

**INTEGRATED REGIONAL WATER MANAGEMENT:
THE NEW DIRECTION IN CALIFORNIA**Steve Macaulay, P.E.¹Francis Borcalli, P.E.²**ABSTRACT**

Water resource planning is approached classically on a project-by-project basis, with an increasing trend towards multiple-benefit projects. Multiple-jurisdiction projects have been more the exception than the rule, largely due to a lack of shared interests, time lines, financing and other factors. Integrated regional water management (IRWM) is a recent phenomenon in California. This concept embodies the integration of a wide range of strategies, management tools and institutions to address water supply reliability, ecosystem enhancement, water quality and other natural resource issues. The IRWM focus is on addressing areas of common concern among a number of interests within a region, whether that region is defined by political, institutional or watershed boundaries. It has proven to be a successful strategy driven by development and population increases, a growing interest in protecting natural species habitat, and the need to diversify water supplies to strengthen water supply reliability for all uses.

This paper describes the evolution of IRWM, from successful programs initiated at the local level to endorsement of the concept for statewide use in the 2005 California Water Plan Update. The paper addresses how the State of California is encouraging IRWM at both the policy and funding levels. We provide an overview of current IRWM planning and implementation throughout California. The Yolo County IRWM Plan is a case study of a successful collaborative effort to enhance water supply reliability —quantity and quality— for urban, agricultural, environmental, and recreational uses while addressing a range of issues related to ecosystem enhancement, flood risk management, and recreation.

BACKGROUND, CALIFORNIA WATER DEVELOPMENT & MANAGEMENT

California is located on the west coast of the United States, and has a Mediterranean climate with warm dry summers and cool wet winters. Most of our rainfall is in northern California, and most of our population is in southern California. We have more than 9 million acres of irrigated farmland, and a population of 35 million people. The general location of the State of California is shown in Figure 1.

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Figure 1. Location of State of California, United States

Water Development

Water resources development has gone through significant changes in California over the past 150 years. Initial water projects were constructed by landowners or small communities to meet their needs: irrigation, gold mining and drinking water. As population increased in larger centers such as Los Angeles and San Francisco, larger projects were developed to bring domestic water supplies from hundreds of miles away. These large projects early in the 20th century were largely single purpose: to meet the needs of growing communities. Several decades later saw the development of multipurpose projects, largely for urban and agricultural water supplies but incorporating hydropower generation, recreation, flood control and fishery benefits. These projects – transferring water from east to west and north to south, were essential in the development of California’s economy and large urban areas.



Figure 2. California’s Developed Water Systems

California and much of the United States went through an environmental awakening beginning in the 1960s, resulting in a new “water ethic” and passage of many federal and state laws

providing a greater level of environmental protection as it related to water projects. The next major change came about as the result of a prolonged drought in California from 1987 through 1994.

Much of California's developed water supplies are withdrawn from the Sacramento-San Joaquin Delta, a tidal estuary east of San Francisco Bay at the confluence of the Sacramento and San Joaquin rivers. The drought seriously affected water supplies and the fisheries associated with the Delta. One of the consequences was greatly reduced water supply reliability to protect endangered fish species. Another was the development of market-based water transfers in response to the drought-induced statewide water supply crisis. Ultimately the drought and its impacts resulted in the creation of a comprehensive federal/state partnership, the CALFED Bay-Delta Program (CALFED), to deal with the water supply, quality, flood control and ecosystem problems of the Delta on a more comprehensive basis.



Figure 3. Sacramento-San Joaquin Delta

Growing Water Supply Reliability Concerns

But the development of CALFED did not address the growing water supply reliability problems in different regions throughout California. Each region has its own environmental conflicts, water supply reliability challenges for both agricultural and urban use, and increasing regulatory restrictions affecting discharges from wastewater treatment facilities. There are also conflicts between urban and agricultural uses.

California water development for most of the 20th century focused on providing a reliable backbone water distribution system – both in its initial construction and subsequent operational challenges. Early in the 1990s – forced by the multi-year drought and other challenges -- different regions began experimenting with more comprehensive ways of solving water and other resource problems. The early 1990s saw a much more explicit relationship between urban and agricultural water uses than California had recognized in the past. The creation of the Governor's Drought Emergency Water Bank saw the flow of \$100 million to farmers and more than 800,000 acre-feet of water from farms to cities in this large-scale, one year market reallocation experiment. There was a great deal of interest in large-scale agriculture-to-urban transfers, and a number of papers were presented at water conferences for several years during this period (including papers given at USCID and ICID conferences by one of the authors).

Those experiences formed one of the bases for developing the concept of integrated water management, recognizing that connecting urban and agricultural supplies in various ways could contribute to the water supply reliability of both uses.

The drought water bank was not the only example of a comprehensive regional approach. In 1996 one of the world's largest wholesale water agencies – the Metropolitan Water District of Southern California (MWD) – developed and adopted an Integrated Resources Plan. That plan was very comprehensive in nature, and expanded classic water planning to a broad array of water management options. A number of years of experience in implementing new conservation, recycled water and groundwater banking programs led to revisions of the plan in 2003. The 2003 plan set revised performance targets for conservation and recycled water use for the year 2020.

Integrated Regional Water Management

While the MWD plan was comprehensive in scope and geography, it covered many different watersheds with a “broad brush” approach. The next obvious approach was a focus at the watershed level. The Santa Ana Watershed Project Authority (SAWPA) developed a comprehensive program for management of water supplies and salinity that served as an important model of a successful regional partnership. The new approach SAWPA brought to the table is reflected in its name: a watershed approach to solving problems. This 2800 square mile watershed in southern California has a population of more than 5 million people. Over the past 50 years – and particularly in the past decade – this region has developed aggressive water management programs including artificial groundwater recharge, state-of-the-art water conservation and recycling programs, brine lines to manage salinity within the basin, desalination facilities, and injection wells along the Pacific coast to provide a hydraulic barrier to groundwater salinity intrusion. What makes this example unique is the cooperation of institutions within the basin, proving successful in setting aside litigation in favor of on-the-ground accomplishments. The region has also been very successful in acquiring several hundred million dollars of state and federal funds, largely due to strong regional institutions with common goals.

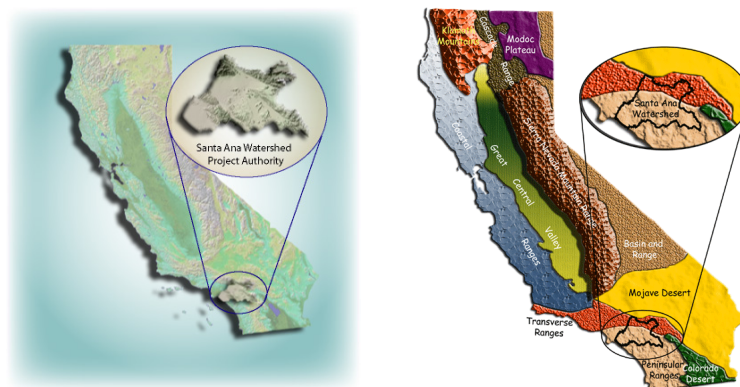


Figure 4. SAWPA location, Santa Ana River watershed

Throughout the 1990s it became increasingly clear that many of the actions needed to improve water supply reliability at the local level needed to be region-wide actions. A more formal Integrated Regional Water Management (IRWM) model came to be the new concept in advancing water resources management and development. It developed from a variety of successes and failures, at both the State and local level. In 2002 California voters approved a USD \$4.6 billion bond measure, Proposition 50, which for the first time encouraged the development of IRWM plans (IRWMP). “Integrated” was intended to apply to: (1) different types of water use, (2) a range of water resource management tools, (3) a range of resource categories in addition to water, and (4) a range of local and regional institutions. Regions were not defined in Proposition 50, leading to a trial-and-error approach of self-selecting regions by the participants of individual IRWMPs. The California Department of Water Resources (CDWR) developed guidelines for allocating bond funds, allowing any three entities to form their own region as long as at least two of the entities were public agencies. In mid-2005, CDWR allocated Proposition 50 bond funds for development of IRWMPs. Each self-defined region took a different approach, developing its own unique blend of geography, hydrology, resource conflicts and institutions. Proposition 50 provided funds for development of the plans (up to \$500,000 per plan), and also included more than \$400 million towards implementation.

2005 Update, California Water Plan

From 2001 through the end of 2005, CDWR developed a major update to the California Water Plan, originally completed in 1957 and updated every five years. The 2005 Update has a strong emphasis on integrated approaches to solving water resources problems, and recommended effective leadership roles at the regional level. Although different hydrologic regions were evaluated in the 2005 Update, there were no clear recommendations as to how IRWMPs were to be defined by region. The 2005 Update concluded that more efficient use of water had the most promise, but that a full range of water management tools were needed to meet California’s long-term agricultural, urban and environmental needs. Information from the 2005 Update is shown in the figure below, summarizing the water management strategies and their promise in contributing to water supply reliability.

Volume 2 – Resource Management Strategies

- Chapter 1 Introduction
- Chapter 2 Agricultural Land Stewardship
- Chapter 3 Agricultural Water Use Efficiency
- Chapter 4 Conjunctive Management and Groundwater Storage
- Chapter 5 Conveyance
- Chapter 6 Desalination
- Chapter 7 Drinking Water Treatment and Distribution
- Chapter 8 Economic Incentives (Loans, Grants, and Water Pricing)
- Chapter 9 Ecosystem Restoration
- Chapter 10 Floodplain Management
- Chapter 11 Groundwater Remediation/Aquifer Remediation
- Chapter 12 Matching Water Quality to Water Use
- Chapter 13 Pollution Prevention
- Chapter 14 Precipitation Enhancement
- Chapter 15 Recharge Area Protection
- Chapter 16 Recycled Municipal Water
- Chapter 17 Surface Storage—CALFED
- Chapter 18 Surface Storage—Regional/Local
- Chapter 19 System Reoperation
- Chapter 20 Urban Land Use Management
- Chapter 21 Urban Runoff Management
- Chapter 22 Urban Water Use Efficiency
- Chapter 23 Water Transfers
- Chapter 24 Water-Dependent Recreation
- Chapter 25 Watershed Management
- Chapter 26 Other Resource Management Strategies

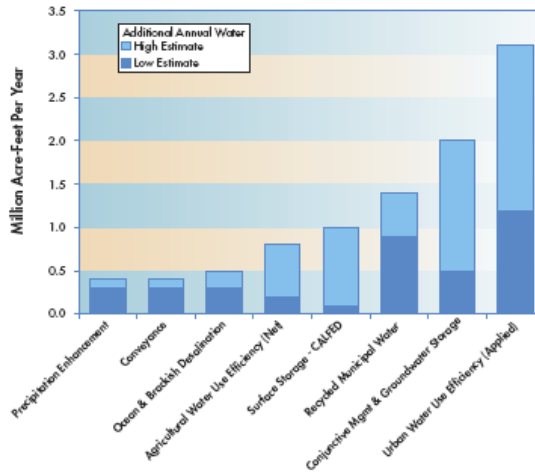


Figure 5. 2005 Water Plan Update, Resource Management Strategies and Potential for Increasing California Water Supplies

The 2005 Update’s top two recommendations were to diversify regional water portfolios and promote and practice integrated regional water management. The 2005 Plan’s “Framework for Action” identified how IRWM should fit in the state’s overall water resources action plan. A graphic from the 2005 Update is reproduced in the figure below.

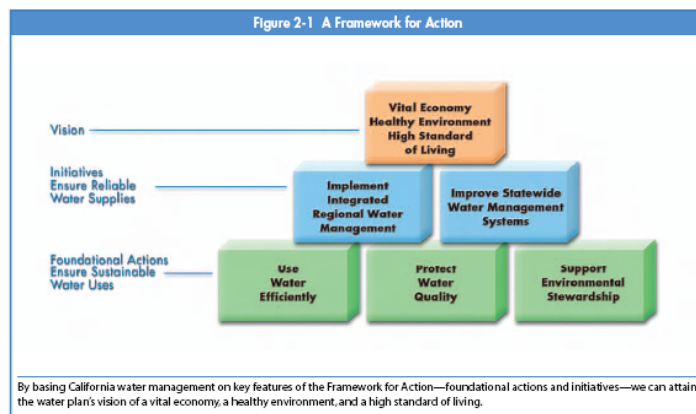


Figure 6. California Water Plan 2005 Update, Framework for Action

The initial experiences in dealing with integrated regional water management issues through Proposition 50 implementation were largely positive, although it was clear that self-selection of regions was institutionally awkward and not the most efficient use of bond funds. These experiences led to an expanded and more specific program in a subsequent bond issue that went before the voters in the November 2006 election. Proposition 84 passed overwhelming along with several other infrastructure investment bonds. Proposition 84 defined the regions on a

hydrologic basis and apportioned USD \$1 billion among the regions using population as a predominant (but not sole) factor.

As of late 2006 IRWM had been established as the strong policy direction from state government, and supported through bond funds approved by California voters. Integrated Regional Water Management Plans have been and are being developed throughout the state, from the large agricultural region of the Sacramento Valley to a comprehensive plan for urban and agricultural uses in San Diego County at the southern end of the state. Each is using the same IRWMP guidelines and management components and tailoring them to their respective regions' unique institutional, hydrologic and infrastructure conditions.

Required elements of California's Integrated Water Management Plans include the following:

- protecting communities from drought
- protecting and improving water quality
- improving local water security by reducing dependence on imported water

Examples of potential projects include (California Water Code Section 79561):

- *Programs for water supply reliability, water conservation, and water use efficiency;*
- *Storm water capture, storage, treatment, and management;*
- *Removal of invasive non-native plants, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands;*
- *Pollution reduction, management, and monitoring;*
- *Groundwater recharge and management projects;*
- *Contaminant and salt removal through reclamation, desalting, and other treatment technologies;*
- *Water banking, water exchange, water reclamation, and improvement of water quality;*
- *Planning and implementation of multipurpose flood control programs that protect property; and improve water quality, storm water capture and percolation; and protect or improve wildlife habitat;*
- *Watershed management planning and implementation; and*
- *Demonstration projects to develop new drinking water treatment and distribution methods.*

YOLO COUNTY – A CASE STUDY

Yolo County (County) is located in the Sacramento Valley on the west side of the Sacramento River opposite the City and County of Sacramento in Northern California, and encompasses 653,370 acres (Figure 7). The County is home to over 175,000 people with nearly 85 percent of the population living in the four cities of Davis, West Sacramento, Winters, and Woodland. The eastern two-thirds of the County consists of nearly level alluvial fans, flat plains, and basins,

while the western one-third is largely composed of rolling terraces and steep uplands used for dry-farmed grain and range. The elevation ranges from slightly below sea level near the Sacramento River in the southern part of the County to 3,000 feet along the ridge of the western mountains.

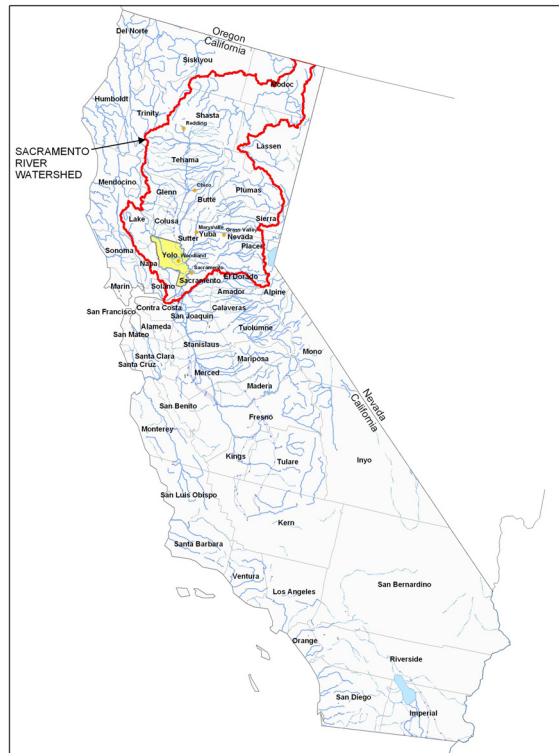


Figure 7. Sacramento Valley and Yolo County

The average annual precipitation varies from approximately 36 inches along the ridge of the western mountains to approximately 18 inches on the east side of the County in the vicinity of Woodland and Davis and the Sacramento River. All precipitation in the County occurs as rainfall. Occasionally, precipitation, as snow, occurs on the mountain ridges in the western part of the County, but melts within days.

Agriculture is the County's primary industry and its gross valuation in 2005 was \$332.7 million. Processing tomatoes is the County's leading commodity and represents 21 percent of the total agricultural valuation. The total taxable sales in the County in 2005, of nearly \$3.1 billion, represented 0.6 percent of the total taxable sales for California.

History of Water and Related Resources Planning

As a result of the foresight of early residents of the County, the investment of their time, energy, and monies paid significant dividends in creating a favorable water supply situation for beneficial uses in the County. The portfolio of water supplies consists of settlement and water service contracts with the U.S. Bureau of Reclamation for water from the Sacramento River, pre-1914 and appropriated water rights from the Cache Creek system, and a small increment of water from the Solano Project (Lake Berryessa) on Putah Creek. The last increment of water developed for use in the County was the Indian Valley Dam and Reservoir Project that was completed in 1975. On average, nearly 1 million acre-feet of water is applied for municipal, agricultural, and domestic uses with 60 to 40 percent being supplied from surface water depending upon the particular water year and the balance being provided from groundwater supplies.

Although the County was equipped with a favorable water supply as a result of agencies and individuals acting alone, the need to coordinate water resources activities among the various water purveyors (Figure 8) and those having land use authority in Yolo County was recognized by leaders in the community.

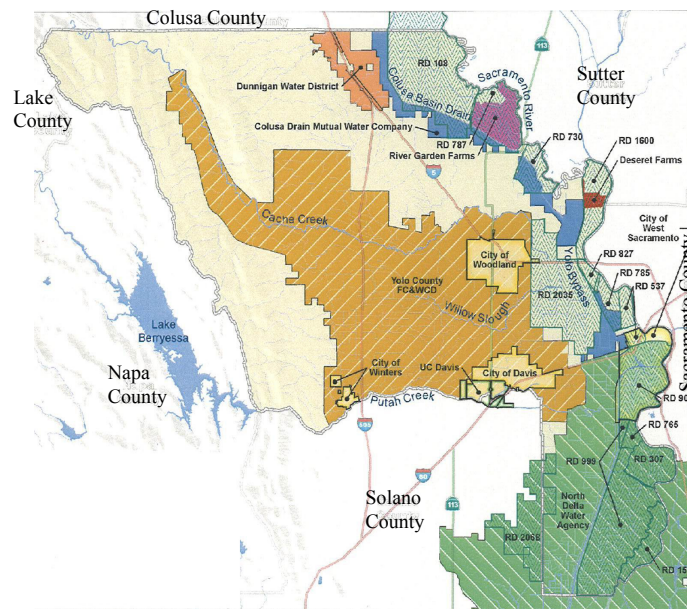


Figure 8. Water Agencies in Yolo County

In 1981, the preparation of the first countywide water plan was initiated. The “Yolo County Water Plan – 1984” was funded by two entities and adopted by the Yolo County Board of Supervisors in December 1984. This effort represented the first attempt to have water purveyors and the County at the same table to address water resource issues and needs within their respective jurisdictions. A good deal of attention was devoted to discussing the merits or benefits of interagency coordination and implementing activities that were deemed important to understanding and managing water resources within the County. The activities were directed at developing new increments of water to enhance water supply reliability, monitoring to better

understand the surface and groundwater resources, and investigating water needs for land beyond the jurisdiction of any existing water purveyor, but potentially significant to the economy of the County. The time to complete the water plan was not driven by the technical elements of the work, but by the time required to get the respective parties to begin communicating about existing and future water-related matters without feeling that their “turf” was being threatened by the activities of another entity. After extensive reviews and edits all parties finally accepted forwarding the water plan to the Board of Supervisors for consideration and adoption.

The water plan included a recommendation to execute an Agreement for Water Management Coordination among the participating agencies and establish an Interagency Water Management Coordinating Group (Coordinating Group). The Agreement was never executed; however, the Coordinating Group, comprised of senior-level staff of participating agencies, was established on an informal basis. Where an agency did not have personnel there was no on-going participation. The Coordinating Group convened on a regular basis and through that process established a good working relationship and implemented some investigative work, although to a large extent independent of each other.

In 1991, the Coordinating Group recognized the need to update the water plan and elevate the overall awareness of elected officials and the public to water issues confronting California and Yolo County as well. Eight agencies participated in funding the water plan update, reflecting a much broader awareness and interest than existed in 1980. In 1992, the “Yolo County Water Plan Update – *To be effective it must be implemented,*” was adopted by the Board of Supervisors and supported by the participating entities. Most of the activities outlined in the 1984 water plan remained to be performed and were highlighted in the Water Plan Update.

The Water Resources Association of Yolo County (WRA) was created as an outcome of the 1992 Water Plan Update. A Memorandum of Understanding was executed by: (1) the cities of Davis, West Sacramento, Winters, and Woodland; (2) the Dunnigan Water District; (3) the University of California at Davis; (4) Yolo County; and (5) the Yolo County Flood Control & Water Conservation District. There is a standing invitation for other water purveyors to participate, and Reclamation District No. 2035 recently joined. By design, the WRA was not established to be an implementing entity but rather to provide a forum for coordinating water resource related activities among member agencies, and to facilitate educating elected officials on water resource issues of interest at the local, regional and statewide levels. For a number of years the accomplishments of the WRA were limited and the viability of the WRA and the wisdom for it to continue was questioned. The member agencies were making significant accomplishments in implementing groundwater and land subsidence monitoring programs as well as special studies and investigations, several of which were funded by the Local Groundwater Assistance Program (AB 303) administered by the CDWR. Nevertheless, the usefulness of the WRA remained to be demonstrated. From time to time the idea of a countywide water agency emerged; however, it had never been articulated as to what its purpose would be or how problems would be resolved that the existing institutional structure could not handle.

Collaboration to Develop an IRWMP

As described earlier, the concept and impetus for IRWM can be credited to the CDWR. The opportunity to develop an IRWMP with funding provided by the CDWR was viewed by some WRA member agencies as an opportunity to determine the usefulness of the WRA. In March 2001, the WRA and the CDWR agreed to "...cooperatively plan an integrated resources management program identifying potentially feasible opportunities, initiatives, programs, or projects to improve water supply reliability in Yolo County." As a result of the agreement -- formalized in a Memorandum of Understanding -- the CDWR and the WRA committed to completing a countywide IRWMP.

The IRWMP was to update the County's 1992 water plan and, in so doing, explore opportunities for cooperative action, serve as a countywide forum to identify and address concerns related to water supply and drought preparedness; water quality; storm drainage and flood control; aquatic and riparian ecosystem enhancement; and recreation. Additionally, the process was to help provide a framework under which local water management policies, projects, and programs could be formulated, evaluated, and implemented.

The IRWMP was developed in two phases. The first phase focused on collecting technical information leading to an improved understanding of the County's water resources issues and concerns. The second phase was to utilize the information from Phase 1 to formulate and evaluate potential policies, programs, and projects needed to effectively address the identified issues and concerns. The first phase was completed in May 2005, with the results presented in the document titled, "Yolo County Integrated Regional Management Plan Background Data and Information Appendix."

Developing the IRWMP (Phase 2)

Preparing Phase 2 of the IRWMP was contingent upon the success of the WRA in receiving a planning grant under the Proposition 50 grant program administered by the CDWR. It was an expressed preference on the part of the CDWR for the "Region" to be geographically as large as practical. In the case of Yolo County, the region, for purposes of preparing the IRWMP, was deemed to be the County. It was the WRA's position that it was not yet prepared to participate in a meaningful dialogue with neighboring regions. It had a great deal of "homework" to perform before expanding the region beyond the County boundary. The CDWR accepted the WRA's justification of the region being limited to the County at this time, and the WRA was awarded a planning grant.

The preparation of the IRWMP was administered through the Technical Committee (TC) of the WRA, comprised of management and senior personnel of the respective member agencies. The TC, in collaboration with a consultant team, worked together closely to develop the IRWMP.

Drawing from data and information presented in the Background Data and Information Appendix (Phase 1), water resource plans, technical studies, and expressed public concerns

projects and programs to address the issues of highest priority. With respect to implementation, it became readily apparent that the chances for success would be highest if integrated actions were formulated according to geographic subareas. Also, the leadership for implementing the respective integrated projects would need to be provided by the agencies or entities currently having jurisdiction, operations, or programs in the respective subareas. Eight integrated projects were formulated that included all actions specifically applicable to the area. The eight integrated projects are as follows:

1. Davis-Woodland Water Supply Project.

The lead partners are the cities of Davis and Woodland and the University of California. They are working together to pursue implementation of a new surface water diversion from the Sacramento River and regional water treatment plant to perfect a 45,000 acre-foot water appropriation under the watershed of origin provisions of the California Water Code.

2. Reclamation District No. 2035 Sacramento River Diversion and Conveyance Project.

The lead partner is Reclamation District No. 2035. It has completed construction plans and specifications to replace its pumped diversion from the Sacramento River with a new pumping plant with state-of-the-art fish screens. This project has the potential of being integrated with the Davis-Woodland Water Supply Project to share in the joint use of the new diversion.

3. Cache Creek Integrated Project.

The lead partners are the Yolo County Flood Control & Water Conservation District, the City of Woodland, and Yolo County. A predominant activity in the integrated project is the risk of flooding to the City of Woodland from Cache Creek overtopping its banks and levees. Several other activities are incorporated in this integrated project that deal with conjunctive water use, environmental restoration, and recreation.

4. Dunnigan Integrated Project

The lead partner is the Dunnigan Water District. The prospects exist as the County finalizes its General Plan for a new community with up to 10,000 new housing units. Central to this integrated project is the provision of water supply, wastewater, and storm drainage to accommodate planned growth while correcting water supply and wastewater issues that persist in the existing community.

5. Putah Creek Integrated Project.

The lead partner is the Lower Putah Creek Coordinating Group. The Group has been effective in planning and implementing a wide range of instream and riparian habitat and environmental restoration projects and has plans for continuing this effort.

6. Yolo Bypass Integrated Project.

The lead partners involve a wide range of stakeholders. The organizational structure is in its formative stages. The integrated project focuses on habitat restoration and management for waterfowl and fisheries while preserving the integrity of agriculture and the flood control function of the Yolo Bypass.

7. Sacramento River (West Bank) Integrated Project.

The lead partners are the City of West Sacramento and Yolo County. Central to this integrated project is the flood protection afforded by the west bank of the Sacramento River and the integration of enhancement projects for environmental restoration and recreation.

8. Yolo County Sloughs, Canals, and Creeks Management Program.

The lead partner is the Yolo County Flood Control & Water Conservation District. This integrated project is broad ranging geographically and involves the enhancement of water management and habitat associated with waterways on the west side of the County and the management of storm runoff resulting from rainfall originating within the County with respect to quantity and quality.

Although the WRA and its member agencies took the lead in preparing the IRWMP, it was recognized that implementation could be more effective if member agencies or organizations currently involved in planning and/or implementing projects and programs in the respective subareas assumed a leadership role for managing the implementation of the integrated projects. The WRA, in turn, would provide support in whatever manner was appropriate for the task. For implementing the eight integrated projects, the leadership or project management role for six of the projects was assumed by member agencies. For two of integrated projects, the Putah Creek Integrated Project and Yolo Bypass Integrated Project, the leadership was assumed by non-governmental agencies. With respect to Putah Creek, the planning and implementation of environmental restoration and enhancement projects has been underway for several years by virtue of a great deal of community involvement and the results of recent litigation that provided a funding source and organizational structure for managing activities along the creek. With respect to the Yolo Bypass, an informal working group has been meeting on a regular basis for several years; however, as it currently exists it is not suitable for more detailed planning and implementation of projects and programs. In this case, the WRA and the CDWR has encouraged and provided support to the working group to facilitate creating an organizational structure that

would be equipped to implement programs and projects associated with the Yolo Bypass Integrated Project. Bringing structure to the group is proving to be a challenge; nevertheless, the process is underway.

The opportunity for public involvement was provided through three public workshops and the distribution of the draft IRWMP for public comment. Comments and input received on the draft IRWMP are being compiled and evaluated and the schedule is to have the final IRMWP presented to the WRA Board of Directors for adoption in late April 2007, and to the respective governing bodies of the member agencies for approval in May 2007.

SUMMARY

Integrated regional water management is the new force in California water resources development and management. California's water future will see greater integration of classic water management tools along with other resources. In the Yolo County example, considerable progress is now being made to advance the planning and implementation of many of the programs, and the relationships among the WRA member agencies has been strengthened through the IRWMP process.

To a large extent, institutional and technical challenges identified in the Yolo County IRWMP process are similar to those in other regions. Differences in geography and hydrology are important, but the existence of institutional challenges within regions appears to be universal (although specific areas of conflict or overlapping jurisdictions are unique to each region). Jurisdictional roles and responsibilities may not always be clear, and maintaining clarity and focus will be a challenge as personnel and politics change. California is gaining valuable experience in the development of regional water resource planning and management. This is expected to move the state forward toward diversifying water portfolios, advancing water supply reliability, and meeting the future needs of a diverse and growing population and economy.

While California's Proposition 50 bond funds and rules opened the door to state-funded IRWM plans, the experience indicated that self-selected regional boundaries will not work well for the future. The November 2006 Proposition 84 bond act provided an additional USD \$1 billion of funding for IRWM implementation, but allocates the funds to ten large regions. The future challenge will be bringing the institutions together within each region to agree on apportionment of these funds, and a great deal of competition is expected. However, substantial benefits for the long term will be gained by the development of greater regional leadership for addressing our water problems.