

Attachment 4. Project Description

Purpose

This grant application presents a proposed conjunctive use water supply project for Reclamation District 2035 (RD 2035) entitled *RD 2035 Conjunctive Use and Environmental Enhancement Program*. In coordination with the State of California, the Water Resources Association (WRA) of Yolo County and other agencies RD 2035 proposes to pursue improved integration of its surface water and groundwater supplies for the benefit of basin water users and the environment. This can be accomplished by developing a forward-thinking optimization model of its supplies using a proven quantitative management technology. RD 2035 can accomplish this because of its unique proximity adjacent to the lower Sacramento River and the north Delta region, combined with its existing surface water diversion headworks, conveyance facilities, and production wells. In addition, the data and model developed will be used to update RD 2035's Groundwater Management Plan (GWMP) to reflect current conditions and state law. The Program is also intended to maximize public, agency, and stakeholder participation.

An opportunity exists to optimize use of senior surface water rights and sub-surface groundwater reservoir to ensure a more reliable water supply for agricultural, urban, and environmental interests in Yolo County and the north Delta region. Conjunctive use optimization is consistent with recent statewide planning efforts, such as SB 1637 and the California Water Plan (2009 Update), that highlight coordination of surface water and groundwater supplies to improve regional water supply reliability and water quality. This project will also develop a valuable conjunctive use management model that can be easily replicated elsewhere throughout the state.

The water supply reliability and environmental benefits of this project will be seen at the local, regional and state level. A California Department of Water Resources (DWR) Local Groundwater Assistance grant would be used to develop a decision-making tool and plan for the optimal utilization of the surface-water and groundwater resources within RD 2035. This tool could then be used each year by RD 2035, the WRA of Yolo County, and the State to develop an optimal water supply plan for the users within Yolo County and the north Delta region. The decision-making tool will be made available to other potential conjunctive use efforts in the Sacramento and San Joaquin Valleys. Specific objectives associated with this effort would be to develop a decision-making tool and plan to contribute to state-wide water planning goals within the following constraints:

- Maintaining and enhancing current irrigated cropping,
- Maintaining sustainable groundwater supplies within both RD 2035 and adjacent areas,
- Avoiding permanent land subsidence,
- Avoiding adverse environmental impacts on the Sacramento River and other streams and
- Improving water quality and quantity to the Delta for environmental purposes.

This would be accomplished by developing a characterization of the hydrologic system, representing that system within a mathematical model, and using the model and the methods of

quantitative management to identify the annual optimal management solution for surface-water and groundwater resources. This information would then be used to update the GWMP to comply with current requirements. The primary focus will be developing a decision-making tool and plan that is implementable using the existing infrastructure within RD 2035.

Reclamation District 2035 Summary

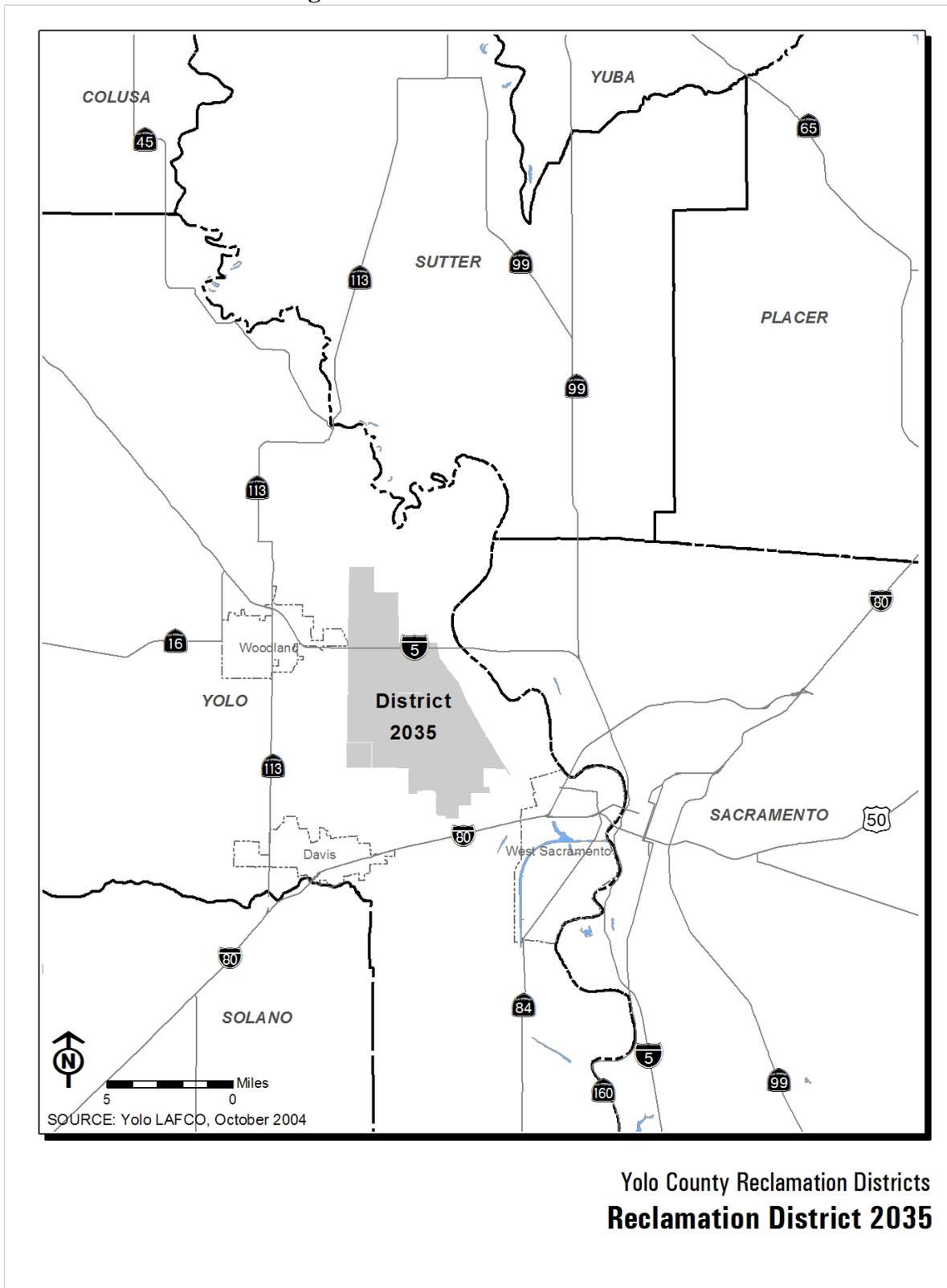
RD 2035 was formed in 1919 to provide flood protection, drainage, and irrigation water to Conaway Ranch and some adjoining lands in Eastern Yolo County. RD 2035 is governed by a Board of Directors consisting of three Directors elected by the landowners. The District encompasses approximately 32 square miles (20,780 acres). Offices are located at 45332 County Road 25, Woodland, CA 95776.

The primary activities of the District are maintaining approximately 12.1 miles of flood control levees and providing water delivery for irrigation purposes. The District diverts Sacramento River water from a pumping plant near the Vietnam Veterans Bridge on Interstate 5. The District also obtains water from Cache Creek and Willow Slough. This water supply is supplemented with groundwater pumping from twenty-three (23) irrigation wells located within the District. The District also maintains ten (10) pumping plants used for lifting water for irrigation, boosting pressure and for purposes of surface drainage from fields for water capture and reuse. Other facilities include a number of pipes through the flood control levees, seven (7) abandoned irrigation wells used as monitoring wells, twelve (12) wells specifically constructed for monitoring purposes, five subsidence survey monuments and a large siphon under Tule Canal and County Road 16. ¹ The annual Sacramento River diversions over the last decade have average about 35,000 acre-feet (AF) and annual groundwater pumping averaged 10,000 AF. Rice is the principal irrigated crop. The service area of RD 2035 is shown below in Figure 4.1.

RD 2035 adopted its GWMP in 1995 to provide a framework for improving management of its water supplies that include groundwater and surface water. Since that time RD 2035 has developed annual reports of groundwater elevations and partners in regional groundwater monitoring activities through the Water Resources Association (WRA) of Yolo County, which includes subsidence monitoring. RD 2035 is looking to comprehensively update its GWMP through this LGA grant program to build on these past efforts and better integrate its water supplies through conjunctive use optimization.

¹ Groundwater Management Plan, April 25, 1995 West Yost & Associates, page 1.

Figure 4.1 - RD 2035 Service Area



Local Groundwater Assistance Grant Eligibility Criteria

Local Public Agency. RD 2035 is a local public agency as defined in the California Water Code (CWC) §10701(a) and is governed by a Board of three Directors elected by the landowners. California Reclamation Districts are legal subdivisions within California’s Central Valley that are responsible for managing and maintaining the levees, fresh water channels, or sloughs, canals, pumps, and other flood protection structures in the area. RD 2035 was formed in 1919 to provide levee maintenance, drainage, and irrigation services to approximately 20,500 acres of land in Yolo County near the City of Woodland.

RD 2035 is a local public entity that has legal authority and jurisdiction under Water Code Section 50000 et seq. to implement flood control programs and projects that reconstruct, replace, improve, or add to facilities as defined in Public Resources Code Section 5096.805(j). In addition, Water Code Sections 50910 et seq. permits reclamation districts to own and maintain irrigation systems and adopt rules and regulations for the distribution of water. Under Water Code Section 50900, “Incidental powers,” a reclamation district “may do all things necessary or convenient for accomplishing the purposes for which it was formed.” RD 2035’s definition of a “Local Public Agency” under California water law combined with the “incidental powers” provides the legal authority for RD2035 to enter into a contract with the State of California related to the LGA grant program.

Urban Water Management and Water Meter Implementation Compliance. RD 2035 does not provide wholesale or retail water service as defined by the Urban Water Management Planning Act CWC §10610 et seq., and therefore is not required to submit an urban water management plan or comply with water meter implementation.

Groundwater Monitoring – CASGEM. RD 2035 is a current member of the WRA of Yolo County and is current with its member dues. The WRA of Yolo County maintains a groundwater monitoring program and is serving as the voluntary groundwater monitoring entity for the Yolo Sub-Basin of the greater Sacramento Valley Groundwater Basin.

Surface Water Diversion. RD 2035 holds multiple rights to surface water diversions within Yolo County. All surface water diversions are reported to the State Water Resources Control Board in compliance with CWC §5100 et seq.

Project Background

Conjunctive use involves the coordinated use of surface water and groundwater to meet some specified water demand in a given area. It often involves addressing some or all of the following general problems:

- What system has to be built in order to minimize the discrepancy (in time, space, and quality) between the natural supply of water and the demand for it?

- To what extent should the water resource system be developed, and how extensive should the region be serviced?
- How should the system be operated to achieve a given set of objectives in the best possible way?

Conjunctive use may be of various kinds. The most common type that is of interest because of its hydraulics is the interconnected stream-aquifer system where development of one affects the other. A failure to accurately account for stream-aquifer interconnections: Unexpected things can happen. Figure 4.2 below provides a simplified version of stream-aquifer interactions due to groundwater elevations: (1) the graphic on the left provides an example of a “gaining” stream reach; while (2) the graphic on the right provides an example of a “losing” stream reach. Under natural conditions (prior to development by wells), aquifers are in a state of balance; inflow (recharge) equals outflow (discharge). Groundwater pumping may lower the water table, causing springs, streams, and wetlands to dry up; in this instance, recharge equals pumping. The decline of ground-water levels around pumping wells located near streams captures some of the ground-water flow that would have, without pumping, been discharged to the streams. If enough water is pumped out of the aquifer, declining ground-water levels can induce flow out of a body of surface water into the aquifer, a process known as induced recharge. The sum of these two effects leads to streamflow depletion. In short, ground water and surface water are both part of a very complex hydrologic system, in which the alteration of one part affects all of the system.

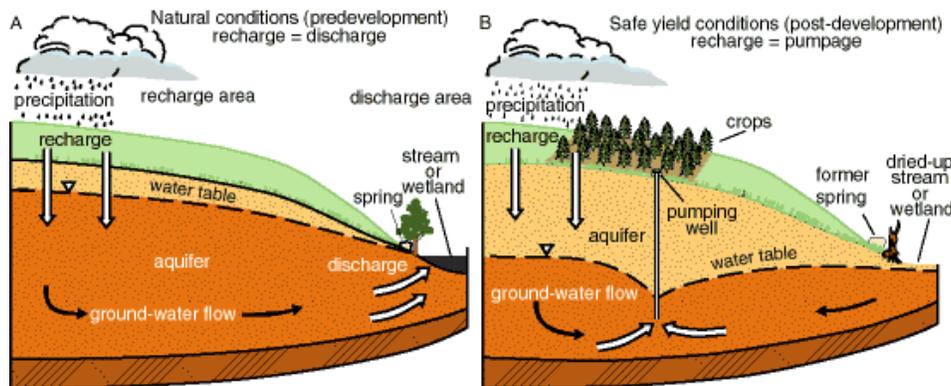


Figure 4.2 – Stream-Aquifer Interactions

As shown in Figure 4.2, surface and ground water are not separate components, and development of either water resource must be based on an understanding of the whole system. An overall objective of such studies might be to utilize the total resource in such a way as to maximize benefits. In the stream-aquifer system, the hydraulic connection between the two sources plays a major role. A second type of conjunctive use operation involves surface water importation for direct use to supplement and/or recharge the groundwater supply with little or no connection between the two sources, other than their availability.

Conjunctive use optimization can be derived using a mathematical decision rule for the timing of surface water importation to supplement or recharge a sub-surface groundwater reservoir. One objective of this type of operation may be to minimize the cost of operation. As a marginal value rule, this decision rule states that the importation should take place when the cost of importation equals the cost pumping. The cost of importation includes the initial investment plus operating costs, whereas the cost of mining includes current pumping charges as well as the capitalized cost of all future pumping charges associated with a lower groundwater storage level. Other decision rules could be developed to delineate the marginal value rule of ecosystem habitat, water quality, subsidence, and so on.

A prerequisite to utilization of a groundwater reservoir for storage is that it be susceptible to depletion at a practical rate. In surface reservoirs, the only limitation on the rate of depletion is the capacity of the outlet works. A groundwater reservoir, however, is depleted by pumping, seepage at the land surface, evaporation, transpiration, or subsurface outflow to adjoining areas. Seepage, evaporation, and transpiration occur chiefly when the reservoir is nearly full.

The Yolo Sub-basin of the Sacramento Valley Groundwater Basin underlying RD 2035 presents an interesting opportunity for optimizing a conjunctive use program that could benefit agricultural, urban, and environmental interests within, nearby and downstream of Yolo County, especially the north Delta region. Its unique proximity to the lower Sacramento River, availability of surface water rights, existing infrastructure in the form of a diversion and conveyance facilities, production wells, and a groundwater reservoir presents an array of solutions that can improve water supply reliability for the region. The spatial, temporal complexity of this unique opportunity requires a numerical model as a decision-making tool often referred to as quantitative management to find the optimal solution.

Quantitative management is simply a sophisticated mathematical approach used to systematically manage large volumes of data over time to find some optimal solution. Quantitative management had its beginning during World War II when mathematicians, physicists, and other scientists joined together to solve military problems. The quantitative management approach now has grown into a useful application for all disciplines from economics to water resources optimization. Its approach involves the use of quantitative techniques, such as statistics, information models, and computer simulations, to improve (or optimize) decision-making.

Project Description

The *RD 2035 Conjunctive Use and Environmental Enhancement Program* will include seven main elements: (1) Data Collection relating to area surface water and groundwater information; (2) Data Analysis and Management associated with determining the best ways to store and retrieve data; (3) Field Studies and Testing to fine tune and develop site specific stream-aquifer interaction data; (4) Development of Operational Alternatives to establish methods to organize the rules for conjunctive use system; (5) Model Development technical analyses involving conjunctive use optimization using a “refined” mesh to accurately capture the important stream-aquifer connections along the lower Sacramento River and demonstrated quantitative management techniques; (6) Preparation of a comprehensive GWMP Update to comply with SB 1938 requirements and new laws pertaining to groundwater management; and (7) Implement Management, Environmental Considerations and Outreach to ensure public

participation and local agency coordination. By following this program a decision-making optimization toolkit can be established that can be applied to groundwater basins through the Sacramento and San Joaquin Valleys.

A communication loop among the seven individual elements seen below will ensure current and consistent information feeds to the other elements that will ensure the program’s objectives and constraints are consistent with the Yolo Integrated Regional Water Management Plan (YOLO IRWMP), the California Water Plan (2009 Update), the Delta Stewardship Plan and other relevant water planning documents.

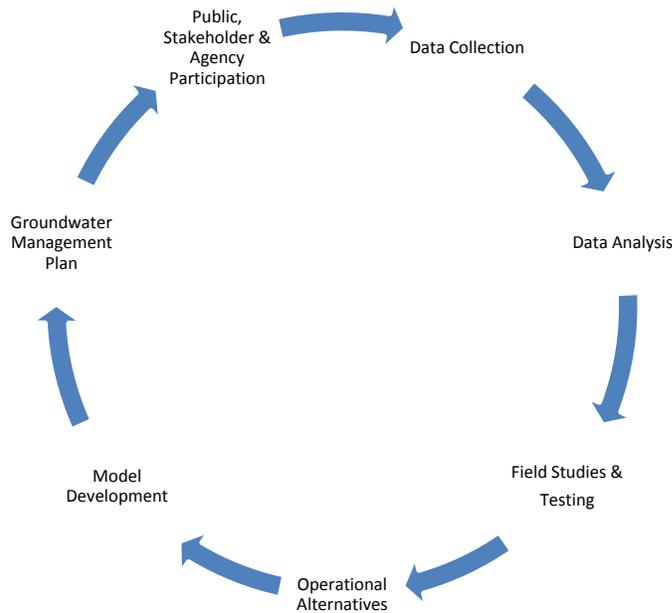


Figure 4.3 – Communication Loop

The proposed Project will consist of existing RD 2035 facilities and water rights. Through development and implementation of a forward-thinking conjunctive use optimization program (i.e., Quantitative Management), (1) potential un-intended impacts will be minimized or eliminated and (2) potential opportunities for increasing water supply reliability to agriculture, urban, and environmental interests in Yolo County and the north Delta region, as well as ecosystem habitat improvements and water quality improvements will be identified, while minimizing land subsidence or other issues of concern.

Conjunctive use optimization requires sophisticated numerical techniques and a wealth of physical data. The Yolo Sub-basin of the Sacramento Valley Groundwater Basin possesses a strong foundation of technical information to build upon and implement the *RD 2035 Conjunctive Use and Environmental Enhancement Program*. A summary of this foundational information is provided below under “Sources of Information.”

Program Goals and Objectives

The program is designed to obtain and utilize resource management based criteria to maximize the water supply for beneficial uses and to protect water quality. These beneficial uses will in turn support the agricultural sector, urban users and the environment, including the north Delta area. The primary program goals are as follows:

- Improve Agricultural, Urban and Environmental Water Use Efficiency by Optimizing Conjunctive Use of Surface Water and Groundwater Resources;
- Protect Groundwater Recharge Areas from Ground Subsidence; and
- Provide for a Sustainable Water Supply and Drought Protection through water transfers for agricultural, urban and environmental uses in the Region.

These goals can be achieved by this program through the implementation of the following objectives:

- Coordinate and conjunctively manage surface water and groundwater supplies through a computerized quantitative management model to optimize opportunities while avoiding potential adverse impacts;
- Formulate and implement a comprehensive Groundwater Management Plan;
- Ensure open and frequent communication with the public, stakeholders and regional and state agencies on water planning issues;
- Continue and build on a sustainable and effective water monitoring and management program;
- Enhance, improve and maintain aquatic and riparian ecosystems and aquatic biodiversity through an optimal conjunctive use program;
- Develop on-going monitoring and management activities and institutional capacity through implementation of the quantitative management model and GWMP;
- Address Statewide Priorities to reduce conflict between water users by establishing methods to improve water use efficiencies and maximize water availability in drought years;

How Program Supports Goals and Objectives

The above goals and objectives are supported by the proposed program. RD 2035 intends to pursue improved integration of its surface water and groundwater supplies for the benefit of basin water users and the environment. By developing an optimization model of its water

supplies using a proven quantitative management technology, multi-beneficial goals of water use efficiency, drought protection, sustainable agriculture, water transfers and an improved environment can be achieved for the basin. The proposed Project will consist of existing RD 2035 facilities and water rights. No additional facilities are required. The conjunctive use optimization program will minimize potential adverse impacts and increase potential opportunities for increasing water supply reliability to agriculture, urban, and environmental interests in Yolo County and the north Delta region. At the same time it will lessen land subsidence and other issues of concern.

Project Consistency with GWMP

The proposed program supports the current RD 2035 GWMP. Through a comprehensive update of its GWMP, the goals and objectives will be enhanced, further building on regional coordination by incorporating new data and information into multiple programs, such as the YOLO IRWMP, GWMPs, the Delta plan, and State water plan updates.

The primary goals of the RD 2035's current GWMP identified the following:

- Protection and Enhancement of Groundwater Recharge;
- Implementation of Conjunctive Use;
- Subsidence Prevention; and
- Protection of Groundwater Quality.

The basin is well suited for storage and extraction of groundwater for irrigation, urban, environmental and other uses. Maximizing the basin for recharge and conjunctive use will provide region-wide benefits. The basin can be managed to provide supplemental water when necessary and store excess surface water until required. The problem is that a quantitative water management model is not currently available to ensure negative impacts, such as losing stream reaches, subsidence and groundwater quality deterioration are avoided. The development of a computer simulation model using quantitative management techniques (optimization) for the optimal utilization of the surface-water and groundwater resources within RD 2035 proposed in this grant will solve this problem and provide the necessary information to maximize water resources in the basin.

Collaboration

The program is intended to fully engage the public, stakeholders and interested outside agencies. The program proposes a robust outreach program that includes numerous public meetings and workshops, as well as a Technical Advisory Committee (TAC) to assist in model development issues. Ongoing communication will be further encouraged through attendance at local and regional meetings where updates and information will be presented. In addition, the GWMP will engage local agencies and stakeholders to address their issues and concerns. Expanding collaboration among RD 2035 and interested parties is a high priority. An excellent benefit of this project is that the end products will be fully documented and available to other agencies to adapt to their basin and particular circumstances.

Ongoing Funding

RD 2035 has a long history of allocating funding to on-going monitoring and testing. This will be continued after this grant program is completed. The model developed through this process will be maintained and updated in accordance with recommendations of the final report and, where appropriate, the GWMP, will be updated as necessary to reflect changing conditions. This will include the frequency of well monitoring, the type and frequency of water quality data, ground subsidence monitoring requirements, model maintenance and updating protocols and the like. The Board of Directors will periodically review the proposed work-plan and budget to determine the level of funding for the on-going program.

Sources of Information

The following reports provide a solid foundation of information and a starting point to develop and implement a conjunctive use optimization program for RD 2035. RD 2035 will use this conjunctive use optimization program consistent with the Yolo WRA and the California Water Plan Update to benefit the water supply reliability of agricultural, urban, environmental interests within Yolo County and the north Delta region. A summary of the significant reports that provide a foundation for developing and implementing RD 2035's conjunctive use optimization program concludes this project description and provides the necessary background for RD 2035's work plan.

Reclamation District 2035 GWMP

RD 2035 adopted its GWMP pursuant to §10753 of Division 6 of the California Water Code (Assembly Bill 3030) on April 25, 1995. The purpose of the GWMP is to provide a framework for the protection and utilization of the aquifer system underlying RD 2035. The specific goals are as follows:

- To define criteria for groundwater pumping and aquifer protection that is based on scientific analysis of monitoring results and provides the flexibility to use groundwater as needed for agricultural production, recreation, wetland restoration, wildlife management, industrial and residential use, and/or water transfers or exchanges.
- To compile data based on work performed within the District service area which includes an existing groundwater and subsidence monitoring program and technical studies on groundwater resources.
- To establish the monitoring, recharge and evaluation programs necessary to actively manage conjunctive uses of groundwater and surface water supplies within the RD 2035 service area.
- To explore joint conjunctive use planning for Eastern Yolo County.

- To establish standards which will help protect the aquifers underlying RD 2035 from water quality degradation.
- To provide a document that can be used as a tool to provide public education about the groundwater basin underlying the service area of RD 2035 and the management of that basin.

RD 2035 coordinates its groundwater management and monitoring efforts through membership in the Water Resources Association of Yolo County. Regular reports are developed through RD 2035 and Yolo WRA to show changing groundwater elevations over time, groundwater quality, and subsidence.

This LGA grant application proposes to implement a conjunctive use optimization program for eastern Yolo County and coordinate its implementation through a comprehensive update of its GWMP.

Woodland-Davis Clean Water Agency

Tri-City Water and Farm, LLC and CPG, owners and operators of Conaway Ranch, landowners within Reclamation District 2035, initiated the permanent assignment of 10,000 acre-feet per year (AFY) of their rights of surface water from the Sacramento River to the Woodland-Davis Clean Water Agency (CWA). Conaway Ranch holds a contract with Reclamation for diversions from the Sacramento River of up to 50,862 AFY, of which 13,452 AFY is available for diversion in the “critical months” of July through September. The assignment of 10,000 AFY is needed to help meet the needs of the CWA for high quality water for municipal and industrial (M&I) purposes. The CWA currently uses groundwater that, while sufficient for agriculture, has relatively high concentrations of certain chemical constituents that are not desirable for M&I uses.

On April 14, 2011, the SWRCB Division of Water Rights issued water-right Permit 20281 (Application 30358) to CWA. This permit authorizes the CWA to divert up to 45,000 acre-feet of surface water per year from the Sacramento River for the Davis-Woodland Water Supply Project (DWWSP). However, this water right is subject to curtailments under certain conditions pursuant to Term 91. This standard permit term prohibits any diversions of water under the permit when the total of the amount of water that Reclamation and the State of California DWR are releasing from storage in Shasta, Oroville, and Folsom reservoirs plus the amount of water that Reclamation is importing into the Sacramento River from the Trinity River exceeds the total amount of water that Reclamation and DWR are exporting from the Delta plus any carriage water (i.e., water lost to the system through evapotranspiration, leaks, etc.) associated with these exports. The water rights approval thus directed that the CWA obtain the right to additional surface water supplies from senior water rights holders to address Term 91 curtailments. The proposed assignment, which was described in the CWA EIR, is intended to fulfill the SWRCB’s directive that the CWA secure additional surface water rights to ensure a reliable, permanent substitute supply of surface water during Term 91 curtailment periods.

The CWA would have the right to divert the assigned water beginning on January 1, 2016. Conaway Ranch would have full entitlement to these water supplies until 2016, at which time CWA could begin diverting up to 10,000 AFY for its use. If the CWA does not divert some or all of the 10,000 AFY supply, then Conaway Ranch would have the right to divert, primarily for irrigation purposes, the remaining supply, along with its remaining rights for diversion. Beginning in 2040, the CWA will have the exclusive right to divert, use, or transfer all of the 10,000 AFY supply (i.e., Conaway Ranch rights to “extra” water for irrigation would terminate).

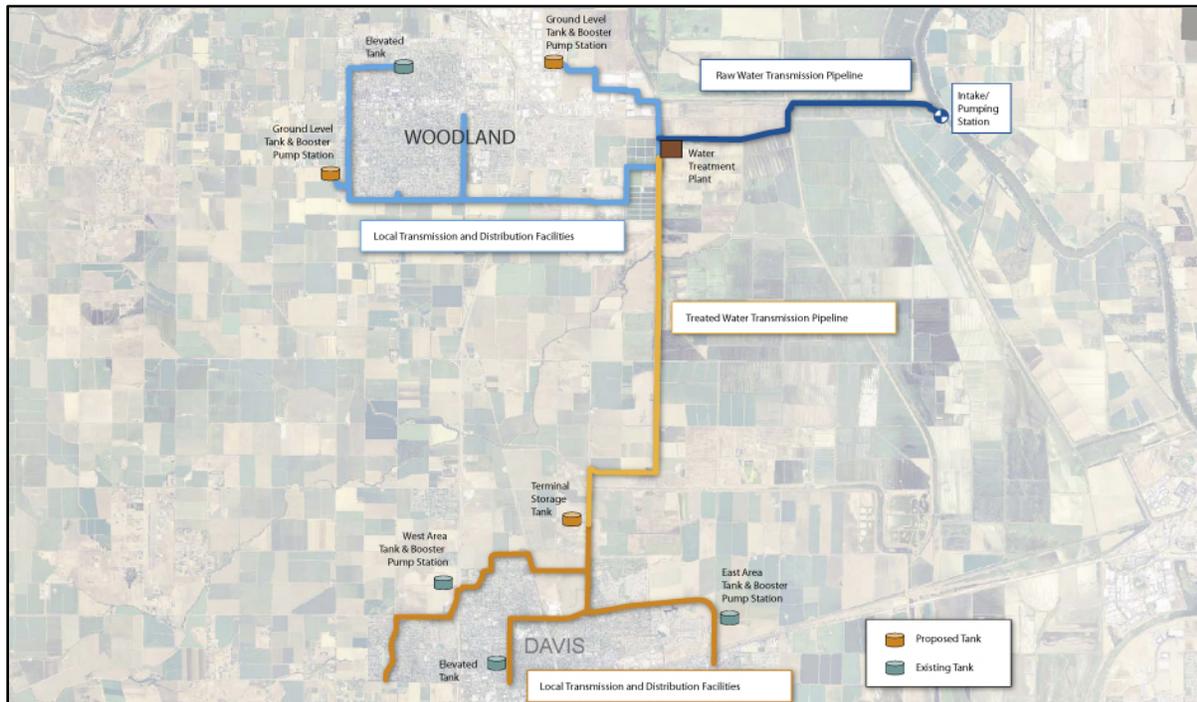


Figure 4.4 – CWA Project Concept

To offset reduced surface water supplies, Conaway Ranch would increase its pumping of groundwater by up to 10,000 AFY to fully replace water assigned to the CWA and meet its irrigation demands. The increased groundwater pumping would be offset by reduced groundwater pumping within the same overall groundwater basin by CWA because surface water deliveries would replace their groundwater pumping. Pursuant to an agreement between Conaway and the CWA, Conaway would not idle or shift any crops as a result of the assignment; demand would be met by groundwater substitution.

Water Resources Association of Yolo County Integrated Regional Water Management Plan (April 2007)

In April 2007, RD 2035 participated with the Water Resources Association (WRA) of Yolo County to prepare an Integrated Regional Water Management Plan consistent with the Integrated Regional Management Program Grant Guidelines issued by the State Water Resources Control Board (SWRCB) and the California DWR. The Yolo IRWMP identifies the following water supply and drought preparedness objectives:

- Provide reliable and sustainable surface water from a variety of sources sufficient to serve urban, agricultural, environmental, and recreational uses (as planned by Yolo County’s water purveyors and consistent with this IRWMP) in normal, above normal, and prolonged drought periods, which is protective of natural resources and surface water flows.
- Manage Yolo County’s groundwater resources on a sustainable yield basis that provides water purveyors and individual users with reliable, high quality groundwater to serve urban, agricultural, environmental, and other uses during normal, above normal and prolonged drought periods.
- Develop conjunctive use and groundwater protection programs within the next 10 years, consistent with this IRWMP and the needs of water purveyors, which maximize the efficiency, sustainability, and value of Yolo County’s surface and groundwater.

With this LGA grant proposal, RD 2035 in coordination with the Yolo WRA and the State is looking to develop and implement a decision-making tool to meet the IRWMP conjunctive use objectives.

Yolo County Groundwater Monitoring Program

The groundwater monitoring program for Yolo County is coordinated through the Water Resources Association of Yolo County. Yolo County Flood Control and Water Conservation District (YCFCWCD) began overseeing the “fledgling” groundwater monitoring program, but with adoption of the IRWMP in April 2007, which identified the groundwater monitoring program as an important regional water management strategy, YCFCWCD continued to develop and expanding the groundwater monitoring program under its leadership. All members of the WRA of Yolo County are active participants in the groundwater program.

YCFCWCD implements the Program under the authority of its adopted AB3030 GWMP and through working agreements with cooperating agencies and private well owners. The Program is comprised of seven elements:

1. Monitoring
2. Modeling
3. Data and Information Management
4. Cooperator Coordination
5. Special Projects
6. Reporting and Decision Support
7. Administration

Program data is placed in the State Water Data Library managed by the DWR and available to the public through the internet. Many plans and projects have used and continue to use Program data. The Program is now championed by the DWR as one of the premier non-urban monitoring programs in the State.

Yolo County Flood Control and Water Conservation District GWMP

YCFCWCD adopted its GWMP to comply with Assembly Bill 3030 and Senate Bill 1938 (Water Code §10750 through §10756) on April 2006. The plan goals include maintaining and enhancing local groundwater quantity and quality through cooperative conjunctive use and management projects. Through its GWMP planning efforts YCFCWCD is the lead agency for implementing the regional groundwater monitoring program being done through the members of the Water Resources Association of Yolo County.

City of Woodland GWMP

The City of Woodland adopted its GWMP to comply with Assembly Bill 3030 and Senate Bill 1938 (Water Code §10750 through §10756) on April 15, 2011. The City relies on groundwater to meet the water demands of its customers, but is seeking to diversify its urban supply by participating in the Woodland-Davis CWA that was successful in securing a surface water right and a permanent water right reallocation from RD 2035 for 10,000 acre-feet per year to support its new SWRCB right during dry years. Woodland cites its purpose for developing a GWMP as the following:

1. State the City's overall groundwater management goal;
2. Put forth Basin Management Objectives (BMO) applicable to the City service area;
3. Provide a mechanism for the continued collection of baseline groundwater and aquifer information; and
4. Establish management actions, including provisions for updating the plan as conditions change and new information becomes available.

Woodland's GWMP supports "an operable conjunctive use system."

Yolo Flood Control & Water Conservation District and Yolo-Zamora Water District Draft Conjunctive Use Feasibility Study (July 2003)

The opportunity to more efficiently use groundwater storage in combination with available surface water supplies through the concept of conjunctive use has been explored within Yolo County by the YCFCWCD. Through a grant from DWR, "Groundwater Storage Feasibility Study/Pilot Project," Grant Contract No. F90002, YCFCWCD worked with the Yolo-Zamora Water District (YZWD) to investigate the feasibility of implementing a conjunctive use project within YZWD. Because YZWD did not receive Tehama-Colusa Canal water as planned in the late 1960's, over reliance on groundwater has resulted in subsidence, in excess of five feet over the last 50-years.

Results from the conjunctive use feasibility study show that a conjunctive use project is not feasible in the YZWD area at this time using water from Cache Creek or the Colusa Basin Drain. The study states that land within the YZWD is fully developed and that the groundwater system seems to be in balance, that is groundwater extraction and recharge appears reasonably balanced due largely to subsurface flow from the area east of the Colusa Basin Drain and the Dunnigan

Hills on the west. Further, the study states that the opportunity to increase groundwater storage or to “bank” water within the YZWD area is limited.

Yolo County Integrated Groundwater Surface Water Model

A May 2006 report by WRIME identifies the YCFCWCD, along with other members of the WRA of Yolo County embarking on the development of analytical tools and technologies to:

- Better understand the nature of groundwater flow system in the county;
- Analyze the benefits and impacts of Cache Creek Groundwater Recharge/Recovery Program (CCGRRP);
- Evaluate the effects of the plans and projects considered under the local and regional GWMPs; and
- Evaluate the benefits and impacts of the regional water management programs considered under the IRWMP.

YCFCWCD in coordination with the DWR conducted a study on modeling goals, objectives, and strategy for the Yolo groundwater basin. Based on the criteria adopted by the stakeholders, the study recommended using the Integrated Groundwater and Surface water Model (IGSM) as the primary analytical tool for basin wide groundwater-related project planning and design.

Yolo County Groundwater Ordinance

Another important reference for Groundwater Management in Yolo County is the local groundwater ordinance, sections 10-7.101 to 10-7.601 of the General Code §10-7.101, which can be accessed via the internet at <http://www.yolocounty.org/Index.aspx?page=432#Title 10>. The groundwater ordinance regulates extraction and exportation of groundwater from Yolo County while also emphasizing the importance for conjunctive use of water supplies within Yolo County.

Building on the Foundational Documents to Support RD 2035’s Conjunctive Use Optimization Program

This collective body of information is a storehouse of management objectives, data, and constraints on water resource management in Yolo County. The multiplicity of objectives and constraints across a spectrum of agencies, plans, and hydrologic uncertainty due to climate change, produces a near impossible task of managing water resources across the region in a manner the maximizes its utility and minimizes its potential impacts [i.e., quantity, quality, stream-aquifer interaction, power costs, subsidence, habitat, and so on]. The RD 2035 Conjunctive Use and Environmental Enhancement Program proposes to solve this dilemma through the development and implementation a quantitative management decision-making tool. Implementation of this tool will bring this body of information together in a manner that will examine the spatial and temporal complexity in a systematic way to produce an optimal solution

to improve agricultural, urban, and environmental interests in Yolo County and the north Delta region.

Study Area Regional Context

Land Use

DWR compiled land use information for Yolo County in 1961, 1973, 1976, 1981, 1989, and 1997. The land use data compiled for 1989 and 1997 is available in electronic form and is used here to describe the study area. Presented in Figures 4.5 and Figure 4.6 are the land uses in Yolo County for 1989 and 1997. Figure 4.7 shows the cropping pattern in 2008. These aerial images show that agriculture remains the primary form of land use within RD 2035, with little change in actual use over the years other than a slight shift away from the dominant crop of rice to field and truck crops.

The gross area within RD 2035 is 20,780 acres with approximately ninety-percent represented by irrigated acreage. Agriculture, consisting primarily of rice with some field and truck crops, represents the crop mix in RD 2035, although crops vary year by year. The remaining ten-percent of the acreage represents flood control activities, habit and native vegetation.

Yolo County completed a comprehensive update of its General Plan in November 2009 (Resolution No. 09-189). From a land use perspective, this General Plan continues the County’s strong focus on protecting our agricultural and open space resources, commodities and identity; resisting urbanization; and directing growth into the existing incorporated cities and towns.

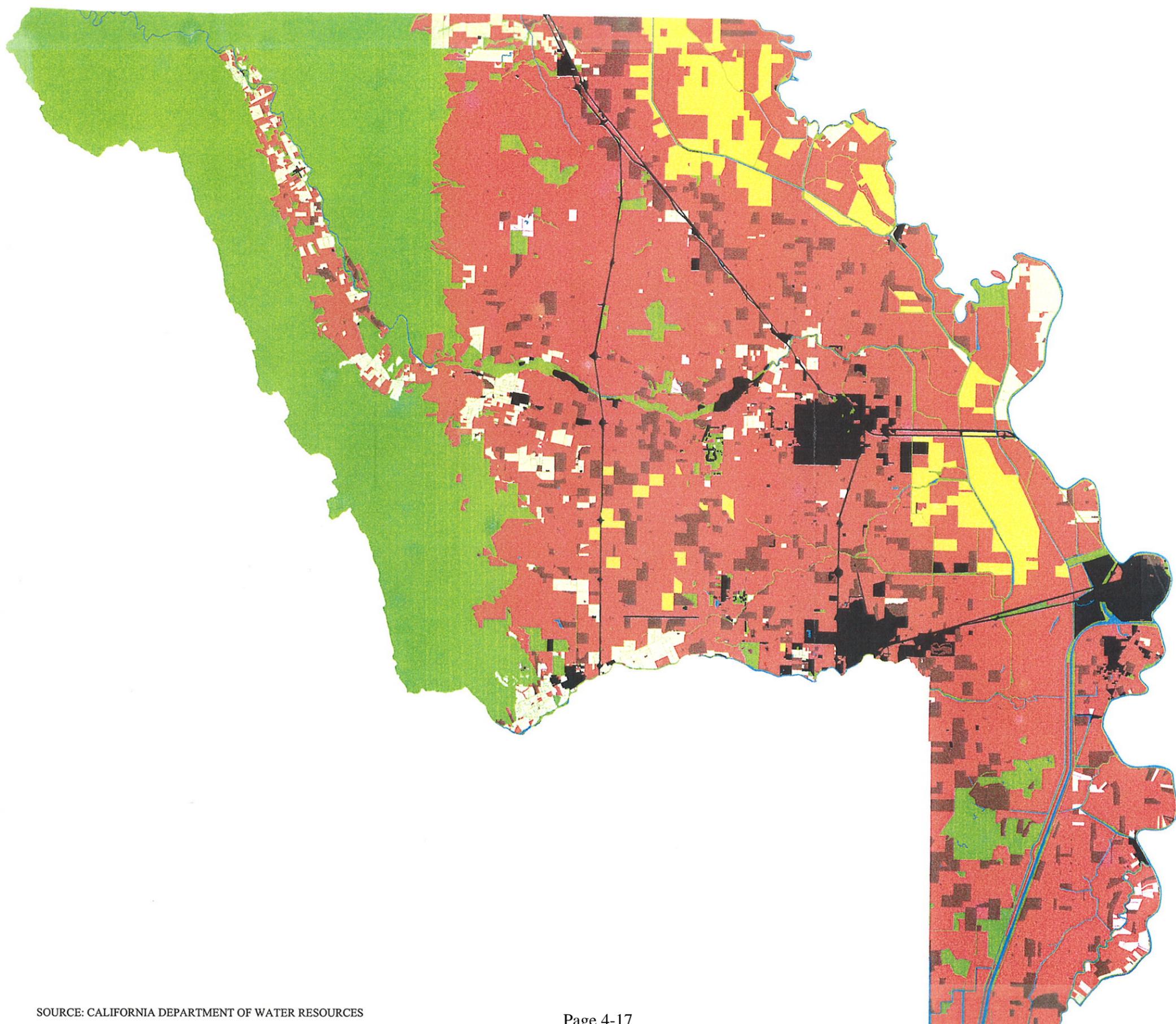
Yolo County General Plan 2009 Land Use Principles	
Principle 1	The success of Yolo County depends upon the success of agriculture
Principle 2	The benefits of open space and natural areas are essential to our quality of life
Principle 7	A strong economy is key to the long-term sustainability of our farms, towns, cities and governments
Principle 8	Aggressive efforts are needed to secure an abundant and clean water supply

These key principles identified in the County’s General Plan Update support the need to develop a better decision-making tool for managing the region’s water supplies in the facing of growing climate uncertainty. The proposed RD 2035 Conjunctive Use and Environmental Enhancement Program will help the County, its communities, agriculture, and the north Delta region succeed in securing an abundant and clean water supply and ensure the other key principles are met.

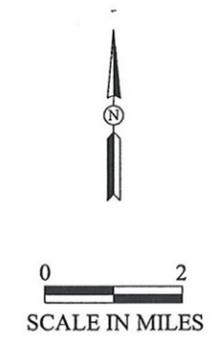
Water Use

The District diverts Sacramento River water from a pumping plant near the Vietnam Veterans Bridge on Interstate 5. The District also obtains surface water from Cache Creek and Willow Slough. This water supply is supplemented with groundwater pumping from 23-

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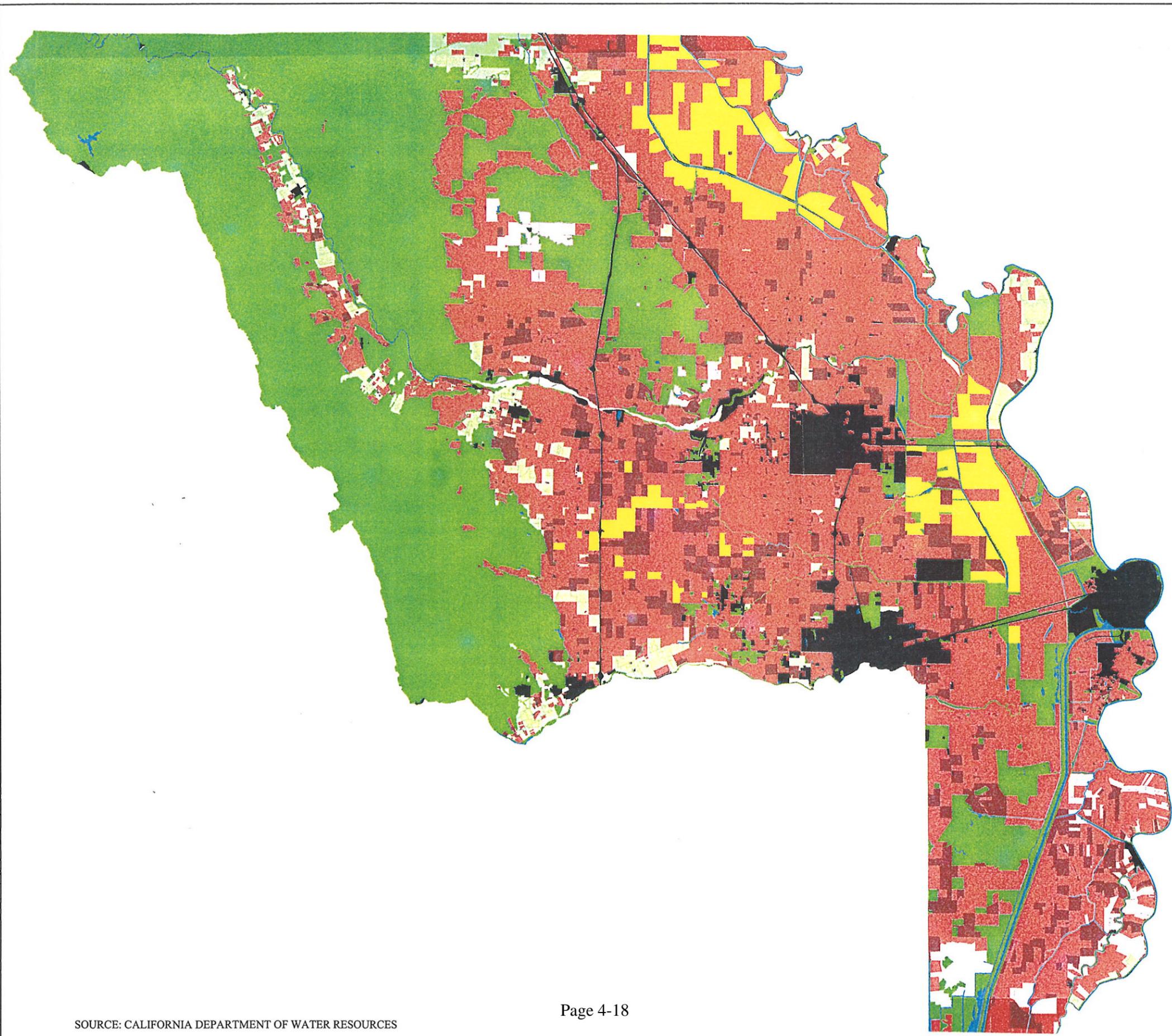


- LEGEND
-  WATER
 -  URBAN
 -  ORCHARDS
 -  PASTURE, FARMSTEADS, DAIRIES, AND LIVESTOCK
 -  FIELD AND TRUCK CROPS
 -  RICE
 -  VINEYARDS
 -  NATIVE AND RIPARIAN VEGETATION



YFCWCD/YZWD CONJUNCTIVE
WATER USE FEASIBILITY STUDY
YOLO COUNTY LAND USE - 1989





LEGEND

-  WATER
-  URBAN
-  ORCHARDS
-  PASTURE, FARMSTEADS, DAIRIES, AND LIVESTOCK
-  FIELD AND TRUCK CROPS
-  RICE
-  VINEYARDS
-  NATIVE AND RIPARIAN VEGETATION
-  BARREN WASTELAND
-  ACCESS FOR SURVEY DENIED BY LANDOWNERS



0 2
SCALE IN MILES

YCFWCWCD/YZWD CONJUNCTIVE
WATER USE FEASIBILITY STUDY
YOLO COUNTY LAND USE - 1997



SOURCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES

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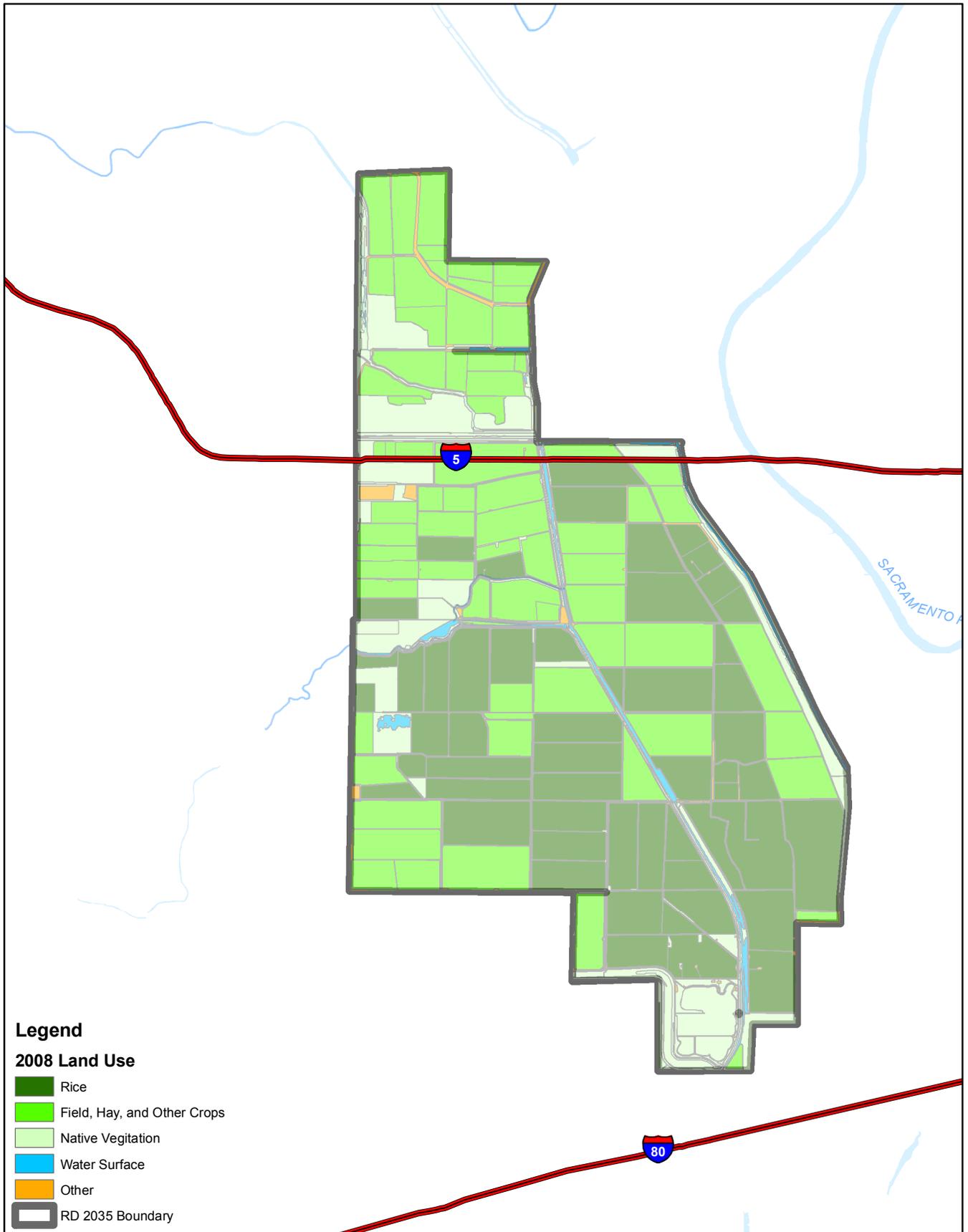


Figure 4.7 - Crops and other land use within RD2035

existing wells and 10-additional new wells located within the District. The District also maintains ten (10) pumping plants used for lifting water for irrigation, boosting pressure and for purposes of surface drainage from fields for water capture and reuse. Other facilities include a number of pipes through the flood control levees, seven (7) abandoned irrigation wells used as monitoring wells, twelve (12) wells specifically constructed for monitoring purposes, five subsidence survey monuments and a large siphon under Tule Canal and County Road 16. ^[1] Diversions from the Sacramento River over the last decade have averaged about 32,000 acre-feet (AF) during April through October; and annual groundwater pumping averaged approximately 10,500 AF. See Figures 4.8 and 4.9.

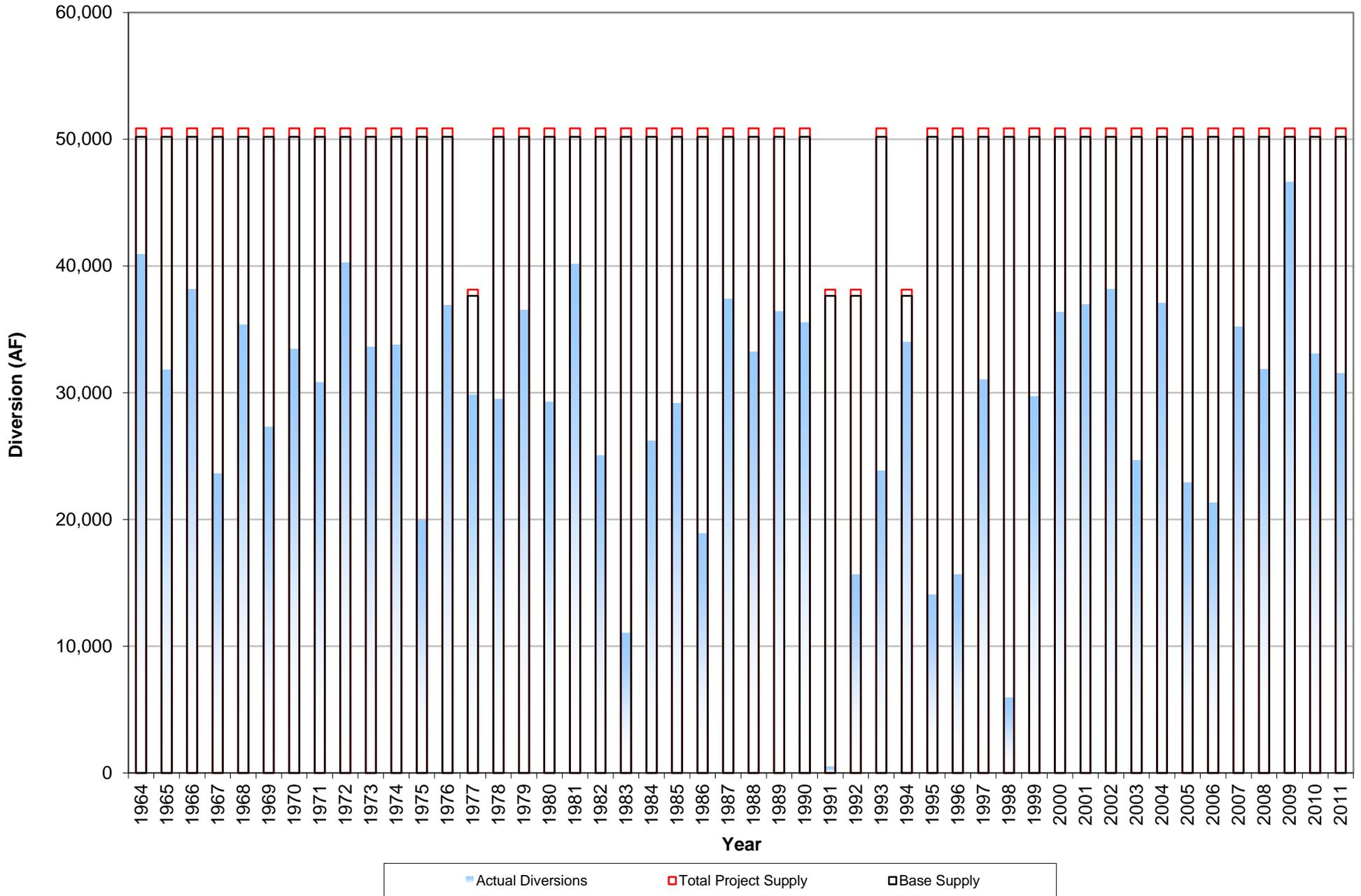
RD 2035 diverts water from the Sacramento River under a contract with the U.S. Bureau of Reclamation (USBR) and appropriative water right Licenses 904, 94, and 5487 (Applications 1199, 1588, and 12073, respectively). The water rights are the basis of a settlement with USBR and are quantified for purposes of the settlement in the contract quantities. The contract specifies a total allowable diversion of 50,862 AF between April 1 and October 31, with a maximum total diversion of 13,452 AF during the months of July through September. These entitlements can be reduced by the USBR by 25% in critically dry years, as determined by inflows to Shasta Reservoir. These reductions have or would have occurred in nine years since 1906.

The Sacramento River water supplies must be pumped from the Sacramento River into the Conaway main canal, which takes water from the Sacramento River and flows in a westerly direction and delivers it to a location near where the Cache Creek water supply enters the same canal. The Conaway Ranch property is the largest in RD 2035 representing a majority of water use. The Conaway main canal turns in a southerly direction and is the western channel of the Yolo Bypass. The pumping from the Sacramento River represents an additional cost, or increased lift, from the other surface water supplies, as the other surface water supplies flow into Conaway's system by gravity. This is an important point to recognize when considering Conaway's operational strategy and practices.

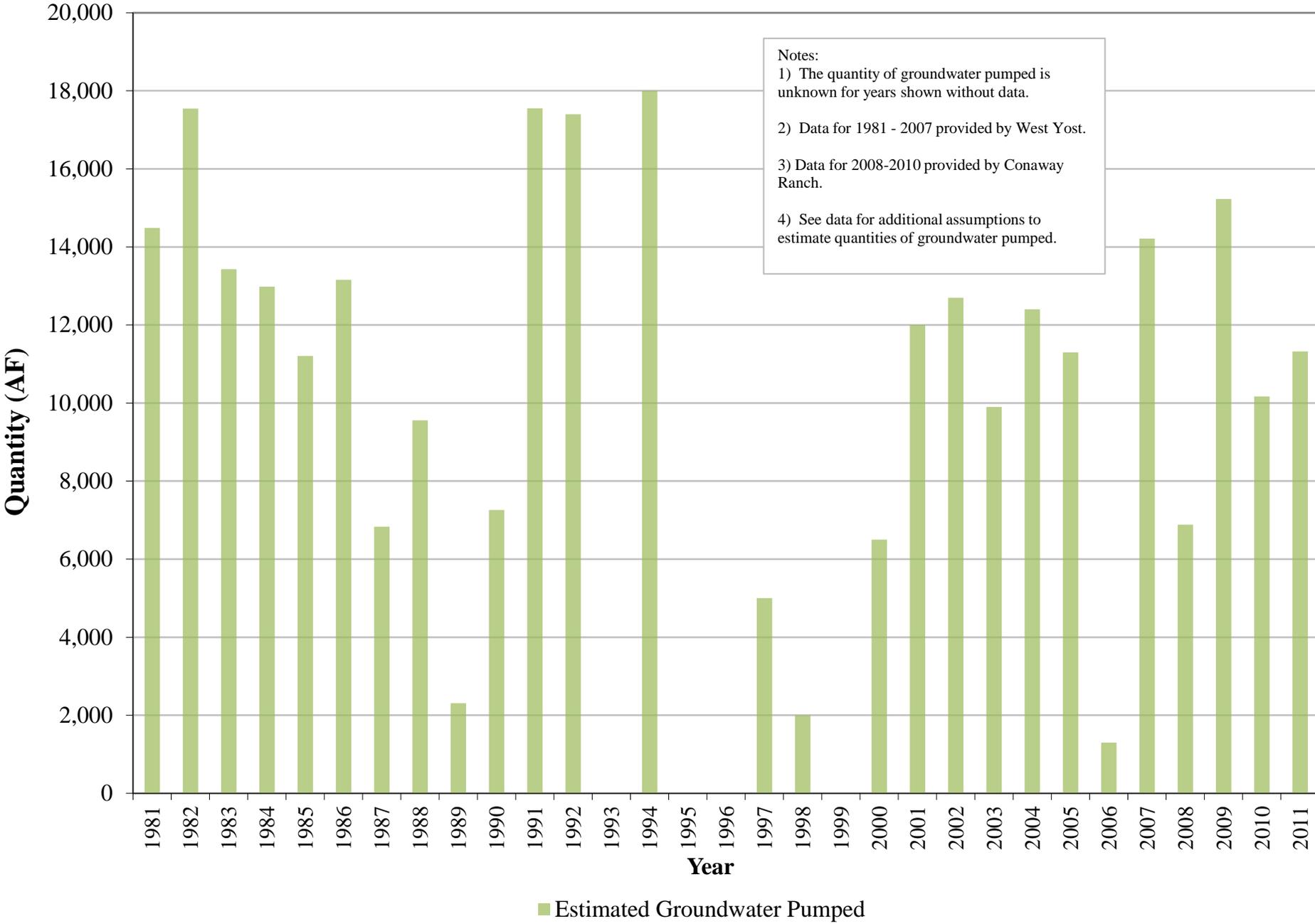
Cache Creek and the Yolo Bypass are also sources of surface water for RD 2035 under appropriative water right Permit 19372 (Application 26695) for diversions of up to 10,000 AF per year from April 15th through September 30th. Cache Creek enters Conaway at the most northern and westerly location, which represents the highest elevation point on Conaway. The Cache Creek source flows into Conaway and the Cache Creek Settling Basin, which may fill and spill at the Cache Creek Settling Basin weir to enter the main portion of Conaway. Water may enter Conaway's main canal at a point just north of Highway 5, and at the same location where Conaway's main canal from the Sacramento River turns in a southern direction. The Cache Creek water supply, therefore, does not require the additional pumping lift that the Sacramento River water supply does to reach this location. The Cache Creek water supply, having its source on the east slope of the Coastal Range, is essentially only a significant and reliable water supply during the spring of most years. During drier water years, Cache Creek may represent little to no water supply during the irrigation season. Diversions of water from Cache Creek are not metered, but estimated to have ranged from 0 to over 8,000 AF per season, and averaged approximately 2,600 AF during 1981 to 1994

^[1] Groundwater Management Plan, April 25, 1995 West Yost & Associates, page 1.

**Conaway Ranch
 Sacramento River Settlement Contract No 14-06-200-7422A
 1964 - 2011 April through October Diversions**



Conaway Ranch Estimated Groundwater Pumped



based on RD 2035 water use calculations and Cache Creek flow measurements at the Yolo gage.

RD 2035 obtains an estimated average of 600 AFY of surface water from Willow Slough under appropriative water right License 6320 (Application 12074), which authorizes diversions of up 9.4 cubic feet per second (cfs) during about April 15th through about October 31st. Willow Slough enters Conaway’s west boundary at approximately the north-south mid-point of the Ranch. The Willow Slough supply is diverted into a regulating reservoir located adjacent to Willow Slough. From the regulating reservoir, water can be delivered through lift pumps to areas north and to the west of the Yolo Bypass. In addition, water in Willow Slough can flow into Conaway’s system for delivery by gravity to essentially the southern half of the Ranch. Again, like Cache Creek, this water is available to a portion of the Ranch through gravity and does not require the increased pumping cost that the Sacramento River supply does. Also like the Cache Creek water supply, the reliability and availability is limited to the spring period during most year types. Of course, during drier years, the supply and availability is limited to minimal or no supply; and during wet years, the supply increases during the spring and extends into the summer months, possibly.

For most irrigation districts or irrigators within the Sacramento Valley, it is a common management tool, and cost effective, to recirculate tail water to reduce your demand of surface water. This can also be viewed as an increase in available water supply. Conaway recirculates water through its numerous facilities. This recirculation of water is most prevalent during the May/June to September period when Conaway has been approved as a closed system through the Yolo County Agricultural Commissioner’s Department.

Groundwater

RD 2035 is located in the Yolo Sub-basin (Sub-basin 5-21.67) of the Sacramento Valley Groundwater Basin as defined in the California DWR Bulletin 118 update. Figure 4.10 shows the location of RD 2035 in relation to the boundaries of other local agencies overlying the groundwater basin. The Yolo Sub-basin is bounded by Cache Creek on the north; the Sacramento River on the east; Putah Creek on the south; and the Coast Range on the west. Table 4.1 below provides summary characteristics of the groundwater sub-basin. This LGA grant application and SB 1938 GWMP update covers the RD 2035 service area.

Sub-Basin	Predominant Freshwater Bearing Sediments	Total Thickness	Primary Developed Land Use	Predominant Water Supply Mix	Comments
East Yolo	Tehama Formation Stream Channel Deposits	> 1,500 feet	Agriculture and M&I	Groundwater	Extensive pumping for domestic needs (Woodland, Davis, UC Davis) and some irrigation needs. Significant land subsidence (more than 1’) has occurred.

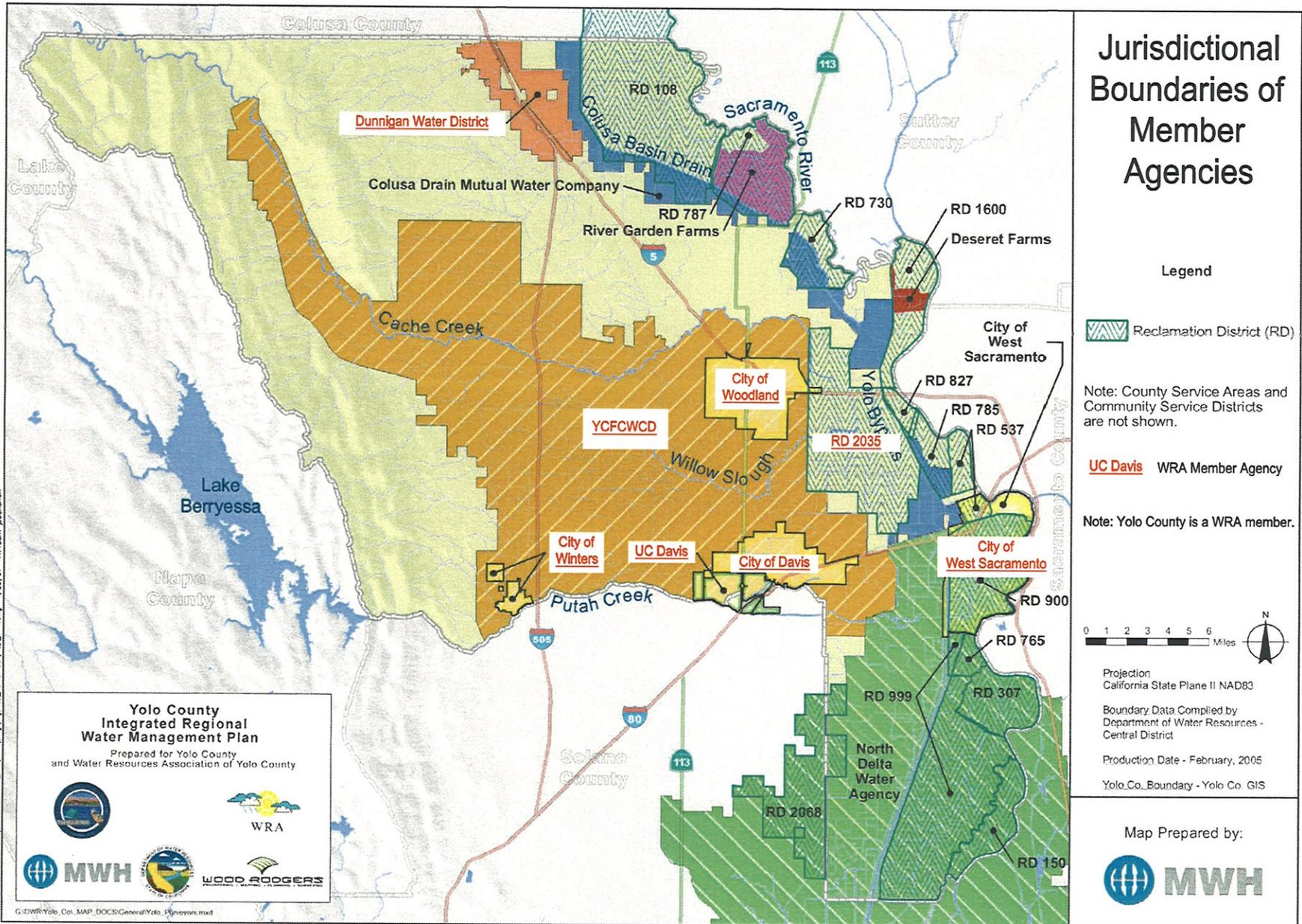


FIGURE 1-1

Existing studies show aquifers in Yolo County are unconfined near the surface and become increasingly confined with depth. There are no regionally continuous barriers to vertical flow, but inter-bedded clays and silts create a cumulative impediment to vertical groundwater flow with increasing depth. Older, deeper sediments also tend to be more compact and therefore less permeable than younger, shallower sediments.

The natural hydraulic gradient of groundwater (its slope and flow direction) is toward the east and south, roughly following the topographic incline. Groundwater pumping has had an impact on this gradient by creating localized depressions in the water table and land subsidence beneath areas of more intensive groundwater pumping.

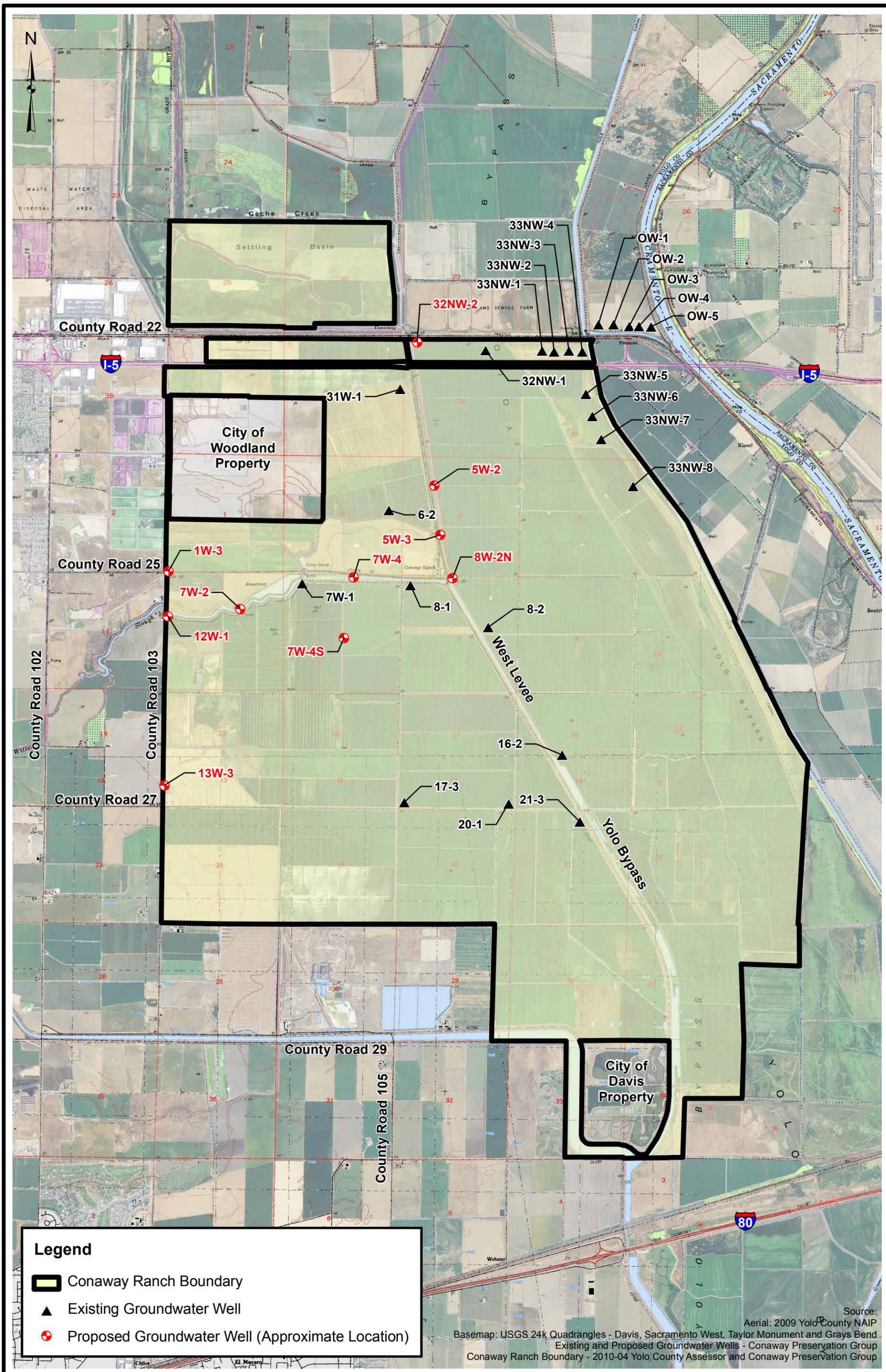
Developing surface water has relieved much of the stress on aquifers beneath Yolo County. Localized groundwater effects are still evident beneath areas dependent on groundwater as a primary water supply, such as beneath the City of Woodland, beneath the City of Davis and the UC Davis area, and beneath the Yolo Zamora Water District.

In RD 2035, a network of twenty-three groundwater production wells and ten new production wells have been drilled to supplement its surface water supply during below normal water year types to satisfy irrigation demands. The wells have also been developed for the purpose of assisting in meeting the peak irrigation demands during all year types, particularly during the months of July through September when diversions from the Sacramento River are limited to 13,452 acre-feet and little supply is available from Cache Creek, Yolo Bypass, or Willow Slough. In addition, these wells provide a critical water supply 'safety net' backup during critical drought years.

Figure 4.11 below shows the location of these existing groundwater wells throughout Conaway. As shown in the figure, the wells are located near Conaway's main canal and throughout Conaway to provide operational flexibility for deliveries to significant portions of the Ranch for supplementing the available surface water supply.

Subsidence

Land subsidence, as a result of groundwater extraction, exists along the east side of the Yolo County from the City of Davis to an area east of Zamora. Subsidence is documented to be nearly five feet in certain areas of the county. Because of the subsidence concern the Yolo WRA along with RD 2035 cooperate on a regional subsidence monitoring program with extensometers installed in strategic locations throughout the county. This network of extensometers tracks the horizontal and vertical relationships between monuments and is stored in the local database.



Legend

-  Conaway Ranch Boundary
-  Existing Groundwater Well
-  Proposed Groundwater Well (Approximate Location)

Source: Aerial: 2009 Yolo County NAIP
 Basemap: USGS 24k Quadrangles - Davis, Sacramento West, Taylor Monument and Grays Bend
 Existing and Proposed Groundwater Wells - Conaway Preservation Group
 Conaway Ranch Boundary - 2010-04 Yolo County Assessor and Conaway Preservation Group



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**Conaway Ranch
 Groundwater Wells**

