local agencies and control of pumping will be exercised through economic incentives and disincentives. Because the missions of the local agencies do not necessarily parallel those of FRWA, FRWA cannot yet rely on the as yet unestablished incentives and disincentives and a unanimous vote of 15 independent agencies.
- Because SGA has not developed an enforceable groundwater banking program to ensure water deliveries, partnering with SGA for a Banking/Exchange project as a component of the FRWP is not feasible at this time (see Issue No. 5 in Table 18-1).

Feasibility of Banking/Exchange in Central and Galt Areas

While groundwater banking in the Central Basin and Galt Basin is technically feasible, the establishment of a groundwater management plan for the Central Basin has only recently begun under the Groundwater Forum process. The Collaborative Stakeholder process is quite extensive and will take several years to develop its ultimate product of a “solution package and implementation plan” (from the Negotiation Phase, currently underway), a basin management plan, and a framework for governance. A similar and parallel process for the Galt Basin is also contemplated under the Water Forum Agreement but has not yet begun. Therefore, for institutional reasons, it is not feasible to implement either scenario at this time.

Program Timing

The progress and current status of the North Area Groundwater Bank is indicative of the complexity of establishing a groundwater management program and generally describes the effort that would be required to establish programs in the Central and Galt basins (see Table 18-2).

Table 18-2. Comparison of Status of Groundwater Management Efforts in North Area with Central and Galt Areas

	North Area	Central Area	Galt Area
Organizational Infrastructure	Formed SGA to Manage Basin; formed Regional Water Authority (RWA) to provide regional forum for project development. Have full-time Executive Director and consultants providing staff support.	SCWA is in place, but not yet organized for banking. SCWA is participating in GWF process to develop a basin management plan.	JPA of Omochochumne-Hartnell, Galt ID and Clay ID; no full-time staff or consultants working for JPA. Water Forum contemplates developing a Galt Basin management plan, but it has not yet begun.
Delivery Infrastructure	Pipeline in place to deliver American River water for recharge.	None. FRWP would provide delivery pipelines and treatment to enable banking.	None. FRWP would provide delivery pipelines to enable banking
Pilot Projects	Completed two pilot projects; SAFCA with Reclamation and Storage for the Environmental Water Account	None. Some feasibility investigations done.	None
Funding Status	Raised \$2 million; obtained \$22.5 million construction grant for facilities.	None for groundwater bank.	None

For the North Area groundwater program to reach the stage described in Table 18-2 required three to four years of efforts by the Water Forum stakeholders and others. It is estimated that it will take the North Area another five years to establish a long-term program that could accommodate outside participants. For the Central Area, because they have begun the collaborative process through the Central Sacramento County Groundwater it is estimated that it will take nearly two years to reach the end of the negotiation phase, and another seven years to have an established plan and long-term program for a total of approximately nine years. For the Galt Area, it would be estimated to take about five years within a process like the Groundwater Forum Process to progress to where the North Area was when they formed the organizational infrastructure and began to implement the banking program, and another five years to get to an established plan and long-term program, for a total of 10 years.

Once a plan and program are in place, a project could be developed and a public/environmental documentation process could be commenced. To meet the project objectives of delivering water supplies to SCWA and EBMUD by 2008, the wet year/groundwater storage alternative cannot be implemented in place of the FRWP. Rather, implementing FRWP enables the future implementation of such a plan.

General Description of Groundwater Banking Component

For purposes of this programmatic analysis, the groundwater banking component assumes the diversion of both EBMUD and SCWA water primarily in wet and above normal years from the Sacramento River at Freeport through facilities essentially identical to those described for the FRWP alternative. The SCWA water would be treated at the Zone 40 Surface WTP and distributed throughout its service area in Zone 40 to demand points and to injection wells near the existing and planned extraction wells. During dry, below normal, and normal years, most demands in Zone 40 would be met through groundwater, stored surface water and other (non-FRWP) surface water. EBMUD water would be conveyed to the FSC for conveyance to the Galt Area for in lieu recharge and percolation. Subsequent extraction would be managed as proposed for Scenario 2 as well.

This analysis evaluates shifting surface water diversions as much as possible from the dry and critical years to the wet and above normal years. This analysis is intended to provide for evaluation of the greatest possible minimization of water supply and environmental effects during drier years.

The overall amount of surface water assumed to be diverted by EBMUD and SCWA for direct storage or in lieu of recharge is the same as for the FRWP alternatives. However, it is assumed that only 90% of the water injected can be extracted. This is because recharged (injected and percolated) water typically cannot be recovered completely; some moves away from the recharge area as groundwater flow and is no longer available for extraction. This analysis assumes that EBMUD would only extract stored surface water (and nonnative groundwater). This operational assumption would serve to minimize the potential of “injury” to other groundwater users in the Basin. Water Code 1220 prohibits the export of groundwater from the combined Sacramento and Delta-Central Sierra Basins, as defined by DWR Bulletin 160-74, unless the pumping is in compliance with a groundwater management plan adopted by the County or the portion of the County that overlies the groundwater basin. The boundaries of these protected basins include Sacramento County (including North, Central, and Galt areas).

Required Facilities

There is a wide range of possible approaches to facility construction and operation that could facilitate a groundwater banking/exchange component. In general, however, facilities would be needed to:

- divert surface water supplies,
- convey surface water supplies to the groundwater bank area,
- inject or percolate surface water supplies into the groundwater basin,

- extract groundwater, and
- convey the extracted water to its point of use.

For purposes of this programmatic analysis, the following assumptions are made:

- The FRWP would provide the surface water diversion and primary conveyance facilities;
- Surface water could be either actively injected through wells or percolated through large (approximately 300–500 acres) percolation basins;
- Some in-lieu recharge may also be incorporated;
- New extraction wells would be constructed; and
- Injection and extraction wells would be at different locations.

Depending on a variety of factors, the following general assumptions can be made:

- Approximately 200,000 feet of new, approximately 36-inch pipeline would be required;
- approximately 40 injection wells may be required;
- Up to 300–500 acres of percolation basins may be required;
- Approximately 20 extraction wells would be required; and
- Other appurtenant facilities would also be needed.

Based on these assumptions, the incremental cost of a groundwater banking component is on the order of \$100–200 million, in addition to the costs associated with the basic FRWP. There also do not appear to be substantial offsetting cost savings associated with a groundwater banking component.

Programmatic Assessment of Potential Environmental Effects Associated with a Groundwater Banking Component

As noted above, no detailed plans are available for a groundwater banking component, and there is a wide range of potential facilities and facility locations that could be conceivably be implemented at part of such a component. However, as noted above, some assumptions can be made regarding the general type and location of such facilities. Based on that information, a general discussion of potential environmental effects is provided below. The discussion focuses on the potential incremental effects of adding a groundwater banking component to the FRWP, where appropriate. It is important to note that actual site-specific impacts would need to be addressed in a subsequent environmental

assessment document if and when a specific project has been identified and appropriately defined.

Hydrology, Water Supply, and Power

Table 18-3 provides results of hydrologic modeling conducted for this programmatic analysis. In terms of the net changes to the availability of water to downstream water users, and the overall system storage in the CVP and SWP systems, the FRWP with a groundwater banking/exchange component does not vary considerably from the FRWP, or from the No Action Alternative.

CVP deliveries to users north of the Delta are largely unaffected. CVP deliveries to users south of the Delta were slightly higher with a groundwater banking/exchange component, primarily in dry years, but this difference was very minor (approximately 0.7%). SWP total deliveries reflect similar results.

The overall maximum and minimum change to the X2 position throughout the entire simulation was virtually unchanged.

As shown in Table 18-3 the effects of adding a groundwater banking/exchange component to the FRWP are generally beneficial, but very slight. It should be noted that the modeling for this analysis was conducted using a slightly earlier version of CALSIM II than the FRWP alternatives analysis. The differences between the model versions are minor, and any differences in results for comparative purposes are negligible.

Table 18-3. Comparison of Downstream Delta Effects of FRWP Base Project and Wet Year/Groundwater Storage Scenarios to 2001 CALSIM Baseline (No Project under FRWP)

Parameter	Freeport Regional Water Project				Freeport Regional Water Project with Conjunctive Use Element ¹			
	No-Action Alternative		Proposed Project		No-Action Alternative		Conjunctive Use	
Water Year	All Years	Dry Year ²	All Years	Dry Year ²	All Years	Dry Year ²	All Years	Dry Year ²
Tracy Pumping (af) ³	2,299,000	1,626,000	2,302,000	1,636,000	2,256,000	1,662,000	2,255,000	1,662,000
North of Delta CVP Storage (af) ⁴	4,469,000	3,098,000	4,444,000	3,043,000	4,315,000	2,343,000	4,306,000	2,348,000
Oroville Storage (af) ⁵	2,100,000	1,528,000	2,100,000	1,662,000	2,063,000	1,505,000	2,072,000	1,506,000
CVP Total Deliveries— North (af) ⁶	2,209,000	1,959,000	2,209,000	2,067,000	2,199,000	1,959,000	2,201,000	1,958,000
CVP Total Deliveries— South (af) ⁶	2,516,000	1,646,000	2,513,000	1,641,000	2,441,000	1,643,000	2,441,000	1,644,000
SWP Total Deliveries (af) ⁶	2,945,000	1,934,000	2,942,000	1,946,000	2,980,000	1,946,000	2,978,000	1,951,000
Maximum and minimum change in X2 position (km) ⁷	89.7 km—Nov 1993		89.7 km—Oct 1932		89.7 km—Oct 1932		89.7 km—Oct 1932	
	42.0 km—Apr 1983		42.0 km—Apr 1983		42.0 km—Apr 1983		42.0 km—Apr 1983	

Notes:

- ¹ This analysis was conducted with the October 29, 2002, official release of CALSIM II. The results would be essentially identical if the analysis was conducted using the March 2003 version of CALSIM II, although individual values may vary.
- ² Dry years were modeled as the 1928–1934 Water Years.
- ³ Tracy Pumping is measured at the Tracy Pumping Plant.
- ⁴ Based on the sum of storage within the Trinity, Shasta, and Folsom Reservoirs during September.
- ⁵ Average September Oroville storage during the 73 year simulation.
- ⁶ Total Deliveries during water year (October–September).
- ⁷ X2 is measured as the distance away from the Golden Gate Bridge. It was not assumed to be accurate to a level of detail less than 0.5 km. The values presented here are the maximum and minimum distances for the duration of the simulation.

Modeled period was the historical runoff from WY 1922–1994. Average period during that period listed

Source: data provided by CH2M Hill, 2002 and 2003. All modeling is based on the 2001 hydrology.

Water Quality

Table 18-4 shows the results of water quality modeling conducted for this analysis. The analysis uses CCWD’s g-model. Based on this model, the average change in chloride concentration at Rock Slough would be 0.3 mg/l. The maximum increase in chloride concentration is 10 mg/l, while the maximum decrease in chloride concentration is 8 mg/l. The standard deviation is 1.4 mg/l.

At Jersey Point, changes in salinity typically are described in terms of electrical conductivity. The average change in electrical conductivity would be 2.4 : S/cm.

The maximum increase in conductivity is 150 : S/cm, while the maximum decrease is 73 : S/cm. The standard deviation is 14.4 : S/cm.

Table 18-4 also compares the g-model results for the FRWP with the g-model results for the FRWP with an additional groundwater banking/exchange component. As clearly demonstrated in the table, there is no substantial difference between the results. The addition of a groundwater banking/exchange component does not result in substantial reduction in the minor water quality effects of the FRWP.

Table 18-4. Summary of Chloride and EC Differences at Selected Delta Locations

	FRWP Alternative		FRWP with Groundwater Banking/Exchange	
	Rock Slough Cl (mg/l)	Jersey Point EC (: S/cm)	Rock Slough Cl (mg/l)	Jersey Point EC (: S/cm)
Average	0.3	2.4	0.3	2.4
Minimum	-4.2	-48	-7.7	-73
Maximum	9.8	126	10.4	150
Std. Deviation	0.9	10.1	1.4	14.4
No Action Range	36–234	208–2189	36–234	208–2189

Fisheries

The effects of the FRWP are very minor on all fish species. There is no evidence to suggest that increasing the proportion of surface water that is diverted during wet years and during wet periods would reduce the minor impacts on fish described in Chapter 5. In addition, fish abundance can also be higher near the intake facility during wetter years, potentially increasing the number of fish exposed to the risk of entrainment.

Recreation

No incremental effects on recreation are anticipated.

Vegetation and Wetland Resources

The facilities required for conveyance and groundwater recharge would include pipelines, injection wells, extraction wells, and potentially percolation basins. The construction of such facilities has the potential to temporarily affect vegetation and wetland resources in ways similar to those described in Chapter 7,

depending on facility locations. It is assumed that most facilities could be sited to avoid or minimize effects on vegetation and wetland resources. The percolation basins, if implemented, would have the greatest potential to affect vegetation and wetland resources because of the large amount of land disturbance involved, and because the percolation basins would be actively managed, thereby preventing the reestablishment of natural vegetation.

Wildlife

The facilities required for conveyance and groundwater recharge would include pipelines, injection wells, extraction wells, and potentially percolation basins. The construction of such facilities has the potential to temporarily affect wildlife in ways similar to those described in Chapter 8, depending on facility locations. It is assumed that most facilities could be sited to avoid or minimize effects on these resources. The percolation basins, if implemented, would have the greatest potential to affect wildlife because of the large amount of land disturbance involved, and because the percolation basins would be actively managed, thereby preventing the reestablishment of natural vegetation. Certain wildlife species, however, may benefit from operation of the percolation basins.

Geology, Soils, Seismicity, and Groundwater

Construction associated with a groundwater component would not be expected to have any effect on geologic conditions. The areas under consideration are relatively flat and generally not subject to unstable conditions.

Facilities would be sited in areas that are currently agricultural. As described in Chapter 9, soils in this area are generally productive, and construction and operation of the facilities would require the conversion of a relatively small amount of land to nonagricultural uses.

The area is not considered to be highly active seismically, but facilities would be subject to potential damage from earthquakes. This risk is considered very slight, and standard engineering design practices would minimize such risks.

Generally, operation of a groundwater banking component would be expected to result in higher average groundwater levels. Operation of a groundwater bank would also likely result in greater annual fluctuations of groundwater levels as compared to existing conditions. This effect is considered beneficial.

Land Use

The incremental effects associated with a groundwater banking component would be expected to be minor. As discussed above, minor changes in land use may result from construction and operation of conveyance, recharge, and

extraction facilities. These facilities are generally similar to other facilities in the area and with agricultural land uses. Therefore, these facilities would not be expected to result in substantial effects beyond those described in Chapter 10.

Agricultural Resources

The incremental effects associated with a groundwater banking component would be expected to be minor. It is anticipated that relatively minor losses of agricultural land would result from the construction and operation of facilities. Effects are dependent on the actual location of facilities and would require further analysis. These facilities would not be expected to result in substantial effects beyond those described in Chapter 11. Potential effects include slight increases in temporary and permanent loss of croplands.

Transportation and Circulation

The incremental effects associated with a groundwater banking component would be expected to be minor. Construction of facilities would be expected to have minor effects on traffic and transportation similar to those described in Chapter 12 but at different and additional locations. Potential effects include minor and temporary disruptions to area roadways and circulation patterns.

Air Quality

The incremental effects associated with a groundwater banking component would be expected to be minor. Construction of facilities would be expected to have minor effects on air quality similar to those described in Chapter 13 but at different and additional locations. Potential effects include minor and temporary increases in emissions related to construction equipment and activities.

Noise

The incremental effects associated with a groundwater banking component would be expected to be minor. Construction of facilities would be expected to have minor effects on noise similar to those described in Chapter 14 but at different and additional locations. Potential effects include minor and temporary increases in noise related to construction equipment and activities.

Public Health and Safety

The incremental effects associated with a groundwater banking component would be expected to be minor. Construction of facilities would be expected to have minor effects on public health and safety similar to those described in

Chapter 15 but at different and additional locations. Potential effects include the possibility of encountering undocumented sources of contamination during construction.

Visual Resources

The incremental effects associated with a groundwater banking component would be expected to be minor. Construction of facilities would be expected to have minor effects on visual resources similar to those described in Chapter 16 but at different and additional locations. Potential effects include introduction of new constructed elements to the landscape. These elements could potentially include pumping plants, wells, and percolation basins. However, these facilities are generally consistent with the local environment and would not likely be considered a detriment.

Cultural Resources

The incremental effects associated with a groundwater banking component would be expected to be minor. Construction of facilities would be expected to have minor effects on cultural resources similar to those described in Chapter 17 but at different and additional locations. The area contains known and likely contains unknown historic and archeological sites. It is anticipated that facilities could be sited to avoid known facilities. However, the potential for impacts on currently undiscovered sites would remain. Appropriate construction management techniques and preparation of a cultural resource discovery treatment plan would minimize the potential for significant effects.

Conclusion

Based on the information presented in Volume 2, Appendix B, “Alternatives Screening Report,” and the additional analysis above, the following conclusions can be made:

- While groundwater banking is viable conceptually and technically, there is no existing or near-term reasonably foreseeable groundwater banking program that could be implemented as a component of the FRWP.
- Opportunities for groundwater banking as a component of the FRWP are largely limited to the Central and Galt basins.
- There are substantial institutional, legal, environmental, and operational issues that must be resolved before groundwater banking in the Central and Galt basins could be considered feasible.
- Implementation of any groundwater banking program in the Central or Galt basins would require construction of surface water diversion and conveyance

facilities essentially the same as those proposed under the FRWP and would therefore not reduce impacts associated with those facilities.

- Implementation of any groundwater banking program in the Central or Galt basins would require construction of the surface water diversion and conveyance facilities as proposed for the FRWP, and the construction of additional conveyance, recharge, injection, and extraction facilities not already proposed for the FRWP.
- Implementation of a groundwater program would result in small reductions in the already minor effects on downstream water quality and water supply described in Chapters 3 and 4.

While groundwater banking in the Central Basin and Galt Basin is technically feasible, the establishment of a groundwater management plan for the Central Basin has only recently begun under the Groundwater Forum process. The Collaborative Stakeholder process is quite extensive and will take several years to develop its ultimate product of a “solution package and implementation plan” (from the Negotiation Phase, currently underway), a basin management plan, and a framework for governance. A similar and parallel process for the Galt Basin is also contemplated under the Water Forum Agreement but has not yet begun. SCWA will continue to investigate groundwater banking/exchange programs through the Central Sacramento County Groundwater Forum.