

COLUSA COUNTY **GROUNDWATER MANAGEMENT PLAN**



September 2008



MAIN REPORT
VOLUME 1 OF 2



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PREFACE

The preparation of this Groundwater Management Plan (GMP) represents the initial effort on the part of Colusa County to address the management of water resources available to the community in a formalized manner. Although this document is titled, "Groundwater Management Plan" it is important to understand that the coordinated and planned management of both surface water and groundwater resources (conjunctive use) is an important part of the management equation. This is not only important for the residents of Colusa County to understand, but also for the people in the Sacramento Valley in general.

The socioeconomic and environmental fabric of this area would not exist as it does today without the accomplishments of numerous citizens investing time, energy, and resources to secure surface water supplies early in the development of the Sacramento Valley. Those water supplies originate largely outside of Colusa County. It is important at this point in time that the community of Colusa County come together to better understand its water resources and the interrelationship between the use of surface water and groundwater. At the same time, this enhanced understanding of the groundwater resources and the interrelationship between the use of surface water and groundwater in the County needs to be communicated effectively to the interested public. This GMP attempts to build on the framework that exists today, not for convenience, but because it is deemed appropriate for this community to advance the coordination as well as the extent and level of communication regarding water-related information and issues or concerns. This GMP also outlines an action program that, when implemented, will advance the level of understanding of the groundwater resources to facilitate enhancing the management of water resources in Colusa County. The interests of a community can be best served and protected by understanding and documenting the resources and the manner in which they are being managed, and publicly communicating these accomplishments.

The surface water supplies available for use in Colusa County are significant. Surface water is used on 74 to 86 percent of the irrigated or developed land within the Sacramento Valley portion of the County. Whereas, groundwater is used on 10 to 22 percent of that land. Of the land where groundwater is used, 6 to 11 percent is not within the service area of an organized entity. Clearly, the surface water supplies are critical to the socio-economic and environmental well-being of Colusa County. These water supplies cannot be taken for granted. They have been and will be challenged in the future, making water management and the documentation thereof more essential. It is important to highlight actions of the State Water Resources Control Board that issued orders and actions to protect beneficial uses of water in the Bay-Delta Estuary against the adverse affects of upstream water diversions. To avert Phase 8 hearings that might have triggered litigation of the Bay-Delta Water Rights Hearings, several water purveyors in the Sacramento Valley signed an agreement that provides for implementing projects to produce up to 185,000 acre-feet of water to the State Water Project and Central Valley Project in dry years. This agreement averted the potential for a lengthy legal process with the prospects of having to provide greater amounts of water. It is important to note that water rights will continue to be challenged as the competition for the limited resources in California continues to increase. These challenges amplify the need for water management to be proactive to understand and



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demonstrate sound management of the water resources available to Colusa County for the benefit of local, regional, and statewide interests.

For this GMP to be effective—it must be implemented—otherwise little will be accomplished that enhances the water future of the County. Accordingly, this GMP is tailored to the community of Colusa County. Implementation dictates that the community invest in its water future now. Some citizens may merely consider this to be an investment in more bureaucracy. This may be true; however, the value added to the community’s water future from a nominal investment can be substantial. Like any organization, its success or lack thereof is determined by the commitment and motivation of the people and entities involved.

In implementing this GMP it must be recognized that the management of the available water resources is accomplished by those that have water rights or entitlements and those that physically divert, deliver, and use the water. Clearly, the availability of surface water does not in any way diminish the right of a landowner to use groundwater beneficially on his/her land that is overlying the groundwater basin. It is the intent of this GMP to facilitate the work and coordination of those that do manage water in order that greater efficiencies in managing the supplies can be achieved while sustaining the socioeconomic and environmental well-being of the community. Accordingly, an institutional structure with functional guidelines or processes and Basin Management Objectives (BMOs) are presented in this GMP. The BMOs presented in this GMP are qualitative at this time, but can become quantitative over time as more efficient and effective management alternatives are defined. The effectiveness of BMOs, quantitative or qualitative, to a great extent depends upon the data gathering and evaluation and processes for dealing with issues as they emerge.

It is the intent of this GMP to be countywide in geographic scope. It is recognized that the County GMP is not applicable to the land within the organized service areas. The amount of land to which water supplies are being provided that is not within an organized entity is small in relation to the land that is within an organized entity. As stipulated in California Water Code §10750.8, ...”a local agency may not manage groundwater pursuant to this part within the service area of another local agency without the agreement of that other entity.” Thus, it is important that water purveyors come together to participate in a single groundwater management plan that serves the needs of all public and private water users in the County. Of the 26 water purveyors in Colusa County, only two have adopted groundwater management plans in compliance with California Water Code §10750. Accordingly, adoption of this GMP provides an opportunity for the other water purveyors to participate in the GMP thus saving the cost to prepare individual documents. To date, three water purveyors have expressed interest in coordinating and participating in implementing the GMP—Reclamation District No. 108, Glenn-Colusa Irrigation District, both of which have a GMP, and the City of Colusa.

Colusa County is part of the Sacramento Valley and it is well known that water, surface water, or groundwater, does not respect jurisdictional boundaries. It is becoming increasingly important to establish effective communication and collaboration of water-related matters. Colusa County currently participates in a Four-County Group with Tehama, Butte, and Glenn Counties. Also, Colusa County and water purveyors within the County participate in a Multi-Party Water Resources Group. The goal of these efforts are to foster coordination, collaboration, and



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communication among the participants. The same parties are also signatories to the Sacramento Valley Integrated Regional Water Management Plan. Implementation of the GMP will facilitate more effective participation of the County and respective water purveyors in these forums.

A successful GMP requires certain essential elements. These elements are addressed in the GMP and include:

- Sound technical program.
- Functional institutional structure.
- Sustainable or stable funding.

Guidance is provided in the GMP for the first two elements with an Action Program and a Groundwater Management Process. However, the Board of Supervisors will be required to develop a strategy to fund the basic activities of the GMP. The investment required by the County, albeit an important sum in today's economic environment, is nominal in terms of the role that water plays in the economy of the County and the value added with enhanced water management.

Wood Rodgers, Inc. would like to express its appreciation for this opportunity to work with the community of Colusa County while preparing this GMP. We are especially grateful to County staff and the California Department of Water Resources for providing technical and financial assistance during the formulation of the GMP. DWR is to be commended for its leadership and proactive support to advance groundwater management in Colusa County to be more in line with other counties. A special thank you is also extended to the University of California Extension Service for developing and maintaining a Website for this program, as well as to the individuals that dedicated time to participate in various Plan Advisory Committee meetings and workshops during the preparation of the GMP.





I. INTRODUCTION

This Groundwater Management Plan (GMP) was prepared by Wood Rodgers, Inc., under the direction of Colusa County and with financial and technical assistance from the California Department of Water Resources (DWR).

A. PURPOSE

In preparing this Groundwater Management Plan (GMP), it was the intent of Colusa County that it be applicable countywide and serve the following purposes:

- To be responsible stewards of the water resources in Colusa County.
- To be eligible for grant funding administered by DWR to increase the understanding of the groundwater basins underlying Colusa County.
- To retain local control of water management decisions.

Important also, is that the County recognized that a GMP that was adopted by the Board of Supervisors, with widespread participation of water purveyors in the implementation of the GMP, would facilitate revising the County Groundwater Ordinance. With an effective GMP with sound Basin Management Objectives (BMOs), a workable institutional structure, and a monitoring program established and supported by all parties, the County Groundwater Ordinance could be completely revised to support implementation of the GMP.

B. AUTHORITY TO ADOPT AND IMPLEMENT A GROUNDWATER MANAGEMENT PLAN

California Water Code §10750 et seq. states that a local agency that overlies part of a groundwater basin can “by ordinance, or by resolution...adopt and implement a groundwater management plan...within all or part of its service area,” so long as the area is:

- Not served by another local agency, a water corporation regulated by the Public Utilities Commission, or a mutual water company.
- Served by a local agency, when the majority of the agency’s governing body declines to exercise its authority to manage groundwater *and* enters into an agreement with the local agency developing the GMP.

As a local agency, Colusa County has the authority to adopt and implement this GMP for all portions of the County not served by another local agency. Accordingly, to function as a countywide GMP necessitates support and formalized but voluntary participation by water districts, irrigation districts, cities, and public utility districts within the County.





Adoption and implementation of the County's GMP will not affect the authority of other local agencies to implement Groundwater Management Plans. With time, it would be in the best interest of the community of Colusa County that the GMP's of the County and local agencies are consistent and that implementation is coordinated. For local agencies that do not have their own adopted plans, the opportunity exists for them to adopt, by resolution, the County's GMP and execute a Memorandum of Understanding (MOU) with the County for cooperation and joint implementation of the GMP.

C. COMPLIANCE WITH WATER CODE SECTION 10750

California Water Code §10750 et seq. defines the required and voluntary components of a GMP and establishes procedures by which they must be developed. DWR recommends additional elements to include in a GMP in *Bulletin 118 Update 2003, Appendix C*. The full requirements are detailed in Appendix B, which also provides a description of current and past groundwater management activities in Colusa County. This GMP includes the components required in the Water Code and has been developed in accordance with the required procedures. This GMP also includes many of the voluntary and recommended GMP components. Table I.1 illustrates the compliance of Colusa County GMP with components required in a GMP. Table I.2 presents the compliance of the Colusa County GMP with procedures for GMP development.

D. PLAN COMPONENTS

This GMP consists of the following components:

- Groundwater Management Goals – The overarching principles that guide groundwater management.
- Basin Management Objectives (BMO) – Measurable parameters or criteria related to data that can be scientifically collected.
- Action Program – Specific actions that will be implemented to manage groundwater resources, and to develop a better understanding of the groundwater resources to facilitate their management.
- Groundwater Management Process – The process followed to achieve the Groundwater Management Goals.

E. PLAN AREA

As noted earlier, it is the intent of Colusa County that this GMP is countywide. As shown on Figure I.1, a large part of the land in the County is within the service area of water and irrigation districts, reclamation districts, cities, and public utility districts. Some but not all of the respective entities have adopted groundwater management plans. The plans can be implemented in concert with this GMP; however agreements will need to be executed to formalize their participation in the GMP.





Those entities that have not adopted GMP's can, with formalized action, adopt the Colusa County GMP and thereby fulfill the requirements of the groundwater management provisions of the Water Code. Presented on Figure I.2 are the groundwater basins as delineated by the DWR that underlie the County.

F. PUBLIC INVOLVEMENT IN PLAN DEVELOPMENT

Aside from the required public notices and hearings related to the GMP development, Colusa County undertook an extensive public outreach program to encourage public involvement in GMP development and to solicit public input for the GMP.

The Colusa County Groundwater Commission and the Board of Supervisors approved a Public Outreach Plan (Appendix D) to ensure public involvement in the development of this GMP. The Public Outreach Plan established the following objectives:

- Establish and open process to facilitate stakeholder input.
- Provide information to facilitate stakeholder education on material forming the basis of the GMP.
- Provide a framework by which stakeholders are kept informed of the process, issues, and potential solutions.
- Incorporate public comments throughout the decision-making process.

To help guide the development of the GMP, a Plan Advisory Committee (PAC) was formed that included representatives of water purveyors, cities, and the general public. The PAC meetings were open to the public. Participation in the PAC was voluntary. Seven meetings of the PAC were held in 2007, on March 14, April 18, May 16, June 20, August 15, October 17, and December 19. The last meeting was held on July 8, 2008, after the public review draft had been available. Presentations given at the PAC meetings, meeting agendas, and meeting attendance sheets are included in Appendix E.

During the course of developing the GMP, meetings were held before the County Board of Supervisors on February 6 and June 26, 2007, and before the Groundwater Commission on June 1, 2007, and March 13 and June 18, 2008. All of the above-referenced meetings were publicly noticed and the public was invited to comment as well.

The public was invited to attend public workshops, which were held in Arbuckle on July 10, 2007 and June 10, 2008, and in Maxwell on July 11, 2007 and June 12, 2008. An additional public workshop was held in Stonyford on December 6, 2007. At each of the first set of public workshops, Wood Rodgers presented a PowerPoint presentation of the purpose, scope, and schedule for preparing the GMP, along with educational information related to groundwater, geology, and wells, and information about the hydrogeology within the County. During the second set of public workshops, the BMOs and elements of the proposed GMP, including the Action Program, were





presented. Presentations, attendance sheets, and a summary of public comments from the Arbuckle, Maxwell, and Stonyford workshops are included in Appendix F.

The University of California Cooperative Extension hosted a website for the GMP at <http://colusagroundwater.ucdavis.edu>. All of the presentations and other meeting information were posted on the GMP Website.

GMP Survey

To obtain further input from the public (including many who did not participate in the PAC or the public workshops), the County sent a Public Opinion Survey to 580 residents and received 122 completed surveys in response. The survey and summarized results are included in Appendix G. Although this was not a statistically-based survey, a brief summary of the survey results is presented here.

Respondents were asked if they had experienced problems with groundwater and/or their wells. Forty-five percent had not experienced problems. The most common problems reported were sand or sediment in the well/water and well or equipment failure. The problems with the well or equipment are not necessarily related to groundwater conditions. Approximately 10 percent of respondents (for each issue) reported having low groundwater levels, high groundwater levels, or poor water quality.

The survey presented a number of goals and objectives for groundwater management and asked respondents to indicate whether they agreed or disagreed with these goals and objectives. Respondents supported all of the presented goals and objectives, but strongly favored (more than 70% of respondents) maintaining local control, ensuring a reliable water supply, protecting surface water rights, ensuring long-term groundwater sustainability, and preventing unnecessary restrictions on groundwater use. Support was also given for protecting against and mitigating adverse impacts from groundwater pumping and maintaining or improving groundwater quality. Fewer responses were received for the objectives of coordinating local and regional groundwater management and optimizing the conjunctive use of groundwater and surface water, although the responses received were still largely favorable.

The survey also presented a number of potential adverse impacts from groundwater pumping that were important to avoid. Respondents strongly agreed (more than 70% of respondents) that it was important to avoid significant declines in groundwater levels or degradation of water quality. Respondents also agreed that limited ability to use groundwater, inelastic land subsidence, and increased pumping costs should be avoided. Fewer responses were received for the adverse impacts of significant adverse impacts to surface water and/or wetlands and damage to infrastructure..

Finally, the survey asked whether respondents supported or opposed voluntary out-of-county water transfers or sales when surplus water existed. Sixteen percent supported such transfers or sales, 44 percent opposed, and 39 percent were undecided or thought it depended upon the circumstances. Forty-four percent of respondents indicated that





permits should be required for water transfers, and 24 percent thought permits should not be required. Respondents were split (about 30 percent each way) on whether out-of-county water transfers should be taxed. Twenty-five percent of respondents were undecided or thought it depended upon the circumstances as to the issue of permits and taxation of water transfers.

G. ISSUES OF CONCERN

A variety of issues or concerns with regard to groundwater and groundwater management have been raised by residents of the County during the development of this GMP. These are discussed below.

1. Will the cost of water remain affordable?

Irrigation water costs are critical to farmers in Colusa County. Many farmers say that their businesses would no longer be profitable if irrigation water costs increased. Additional surface water is available from the Tehama Colusa Canal, but is not used because this higher-cost water is viewed as being unaffordable for irrigation use.

This concern is difficult to evaluate because the level of “affordability” of irrigation water is dependent upon a number of variables, including fluctuating prices of other goods and services needed for farming and crop prices. Developing a defined and frequently updated cost target for irrigation water is probably not feasible. Implementation of management strategies to maintain affordable irrigation water costs will have to be based largely on input from the Colusa County Water Users Group (as discussed in Section IV.A.2.d) and the community as to what constitutes an “affordable” water supply during various conditions. The Water Users Group would be comprised of a “core” group of individuals representing a cross-section of landowners and managers representing water purveyors and non-organized areas.

2. Is there enough groundwater to sustain a drought?

Increased use of groundwater in some areas is perceived to be taxing the available supply, and there is concern that wells will go dry during a drought. A related concern is that existing wells may be damaged by increased pumping. This concern is particularly widespread in the Arbuckle area, where groundwater is used extensively for irrigation. Additionally, changes in cropping trends to more permanent crops have raised concerns about the ability to reduce groundwater use during drought periods without sustaining substantial economic losses.

This concern is understandable given the history of significant groundwater level fluctuations in the Arbuckle area during past drought periods. Data also indicate that during wetter periods, or when pumping is reduced, groundwater levels fully recover. The need for water supply reliability to support businesses in the County is





best addressed through the conjunctive use/management of available surface water, groundwater, and recycled water supplies. Together, these water sources comprise the irrigation water supply for the County, and can be used in fluctuating proportions to meet demands during different hydrologic (including climatic) and economic conditions. Successful management will also require better coordination among water users, and water users will need to work together to develop strategies for curtailing water use during drought periods. Intra-county water transfers (transfers from one party to another within Colusa County) become an important water management consideration during these periods.

3. Are there plans to “take” water out of Colusa County?

There is general concern that projects related to groundwater studies and groundwater management (including this GMP) are somehow related to the desire to “take” water from the County. Those who express this concern feel that DWR (and other parties within and outside of the County) cannot be trusted to protect the interests of the community of the County.

This concern can be somewhat allayed by maintaining local control of water management decisions. Also, establishing an open process for discussing groundwater conditions and making management decisions will help allow people and entities within the County to have a better understanding of the resources and issues and to voice their concerns and have them addressed. If groundwater (and the conjunctive use of groundwater and surface water) can be effectively and sustainably managed, the community of Colusa County can take the lead in determining which actions or projects would be acceptable. These determinations should be based upon sound hydrogeology rather than ideology, and must also work within the framework of existing water and property rights.

4. Will there be taxes or fees for groundwater use?

Concerns have been expressed about the sources of funding for the GMP and other groundwater programs in the County. Funding will be necessary for implementation of the GMP, to provide for staff and ongoing monitoring and evaluation activities and to undertake groundwater investigations. Funding for the latter may be available from DWR and other grant programs. There is concern about the potential for taxes and fees on groundwater use, and metering of pumps.

This GMP does not contain any recommendation to meter groundwater pumping or to enact use-based fees or taxes, although they are considerations and are used in other areas. Property owners have a right to make beneficial use of groundwater on their land. A variety of potential mechanisms to fund ongoing groundwater management are discussed in this GMP. The objective of these potential funding mechanisms would be to generate revenue to cover the costs of groundwater management only.





5. How can we obtain good quality water?

Water quality problems are significant within the County, and concerns have been expressed about water quality with regard to salinity, arsenic, and manganese. The hydrogeology of the County as it relates to water quality is not well-understood, and further study will be necessary to develop guidelines for how to obtain good-quality water in different areas of the County, and to determine how to manage groundwater without causing water quality deterioration in areas with otherwise good quality water.

6. Is this going to generate new regulations on groundwater?

Concern has been expressed about the potential for additional layers of bureaucracy and regulations on groundwater use. In general, stakeholders recognize a need to better understand and manage groundwater in the County, but have expressed a desire for a “balance” between achieving this objective and minimizing bureaucracy and regulations.

To implement the GMP, an institutional framework will be needed; however, the intent of this GMP is to minimize the bureaucracy and regulations needed to achieve the goals and objectives of the GMP. The GMP provides a framework and a forum for studying, discussing, and managing groundwater within the County. Ideally, management will be accomplished cooperatively amongst groundwater users in the County. If this cooperative process is not successful, the GMP describes a process for addressing issues and disputes that may arise.





II. THE COUNTY

A. DEMOGRAPHIC AND PHYSICAL SETTING

Colusa County is located in the Central Valley and Coast Ranges of northern California. The County seat, Colusa, is located approximately 50 miles northwest of Sacramento, and 10 miles west of the Sutter Buttes. The County covers approximately 1,151 square miles, and had an estimated population of 21,272 in 2006 (U.S. Census Bureau). The majority of the population resides in the Cities and communities, with about 15 percent of the population in rural areas. Land use within the valley portion of the County is largely agricultural, with approximately 304,000 acres in production (2003 California Department of Water Resources Land Use).

The main population centers in the County are the City of Colusa, population 5,402, City of Williams, population 3,670, and community of Arbuckle, population 2,332 (2000 United States Census). The main transportation routes are Interstate 5, which runs north-south through the valley portion of the County, and California State Route 20, which runs east-west through the County.

Land surface elevation in the County is higher in the west and lower in the east. The highest land surface elevation in the County is approximately 7,040 feet above sea level near the peak of Snow Mountain East, in the northwestern corner of the County. The lowest land surface elevation is approximately 25 feet above sea level in the Colusa Basin in the southeastern portion of the County.

The Sacramento River flows from north to south through the eastern portion of the County, forming the Sutter-Colusa County Line in the southern half of the County. Butte Creek forms the Sutter-Colusa and Butte-Colusa County Line in the northern half of the County.

Colusa County is also fortunate to have substantial surface water supplies by virtue of the foresight, dedication, and investment made by citizens of Colusa County and the Sacramento Valley generally. A number of the water districts in the County (Figure I.1) divert and transfer surface water from the Sacramento River directly or from the Tehama-Colusa Canal, which diverts and transfers water from the Sacramento River at Red Bluff. Water districts in Colusa County have settlement or water service contracts with the United States Bureau of Reclamation for an estimated 645,000 acre-feet of base supply and over 118,000 acre-feet of supply from the Federal Central Valley Project. Some of this water is used for agriculture in Glenn and Yolo Counties.

B. WATER PURVEYORS AND USERS

The management of water resources in the County is performed by water purveyors and individual water users having “hands on” control of both surface water and groundwater for agricultural, urban, environmental, and domestic uses. These water managers represent a complex mix of organized water purveyors, non-organized areas, and areas





within National Wildlife Refuges. A brief discussion of each category is presented below. A breakdown of the land area within each water management entity/area is presented in Table II.1. The location of the respective entities is shown in Figure I.1. The amount of land in the Sacramento Valley portion of the County that is irrigated, developed, or managed as wetlands is about 400,000 acres, or 54 percent of the approximately 740,000 acres in the County. The remaining approximately 340,000 acres represents the western portion of the County, which is mainly native and riparian vegetation and non-irrigated agriculture (i.e. grazing).

Please note that due to rounding, the land and water use values presented in tables in this and following sections may vary slightly based on the way they are summarized.

1. Water Purveyors

There are 26 water purveyors in Colusa County that provide water service to their customers. These water purveyors are comprised of water districts, irrigation districts, reclamation districts, mutual water companies, public utilities districts, and incorporated cities.

There are six water purveyors that provide water service in both Colusa and Glenn Counties. They are:

- Glenn-Colusa Irrigation District (GCID)
- Princeton-Codora-Glenn Irrigation District
- Provident Irrigation District
- Reclamation District No. 1004
- Willow Creek Mutual Water Company
- Stony Creek Water District

Of the six water purveyors noted above, all are within the Sacramento Valley part of Colusa County except the Stony Creek Water District, which is in the Coast Ranges in the western portion of the County.

There are three water purveyors that provide water service in both Colusa and Yolo Counties. They are:

- Reclamation District No. 108 (RD 108)
- Colusa County Water District
- Colusa Drain Mutual Water Company





As shown in Table II.1, 42 percent of the County, or 78 percent of the area of the County in irrigated agriculture, is within the service area of a water purveyor.

It is important to note here that of all the water purveyors in the County, only four have groundwater management plans established under provisions of AB 3030. Of these, only two have adopted Groundwater Management Plans that incorporate provisions of SB 1938. These are as follows:

AB 3030 Compliant

Princeton-Codora-Glenn Irrigation District and Provident Irrigation District.

AB 3030 and SB 1938 Compliant

GCID and RD 108.

2. Non-Organized Areas

The non-organized areas within the County are comprised of land under irrigated agriculture but not within the boundaries or service area of established water purveyors. For purposes of the GMP, the land under irrigation but outside of an established water purveyor's boundaries were grouped, for "bookkeeping" purposes into six contiguous areas noted as NOA-1 through NOA-6. Small fragmented areas of land that were not contiguous to these six areas were included within an adjacent or nearby water purveyor. Nineteen percent of the irrigated agricultural land in the County is not within an organized or managed area; this represents about 11 percent of the County.

3. National Wildlife Refuges

There are three National Wildlife Refuges located within the County. They are:

- Sacramento National Wildlife Refuge (in both Colusa and Glenn Counties)
- Delevan National Wildlife Refuge
- Colusa National Wildlife Refuge

The Wildlife Refuges represent 3 percent of the irrigated land in the County, and 2 percent of the County at large.

C. LAND USE

Colusa County encompasses approximately 740,000 acres. DWR performed detailed surveys of land use within the County in 1993, 1998, and 2003, which provide a good





record of changes in land use with specific information related to the location. This information is extremely useful from the standpoint of water management.

Presented in Table II.2 is a breakdown of land use in the County for the respective years. During the 1993-2003 period, there was an increase in permanent crops of approximately 33 percent, from 31,985 acres to 42,680 acres. Almonds, which represented 70 percent of the permanent crop in 2003, showed the largest increase, from 19,948 acres in 1993 to 30,232 acres in 2003, a 52 percent increase. Although there was a significant increase in the amount of permanent crops, overall there was a decrease of 16,000 acres, or about 5.5 percent of the total permanent and non-permanent crops. Even though urban land use increased 20 percent from 1993 to 2003, it represents only 4,881 acres of land, or less than 2 percent of the irrigated land within the county. Figure II.1 shows the land use in Colusa County in 2003.

Presented in Table II.3 is a summary of the irrigated crops and associated acreage in 2003. The crops representing more than 10 percent of the irrigated land are rice, grain, and almonds, which were about 49, 12, and 11 percent respectively. Presented in Table II.4 is the area within the various water management entities/areas in the County. Seventy-five percent of the land in rice was, in decreasing order, in GCID, Reclamation District No. 1004, RD 108, and Colusa Drain Mutual Water Company. Land planted with grain in 2003 was more widespread throughout the various water management entities/areas. Almonds on the other hand were produced largely (94 percent) in the Colusa County Water District, Westside Water District, and the area identified as Non-Organized Area 2.

D. WATER USE

The amount of water applied for agricultural production and urban or community use has been estimated using information from DWR Northern District office with respect to unit crop, consumptive use, and applied water, with corresponding losses included and accounted for. Water use within cities and communities was estimated using limited production data from some water purveyors. The Water Use and Supply Technical Memorandum (Appendix H) provides a complete discussion of the land and water use in the County, along with a more detailed description of the methodologies used.

1. Agricultural Water Use

Estimates of water applied for irrigated agriculture were calculated for 1993, 1998, and 2003, the three years for which land use information was available. It was not possible to perform a water balance analysis as part of this GMP. The estimates of applied water provide some dimension of water use as it relates to the management thereof. Presented in Table II.5 is an estimate of the applied water for crop production for the year 2003.





Of the total estimated applied water of 1,066,000 acre-feet, only 16 percent is applied to land for which no organized entity exists for water management. During a dry year, the applied water could increase by about 40,000 acre-feet for the same crop mix.

With respect to water management, the total applied water is important; however, the extent of the conjunctive use of surface and groundwater is important as well.

Although data to determine groundwater extraction is not available, information compiled by DWR does allow for an estimate of the mix of land using surface water and groundwater. Accordingly, using the available information and assumptions noted in Table II.5, an estimate was made of the amount of surface water and groundwater used for irrigation. Taking into account the assumptions made, the estimate of groundwater use for 2003 is judged to be somewhat higher than might actually have occurred.

As shown in Table II.5, the use of surface water and groundwater was estimated to be roughly 80 percent and 20 percent, respectively. By comparison, the neighboring counties of Yolo and Glenn show greater groundwater utilization. Yolo County is estimated under average water year conditions to use 67 percent surface water and 33 percent groundwater. Glenn County's water mix on average is approximately 72 percent surface water and 28 percent groundwater.

2. Urban/Community Water Use

Water for urban and community use is from groundwater. The total applied water was estimated at 7,600 acre-feet in 2000, and projected to 8,400 acre-feet in 2010. This amount represents less than 1 percent of the total applied water for agriculture, and less than 4 percent of the estimated groundwater use for agriculture.

3. Rural/Domestic

The population residing outside a city or community is estimated to be about 3,400. This population uses groundwater entirely, and is estimated to use about 1,200 acre-feet annually.

E. WATER RESOURCES

1. Surface Water

a. Seasonal and Long-Term Hydrology

Climate has a direct impact upon the availability of water in Colusa County. According to the data collected by the Western Regional Climate Center, the average annual precipitation is 15.64 inches per year and average snowfall is 0.5 inches per year (WRCC, 2007). The annual average temperature is





approximately 61°F, with an average high of 96.6°F in July and 36.1°F in January.

Rainfall in the Sierra Nevada, Coast Range, and Cascade Mountains contribute to surface water flow and groundwater recharge in the Sacramento River Basin. The general direction of surface water flow is toward the center of the valley, flowing south. Water diversions, evaporation, and groundwater recharge reduce flows as the Sacramento River approaches the Delta. Peak flow typically occurs in the months January through March and minimum flows typically occur September through November (GCDA, 2005).

b. Seasonal and Long-Term Water Quality

Under the USGS National Water Quality Assessment (NAWQA) Program, the USGS conducted an intensive study of the Sacramento River Basin and collected data between 1995 and 1998. Through the sampling process, indicator streams were determined based upon the characterization that they drain small to intermediate sized watersheds with relatively homogeneous land use and geology. The Colusa Basin Drain basin is located entirely in the Sacramento Valley and was chosen as an indicator stream to determine the impacts of agriculture on stream-water quality (USGS, 1998). At the indicator water quality station, Colusa Basin Drain at Road 99E near Knights Landing, it was determined that pH levels were generally on the higher end, with declining suspended sediment concentrations over the two-year sampling period. The higher concentrations of mercury correlate with suspended sediment because much of the load of total mercury is transported with the suspended material.

The findings of the USGS study also indicated that the water of the Sacramento River and its major tributaries is generally of good quality; the amount of dissolved solids in the Sacramento River and its major tributaries (Yuba, Feather, and American rivers) was low at all of the sampled locations. Higher median concentrations of dissolved solids occurred at agricultural sites such as the Sacramento Slough and Colusa Basin Drain, but those are diluted upon mixing with Sacramento River water (USGS, 2000). Nutrient concentrations such as nitrate also were low throughout the Sacramento River Basin (USGS, 2000), and drinking-water standards for nitrate were not exceeded during the course of this study. The concentrations of molinate and other pesticides (used in rice farming) measured during this study in the Colusa Basin Drain or in the Sacramento River, represent a significant improvement over concentrations measured in previous years (USGS, 2000).

c. Surface Water Bodies

The Sacramento River is the only major naturally occurring water body in Colusa County. The three major man-made water bodies in the County are the





Colusa Basin Drainage Canal, the Tehama Colusa Canal, and the Glenn Colusa Canal.

The following discussion provides information on the location, ownership, infrastructure, and an overview of the operational practices of the major water bodies that relate to or are within Colusa County.

(1) The Sacramento River

The Sacramento River is the only major naturally occurring water body in Colusa County. It runs north-south through the eastern part of the County and passes through on its way to the Delta and San Francisco Bay. Many tributary streams flow from the mountains on both sides of the valley into the Sacramento River. According to a 2005 report by the Glenn County Department of Agriculture (GCDA), flows in the Sacramento River near Grimes in Southern Colusa County range from 6,500 cfs to 16,900 cfs for the period of record of 1946-2003 (GCDA, 2005).

Data is not available to characterize the stream/aquifer interaction along the Sacramento River through Colusa County. To properly determine groundwater-surface water interaction, it is necessary to have nested monitoring wells located in close proximity to a stream gage. The nested monitoring wells must be completed in the very shallow groundwater zone that is directly connected to a surface water system, and in the deeper zones as well. The existing nested monitoring wells in Colusa County are shown on Figure III.3. The well locations are not suitable for characterizing the stream/aquifer interaction. The DWR Northern District has stated that existing data is inadequate to characterize the system.

(2) The Colusa Basin

The Colusa Basin is a flat, lowland on the Sacramento Valley floor and extends from the City of Orland south to Knights Landing, and the Sacramento River and the Coastal Range foothills form its eastern and western boundaries, respectively (USBR, 2000). The Colusa Basin watershed is approximately 1,620 square miles (over one million acres) and lies within Glenn, Colusa, and northern Yolo Counties (USBR, 2000). Most of the land in the Basin is used primarily for agricultural production and also contains three national wildlife refuges: Sacramento, Delevan, and Colusa. Reclamation District No. 2047 (RD 2047) was formed in 1919, prompted by the inadequacy of the existing drainage facilities with the Colusa Basin (USBR, 2000). Increased development of the Colusa Basin caused return flows from irrigation to create flooding problems downstream of the irrigated areas (USBR, 2000). RD 2047 developed a plan to construct physical works to handle the irrigation return flow





(USBR, 2000). The principle feature of the RD 2047 plan was the Colusa Basin Drainage Canal.

d. Colusa Basin Drainage Canal

The manmade Colusa Basin Drainage Canal conveys stormwater runoff and agricultural return flows from the Colusa Basin watershed and discharges to the Sacramento River at Knights Landing (DWR, 2007). The canal begins at the junction with Willow Creek and flows southerly to its terminus at the Knights Landing Ridge Outfall Gates. The Colusa Basin Drainage Canal is designed to convey irrigation drainage flows to the Knights Landing Outfall Gates for discharge into the Sacramento River. During high flows, the Knights Landing Outfall Gates are closed and water in the Colusa Basin Drain is often diverted through the Knights Landing Ridge Cut to the Yolo Bypass. The Colusa Basin Drain is the single largest source of agricultural return flows to the Sacramento River (DWR, 2007).

The Colusa Basin Drainage Canal has thirty-two naturally occurring ephemeral creeks, fourteen of which are in Colusa County, that drain flows from the foothill area (USBR, 2000). Those in Colusa County include:

- Cortina Creek
- Elk Creek
- Freshwater Creek
- Funks Creek
- Glenn Valley Slough
- Lurline Creek
- Manor Slough
- Petroleum Creek
- Salt Creek
- Sand Creek
- Spring Creek
- Stone Corral Creek
- Sycamore Slough
- Walters Creek

Runoff in these creeks typically begins in late fall, peaking in mid-winter, and decline to no flow in late spring (USBR, 2000). According to the 2000 USBR Draft EIS/EIR, this runoff generally passes through the Colusa Basin with little impairment for consumptive use and continues to the Sacramento River or Yolo Bypass through the Colusa Basin Drain. According to the 2000 Draft EIS/EIR, there is little to no naturally occurring water supplies in the Colusa Basin in the summer other than groundwater (USBR, 2000). Water from the Sacramento River was initially diverted and used for irrigation use; however, after the construction of the Colusa Basin Drain, irrigators started reusing the irrigation return flows.





In addition to the main Colusa Basin Drainage Canal, a branch channel that follows the boundary between RD 108 and RD 787 was constructed to connect the Colusa Basin Drainage Canal to the Sacramento River. The branch channel is now used to convey water pumped from the Sacramento River to RD 108 and RD 787 (USBR, 2000).

(1) The Sacramento Canals Unit of the Central Valley Project

The USBR Sacramento Canals Unit of the Central Valley Project was designed to provide irrigation water in the Sacramento Valley, principally in Tehama, Glenn, and Colusa Counties, although it was planned that water would be diverted to storage in Sites Reservoir in the winter and released later for conveyance to Yolo and Solano Counties. By exchange, water was to be made available to Lake and Napa Counties. Authorized in 1950, the unit consists of Red Bluff Diversion Dam, Funks Dam, Corning Pumping Plant, Tehama-Colusa Canal, and Corning Canal. Supplemental irrigation water supplies are provided to about 94,000 acres in Colusa County (USBR, 2007).

2. Surface Water Supply Contracts

a. Settlement Contracts

USBR currently contracts with approximately 145 water districts, water purveyors, or private users for water rights to the Sacramento River. The total amount of water under the settlement contracts is approximately 2.2 million acre-feet and cover a total of almost 440,000 acres of land bordering the Sacramento River and its tributaries between Redding and Sacramento. The Settlement Contracts were originally executed in 1964 with a term not to exceed 40 years. New contracts have been executed with approximately 145 existing Sacramento River Settlement Contracts.

The Settlement Contracts include a Base Supply and Project Water. The Base Supply is the amount that reflects the agreed-upon water right of the respective entity. This is generally regarded as pre-1914 water rights and reflects water that would be available to the respective entities under “natural” conditions. Project Water represents the amount of water the Bureau of Reclamation agrees to provide from its Central Valley Project yield. The Settlement Contractors in Colusa County are presented in Table II.6. Altogether, there are 42 contractors in Colusa County, representing an estimated total contract amount of 763,000 acre-feet, with approximately 84 percent Base Supply and 16 percent Project Supply. Approximately 8 percent or 60,000 acre-feet is within contracts with entities within the non-organized areas. The balance, or 92 percent of the contract amount, is managed by water purveyors, some of which serve land in both Colusa County and Glenn or Yolo Counties.





Under the provisions of the Settlement Contracts both the Base Supply and Project Supply could be reduced by 25 percent of the total contract amount.

b. Long-Term Renewal Contracts

In accordance with the Central Valley Project Improvement Act (CVPIA), the USBR negotiated long-term water service contracts in 2007. According to Section 3404c of the CVPIA, Renewal of Existing Long-Term Contracts requires the USBR to renew any existing long-term repayment or water service contract for the delivery of water from the Central Valley Project for a period of 25 years and may renew such contracts for successive periods of up to 25 years each. It is anticipated that as many as 113 CVP (Central Valley Project) water service contracts, located within the Central Valley of California, may be renewed during this negotiation process (USBR, 2007a). There are seven water service contracts within the County, including with Colusa County, as presented in Table II.7. The total contract amount is 224,586 acre-feet, of which 20,000 acre-feet is with Colusa County. Colusa County has subcontracted the 20,000 acre-feet to seven water purveyors.

The long-term renewal contracts, unlike the Settlement Contracts, have no specified reduction in delivery; during critically dry or water-short years, the water supply available from the Project will be allocated among the contractors. There is no minimum allocation, thus it is conceivable, as noted in Table II.7, that no water would be delivered.

Also, the long-term renewal contracts contain a tiered pricing provision. As shown in Table II.7, the Base Supply is 80 percent of the total contract amount, and Tier 1 and Tier 2 supplies represent 10 percent each of the remaining contract amount. Each tier has an incrementally higher water cost. The Tier 1 and Tier 2 water, which is available in most years, is not used due to the incremental higher cost of water. To illustrate the use of contract water in relation to the contract amount, in 2003, 137,302 acre-feet was delivered by the USBR, representing 76 percent of the total 179,668 acre-feet of Base Supply.

3. Groundwater

a. Groundwater Basins and Subbasins

There are seven groundwater basins within Colusa County (Figure I.2), as defined by DWR in "California's Groundwater, Bulletin 118 – Update 2003": the Stonyford Town Area, Bear Valley, Little Indian Valley, Funks Creek, Antelope Valley, Blanchard Valley, and Sacramento Valley Groundwater Basins. Of these, all except the Sacramento Valley Groundwater Basin are small (less than 15 square miles) isolated basins located in the Coast Ranges in the central to western portions of the County; they have not been divided into





subbasins. The Stonyford Town Area and Funks Creek Groundwater Basins also extend into Glenn County.

The Sacramento Valley Groundwater Basin, in contrast to the smaller basins described above, covers over 5,900 square miles and 10 counties, and has been divided into 18 subbasins. According to DWR:

“A groundwater basin is defined as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined [...] features that significantly impede groundwater flow such as rock or sediments with very low permeability or a geologic structure such as a fault. [...]

“A subbasin is created by dividing a groundwater basin into smaller units using geologic and hydrologic barriers or, more commonly, institutional boundaries [...]. These subbasins are created for the purpose of collecting and analyzing data, managing water resources, and managing adjudicated basins.”

Colusa County overlies portions of two subbasins of the Sacramento Valley Groundwater Basin: the Colusa and West Butte Subbasins. The Colusa Subbasin underlies the entire valley portion of the County west of the Sacramento River, and also extends into Yolo, Glenn, and Tehama Counties. The West Butte Subbasin underlies the portion of the County east of the Sacramento River, and also extends into Glenn and Butte Counties.

b. Geology

(1) Overview of Groundwater and Geology

Groundwater is water that is underground and below the water table, as opposed to surface water, which flows across the ground surface. There are three main types of subsurface geology where groundwater can exist:

- Hard Rock – Groundwater can be present in cracks or fractures in the rocks.
- Underground Caverns – Groundwater can fill these underground voids.
- Porous Sediments – Groundwater can fill the pore spaces between grains of sand and gravel.

In Colusa County, groundwater exists in hard rock and porous sediments. In the mountainous portions of the County, groundwater exists in hard rock aquifers; in the valley portions of the County, groundwater exists in





porous sediments, or alluvial aquifers. Figure II.2 shows simplified surface geology and the major structural faults in the County.

In the western portion of the County, the surface and subsurface are made up of igneous and metasedimentary rocks. In these areas, groundwater is present in the cracks and fractures in the rocks. In order for this groundwater to be replenished after it is removed by pumping, the fractures must receive recharge from precipitation or intercept a renewable water source like a river or stream, which must have an available supply of water to recharge the fractures. The fractures in hard rock can be irregular and disconnected, which can explain why two wells in a hard-rock setting can be very close together, but may produce very different amounts of water. Additionally, the groundwater available to supply wells in hard rock aquifers can vary significantly with seasonal and year-to-year variations in rainfall.

In the central-western portion of the County, the surface and subsurface are made up of marine sediments. These marine sediments are not typically as hard as the igneous and metasedimentary rocks, but still basically function as hard rock aquifers. The marine sediments were deposited under a salt-water environment, so water quality can be poor and often deteriorates with depth. Groundwater can also be irregular and disconnected, so nearby wells can have very different well yields and water quality.

In the valley portions of the County, both in the small valleys in the Coast Ranges and in the Sacramento Valley, the subsurface consists of layers of gravel, sand, clay, and in some cases volcanic ash. Groundwater is present in the pore spaces between the matrixes of particles that make up the alluvial aquifers. The characteristics of different aquifers, and zones within each aquifer, are related to the aquifer materials (sands, gravels, clays, etc.). Within a single aquifer zone, nearby wells with similar construction can have very similar well yields and water quality. It should be noted that many of the geologic formations that contain alluvial aquifers are continuous units that are also present in other counties as discussed.

Smaller valleys often contain a very limited amount of sediment and thus have less capacity to store groundwater. For this reason, changes in the balance of recharge and pumping can quickly cause significant changes in groundwater conditions in small valleys. It is possible for small valleys to experience significant water level declines in a single year if pumping exceeds recharge. In contrast, the larger storage capacity in larger valleys can in many cases accommodate variations in the recharge/pumping balance over a number of years, with smaller variations in water levels.





It is difficult to characterize groundwater in the igneous and metasedimentary rocks and marine sediments over large areas. Groundwater in these areas is generally limited, and data on water levels and water quality have not been collected. Additionally, the nature of hard rock aquifers makes them difficult to study. Groundwater is not continuous over large areas, so data from one area may be completely unrelated to data in another area. In the small alluvial valleys in the Coast Ranges, there is very limited data available to characterize their groundwater systems; however, if data were collected and analyzed, these valleys could likely be well-characterized because groundwater is probably continuous within these valleys. There is a large amount of data available in the Sacramento Valley, it has been widely studied, and groundwater is continuous within specific aquifer zones (although discontinuous between different aquifer zones) over large areas within the Sacramento Valley. For this reason only, further discussion will focus on the Sacramento Valley.

(2) Status of Understanding of Regional and Local Geology

The geology of the Sacramento Valley has been studied for at least 95 years, and much has been learned over this time. However, there are still many areas of active study and debate. In Colusa County, areas that are not well-understood include:

- The nature and extent (location and depth) of the deposits that eroded from the Sutter Buttes.
- The interaction between the Coast Range-sourced Tehama Formation and analogous Sierra Nevada-sourced deposits, and where this interaction occurs.
- The possible existence of subsurface barriers to groundwater flow within the County.
- The nature and extent of different aquifer units within the Tehama Formation.

(3) Regional Geology and Structure

The Sacramento Valley Groundwater Basin acts as a trough that is filled with layers of different sediments. The deepest portions of the Basin generally consist of marine sedimentary rocks, ranging in age from Late Jurassic to early Miocene. These marine units are overlain by younger alluvial and locally prominent volcanic rocks of early Miocene to Holocene age (Harwood and Helley, 1987). Within the Basin, these deposits are disrupted by deformational stresses derived from east-west





compressional forces associated with regional uplift along the western margin of the valley and extensional forces within the Basin and Range Provenance (Harwood and Helley, 1987). Over time, these forces have applied great stresses and strain on valley deposits, creating complex and diversely-oriented fold and fault structures.

One of the prominent fault systems that occurs in Colusa County is the Willows-Corning Fault, which crosses through the northeastern portion of the County. This fault is located immediately northeast of the City of Colusa and extends north toward Red Bluff and southeast just below the Sutter Buttes toward Sacramento. The Willows-Corning Fault is an active northwest-trending fault that dips steeply to the east and shows reverse displacement, meaning the ground east of the fault has moved up relative to the west side.

A prominent structural feature in the Sacramento Valley is the Sutter Buttes. It is composed of late Cenozoic volcanic rocks that rise about 2,000 feet above the Sacramento Valley floor. The Sutter Buttes volcanic feature formed between 2.4 and 1.4 million years ago as magma was injected in to overlying Cretaceous and Tertiary rocks (Harwood and Helley 1987).

(4) Regional Stratigraphy

The prominent non-marine water-bearing stratigraphic units found within the Colusa and West Butte Subbasins include (from youngest to oldest): the present-day stream channel and basin deposits, the Modesto Formation, the Riverbank Formation, the Sutter Buttes Alluvium, and the Tehama Formation. The Tuscan Formation, which is a prominent aquifer in Glenn and Butte Counties, is likely not significantly present in Colusa County. The stratigraphic descriptions presented herein are based primarily upon DWR's "Bulletin 118 – California's Groundwater", and are shown in the conceptual geologic cross-section (Figure II.3). The location of this cross-section is shown in Figure II.2.

(5) Recent Alluvial Deposits

Recent alluvial deposits include stream channel deposits, basin deposits, the Modesto Formation, and the Riverbank Formation. These deposits were created by moving stream channels that meandered, cutting through existing sediments within the valley and creating an interconnected relationship. As such, it is likely that many channels or pathways exist that allow groundwater to move among all of the recent alluvial deposits. There is limited data in well logs to allow for differentiation among the different recent alluvial deposits.





Stream channel deposits are Holocene in age and were deposited between 11,000 years ago and present day. The stream channel deposits occur along the current and ancestral paths of streams and rivers in the Colusa County. Where present, the stream channel deposits extend from ground surface to a depth of 1 to 200 feet below ground surface (bgs). The stream channel deposits consist of unconsolidated gravels, sand, silt, and clay, derived from the erosion and reworking of the Quaternary stream terrace deposits (Modesto and Riverbank Formations) and the Tehama Formation. This unit is moderately to highly permeable, but because of its shallow depth and limited thickness, it possesses limited water-bearing capacity.

Basin deposits are Holocene in age and, like stream channel deposits, were deposited between 11,000 years ago and present day. Basin deposits occur where sediment-laden floodwaters breached natural stream and river levees and spread across lower-lying topography. Where present, the basin deposits extend from ground surface to a depth of 1 to 200 feet bgs. The basin deposits consist mainly of silt and clays. These units have low permeability and generally yield small quantities of water to wells.

The Modesto Formation is Pleistocene in age and was deposited between 2 million and 500,000 years ago. The Modesto Formation is a stream terrace deposit consisting of gravels, sands, and clays derived from the reworking and deposition of the Riverbank Formation. The Modesto Formation was probably deposited by the same stream and river systems that flow today, because it generally borders existing channels (Blake et. al., 1999). Where present, the Modesto Formation begins between ground surface and 100 feet bgs and extends to a depth of approximately 200 feet bgs. The units of the Modesto Formation are moderately to highly permeable and can yield limited quantities of water to wells.

The Riverbank Formation is Pleistocene in age and was deposited between 2 million and 500,000 years ago. The Riverbank Formation consists of pebbles and small cobble gravels, interlayered with reddish clay, sands and silts. Like the Modesto Formation, the Riverbank Formation is a stream terrace deposit; however, the Riverbank Formation is older than the Modesto Formation. The Riverbank Formation has two units. The lower unit of the Riverbank Formation is lithologically similar to the Red Bluff Formation (which occurs further north in the Sacramento Valley) and has a similar brick-red color. It occurs on the higher of two terraces that have been cut and filled into the surface of the Red Bluff and/or Tehama Formations. The upper unit of the Riverbank Formation consists of extensive flat stream terraces along major creeks in the valley (Helley and Harwood, 1985). The Riverbank Formation begins between ground surface and 150 feet bgs and extends to a depth of approximately 200 feet bgs. The Riverbank Formation is moderately to highly permeable and can yield moderate quantities of water to wells.





(6) Sutter Buttes Alluvium

The Sutter Buttes Alluvium is an alluvial fan deposit observed in the subsurface, which may range in thickness up to 600 feet thick (DWR, 2000). These fan deposits consist largely of gravels, sands, silts, and clays, and may extend up to 15 miles north of the Sutter Buttes and west beyond the Sacramento River. Certain zones within this unit yield large quantities of water (DWR, 2004).

(7) Tehama Formation

The Tehama Formation is Pliocene in age and was deposited between 4 million and 1 million years ago. The Tehama Formation was deposited by coalescing alluvial fan deposits from the Coast Ranges, and consists of interbraided gravel, sand, silt, and clay. The Tehama Formation outcrops in the low foothills of the Coast Ranges at the western edge of the Sacramento Valley. Throughout the flat areas of the western Sacramento Valley, the Tehama Formation is overlain by one or more of the younger deposits described above. Toward the center of the Sacramento Valley, near the Sacramento River, the Tehama Formation interfingers with the Sierra Nevada- and Cascade Mountains-sourced Tuscan and Laguna Formations. Within the Tehama Formation, the gravel, sand, and silt materials are separated into distinct zones by impermeable and semi-permeable layers of clay and other fine-grained materials. The gravel and sand zones are generally less than 50 feet thick, and may lack lateral continuity. Although the Tehama Formation is the principal water-bearing formation in the western half of the Sacramento Valley, the units of the Tehama Formation have not been studied in detail in Colusa County. The Tehama Formation begins between ground surface (in the outcrop areas) to 200 feet bgs and becomes thicker toward the center of the Sacramento Valley, extending to a depth of up to 1700 feet bgs. The units of the Tehama Formation are moderately permeable, but because of its extent and thickness, the Tehama Formation can yield moderate to high volumes of water to wells.

Vertical offset occurs in the Tehama Formation across the Willows-Corning Fault. The exact amount of offset across the fault is hard to determine because of constraints placed on available well data. It can be assumed that before or during the deposition of the basal Tehama Formation sequence, the Willows-Corning Fault system was actively moving. Harwood and Helley (1987) observed this type of movement and deposition in Tehama outcrop patterns in the Elder Creek area. A distinctive marker bed within the basal portions of the Tehama Formation is the Nomlaki Tuff member, which was deposited approximately 3.4 million years ago (Harwood and Helley, 1987). Changes in formation thickness within the basal Tehama Formation are substantiated by the





change in position of the Nomlaki Tuff member across the Willows Fault system, as observed in outcrops in Tehama County. Northeast of the Willows-Elder Creek Fault, the Tehama Formation dips gently to the east and the Nomlaki Tuff member is at its base. Southwest of the Willows-Elder Creek Fault, the Tehama Formation dips steeply eastward into the Sacramento Valley, and the Nomlaki Tuff is a few hundred meters above the base of the Tehama Formation (Harwood and Helley, 1987).

(8) Tuscan Formation

The Tuscan Formation has been the subject of much interest in recent years, but records from gas wells indicate that it is likely only present in the very northeastern corner of Colusa County and consequently is not a major water source for the County.

The Tuscan Formation is Plio-Pleistocene in age and was deposited between 4 million and 2 million years ago. The Tuscan Formation was derived by alluvial deposition associated with erosion of volcanic material derived from Cascadian Volcanics. It outcrops from Red Bluff, in the northern part of the Sacramento Valley, to Oroville, southeast of Chico, and has been recognized in the subsurface at a distance of about 15 miles west of the Sacramento River (DWR, 2003a). The deposits of the Tuscan Formation thin from east to west, from about 1600 feet thick in the foothills of the Sierra Nevada to about 300 feet thick in the subsurface in the Sacramento Valley (Lydon 1969). In outcrop, the exposures of the Tuscan Formation are described as four separate but lithologically similar units, Units A through D (Helley and Harwood, 1985); Units A, B, and C could exist within Glenn County in the subsurface (DWR, 2006). All of the units of the Tuscan Formation contain volcanic mudflows, volcanic conglomerates, volcanic sandstones, siltstones, and tuff deposits. In the subsurface, the Tuscan Formation consists largely of black volcanic sands and gravels, with interbedded layers of tuff breccias and tuffaceous clays (Ferriz, H., 2001). Unit A is the oldest water-bearing unit and is distinguished from Units B and C by the presence of metamorphic clasts. Unit B contains equal distributions of volcanic mudflows, conglomerates, and tuffaceous sandstones. Units A and B are referred to as the "Lower Tuscan Formation". Unit C is capped by massive volcanic mudflows with some interbedded conglomerates, and sandstones. In the subsurface, the volcanic mudflows of Unit C act as a confining layer to movement of groundwater in the more permeable deposits of the Lower Tuscan Formation (Helley and Harwood, 1985).

c. Groundwater Levels

DWR maintains a publicly available on-line database, which includes groundwater level data for the County. DWR's Water Data Library (WDL)





Website can be found at <http://www.wdl.water.ca.gov/>. Wells monitored by DWR and cooperating agencies, are identified by the State Well Numbering System (SWN). Data can be obtained for specific wells by means of a map interface, by groundwater basin, or by the assigned SWN. The 77-year period of record for water level measurements in Colusa County depicts a groundwater system that has experienced changing conditions over time. Figure II.4 shows an example of these conditions in Well 13N/2W-4G3, a 252-foot-deep DWR monitoring well located just west of Arbuckle, and in Well 18N/1W-35K1, a 99-foot-deep well located southeast of Princeton. Together, these two wells are typical of the different groundwater levels within the County. Figure II.5 shows groundwater elevations in more wells throughout the County. Groundwater levels in Well 13N/2W-4G3 are characteristic of areas of high groundwater use and differing water conditions; water levels fluctuate, sometimes dramatically, in response to changes in groundwater use and hydrologic conditions. This well is located in an area where agricultural demands were historically supplied entirely with groundwater, with surface water availability changing over the years with the construction of delivery facilities and changes in hydrologic conditions. Groundwater levels in Well 18N/1W-35K1 are characteristic of areas with lower groundwater use and more stable water conditions; water levels have not exhibited significant fluctuations over times. This well is located in an area where agricultural demands have been met almost entirely with surface water, and groundwater demands have consequently been small.

Groundwater levels in Well 13N/2W-4G3 have varied from 60 to 140 feet bgs. In 1967, surface water first became available on an emergency basis from the Colusa Basin Drain. With the availability of surface water, groundwater levels increased slightly through 1975. Groundwater levels decreased during the 1975 to 1977 drought, then increased slightly until 1982. At that point, surface water from the Tehama Colusa Canal became available, and groundwater levels increased quickly from 1982 through 1986. Seasonal water level fluctuations decreased during this period from about 20 feet to less than 10 feet, indicating a reduction in groundwater pumping. Groundwater levels declined from 1988 through 1994, when deliveries from the TCC were only 25-65% of normal, and have generally increased from 1994 through present. Groundwater levels in this well are currently about 50 feet higher than they were in 1970.

Well 18N/1W-35K1 shows a very stable groundwater elevation since measurements began in 1957. Groundwater elevations have remained virtually unchanged, with seasonal fluctuations of less than 10 feet, and water levels within 5 feet of ground surface.

The direction of Spring groundwater flow within the County has not changed from 1977 to 2006. It generally follows the topography of the County, flowing from the Coast Ranges toward the Sacramento Valley (west to east), and north to south within the Valley. Spring groundwater elevations were about 5 to 30 feet higher in 2006 than in 1977, depending upon the area.





Data from the two nested monitoring wells (Section III.C.2.a.(1)) at the extensometer sites in the County shows that for the four years of available data, the spring groundwater elevations in the monitored aquifer zones have been very similar, within three feet of one another (Figure II.6).

d. Groundwater Quality

DWR maintains a database for groundwater quality that can be obtained from the WDL for specific well sites within Colusa County, identified by the assigned SWN. Data can also be obtained by groupings of wells.

For the purpose of evaluating overall water quality, there are several analyses that can be used. The most common are specific conductance or total dissolved solids, which are indicators of the total concentration of minerals in the water. Lower specific conductance or concentrations of total dissolved solids generally indicate better water quality, while higher specific conductance or concentrations of total dissolved solids generally indicate poorer water quality. For Colusa County, specific conductance was selected as an indicator of overall water quality, because there were more records for specific conductance than for total dissolved solids. Figures II.7 through II.10 show maximum recorded concentrations of specific conductance, boron, nitrate, and manganese for wells in Colusa County. The water quality data has been separated by depth into data for wells less than 200 feet deep (generally the recent deposits), 200 to 500 feet deep (Tehama Formation), more than 500 feet deep (Tehama Formation), and for wells without construction information.

Specific conductance within the County is generally acceptable for agricultural and domestic use, with the exception of two areas. In the marine sediments in the foothills of the Coast Ranges, specific conductance is marginally acceptable for domestic use and can reduce the yield of a number of crops grown in the County. An area of anomalously high specific conductance is located north of Highway 20 between Colusa and Williams. Specific conductance in this area is generally unacceptable for domestic use and can reduce the yield of many crops grown in the County.

Boron concentrations in the County are generally acceptable except for an area southwest of Arbuckle, where concentrations of boron can be problematic for several crops grown in the County. Nitrate concentrations typically meet drinking water standards. Where present, elevated concentrations of nitrate are likely a result of inadequate sanitary seals or point sources (i.e. septic systems). Manganese concentrations are elevated in the eastern portion of the County, at levels that may cause aesthetic problems (odor or staining) for domestic and municipal uses, but generally below levels that could represent a health risk.





e. Land Subsidence

DWR maintains a network of extensometers that record data for land subsidence, two of which are located in Colusa County. DWR maintains a database of the land subsidence data that can be obtained from the DWR Northern District Website:

<http://www.nd.water.ca.gov/Data/Entensometers/Data/index.cfm>.

In the approximately two years since they began recording measurements of land surface elevation, the two extensometers in Colusa County have recorded seasonal elastic land subsidence of approximately 0.025 feet (approximately one-third inch). There has been no indication over the period of record that any inelastic subsidence has occurred.

In the future, data will become available from the Sacramento Valley GPS Height Modernization Project, which is being developed and implemented by DWR with participation of federal and local agencies.

f. Surface Water Flow and Quality

Historic data for Colusa County are inadequate to evaluate the changes in surface flow or quality that directly affect groundwater levels or quality, or are caused by groundwater pumping. To make these determinations, it is necessary to have clustered monitoring wells located immediately adjacent to a surface water body, with a stage gage located in the immediate vicinity. Even with these grouped monitoring locations (which do not currently exist in Colusa County), the flow in a stream or river may be so great that any interactions among groundwater and surface water are smaller than the measurement error.

g. Groundwater Infrastructure

According to DWR records dating to 1912, Well Completion Reports have been filed for 2,902 wells in Colusa County, and records of well destruction have been filed for 44 wells. Well Completion Reports are not always filed with DWR, even though they are now required, so these figures likely under-represent the actual totals for the County. Of the wells for which Well Completion Reports have been filed, 1,211 are domestic wells, 767 are irrigation wells, 485 have unknown or other uses, 152 are test wells, 149 are monitoring wells, 50 are stock-watering wells, 48 are municipal wells, and 40 are industrial wells.

Figure II.11 shows the number of DWR well completion reports filed for Colusa County from 1950 through 2005 (data before 1950 is sporadic). Domestic wells were constructed at a rate of approximately 16 per year from 1950 through 1989, but have been constructed at a rate of approximately 31 per year since then, likely as a result of the increasing population in the County. Irrigation





wells tend to be constructed more frequently during drought periods, in the mid-1970's and early 1990's. On average, 13 irrigation wells are constructed per year; an average of 20 to 30 wells per year are constructed during droughts. Municipal well construction has been sporadic and has been one to four per year.

Figure II.12 shows the average depth of wells constructed from 1950 through 2005. The average depth of domestic wells has fluctuated since the 1930's, but has generally been about 200 feet deep. The average depth of irrigation wells has fluctuated significantly, but has been about 200 feet deeper than the average depth of domestic wells in any give year, or an average of about 400 feet deep. Municipal well depths are inconsistent and vary widely, from about 150 to 850 feet deep; combined with the small number constructed annually, calculation of an average depth of new municipal wells would not be meaningful.

Figures II.13 and II.14 show the distribution and depths of irrigation and domestic wells in Colusa County.





III. THE PLAN

A. GROUNDWATER MANAGEMENT GOALS

Colusa County's groundwater management goals represent the overarching intents of the County with regard to groundwater management. BMOs and Management Actions must be consistent with these Groundwater Management Goals, and must contribute to achieving the goals. Colusa County's goals for groundwater management (as developed with input from the public through PAC meetings, workshops, and surveys) are to:

- Ensure a Reliable Water Supply
- Ensure Long-Term Groundwater Sustainability
- Optimize Conjunctive Use of Surface Water and Groundwater
- Protect Water Rights
- Maintain Local Control
- Prevent Unnecessary Restrictions on Groundwater Use

It is important to recognize that each of these Groundwater Management Goals is best accomplished by:

- **Developing a better understanding the available groundwater and surface water resources, and the constraints and opportunities for efficient and effective management of these resources.**
- **Implementing and refining the BMOs over time.**
- **Executing coordinated and collaborative efforts among the County, water purveyors, and water users.**

Each of the Groundwater Management Goals is discussed below.

1. Ensure a Reliable Water Supply

Colusa County's main goal for groundwater management is to ensure a reliable water supply so that water users in the County can be confident that water will be available to meet domestic, irrigation, and other demands on an ongoing basis. The amounts of available surface water and groundwater will vary over time with fluctuations in hydrologic and climatic conditions. Further, political and legal changes and challenges may also affect the amount and timing of available water supply.





2. Ensure Long-Term Groundwater Sustainability

The goal of ensuring long-term groundwater sustainability is intended to provide for useable groundwater now and into the future. This is important because the socio-economic well being of the County could be adversely affected if the groundwater supply becomes less useable from a supply or quality standpoint. Ensuring long-term groundwater sustainability will help protect groundwater rights and maintain local control because adjudication of the groundwater basin will not be warranted if long-term groundwater sustainability can be achieved.

It is important to understand that in order to manage ground water to ensure long-term groundwater sustainability, it is necessary to thoroughly understand the groundwater system underlying the County, along with its capabilities and limitations.

3. Optimize Conjunctive Use of Surface Water and Groundwater

The goal of optimizing conjunctive use of surface water and groundwater will enhance the County's water supply reliability and maximizing the available water supply. The term "conjunctive use" basically means using surface water and groundwater together to meet water demands, using different proportions of each depending upon availability. For example, in years of reduced surface water availability, more groundwater would be used and groundwater levels might decline; conversely, in years of full surface water availability, less groundwater would be used and groundwater levels would recover. Optimizing conjunctive use generally means that, whenever possible, surface water is used to the fullest extent with groundwater serving as a "back-up" supply. This maximizes the available water supply because unused surface water generally flows downstream and is lost, but unused groundwater remains in the ground and available for later use.

On the other hand, the potential may exist in some areas of the County where groundwater levels are and have historically been high, to utilize more groundwater and induce more recharge thereby increasing the total water supply available in the County.

A related goal is to "even out" water availability in the County. There are cases when surplus water is available in some areas of the County, but other areas have inadequate supplies. For example, an area with high groundwater levels may have adequate or excess surface water, while another area may have low groundwater levels and inadequate surface water. In this case, groundwater could be pumped in the area with high groundwater levels, and their surface water could be transferred to the area with low groundwater levels so that area does not have to rely as much on groundwater. Undertaking such projects will help improve the overall water supply reliability in the County.





4. Protect Water Rights

The goal of protecting surface water and groundwater rights is critical to preserving Colusa County's overall water supply. Protecting groundwater rights is important for groundwater management because it relates directly to maintaining the County's groundwater supply. However, protecting surface water rights is also an important Groundwater Management Goal. The County's overall water supply is primarily surface water, and changes in surface water rights and reductions to the amount of available surface water will result in an increased demand for groundwater.

Water rights and water supply contracts are not necessarily "guaranteed", and will continue to be challenged as supplies become more constrained. The most effective means of protecting water rights is to truly manage and document the management of the available water resources and to disseminate data and information documenting these efforts. The rules that allowed the County to secure relatively abundant water supplies could change. Being responsible stewards of the resource is the most effective defense.

5. Maintain Local Control

Colusa County desires to maintain local control of groundwater management within the County. Maintaining local control is an important Groundwater Management Goal because it allows water users in the County to control the decisions that affect their water supply to the fullest extent possible.

Maintaining local control requires a proactive and public effort. Effective management of the resources must be demonstrated. Local control will not be accomplished with a "protectionist" approach to handling water.

6. Prevent Unnecessary Restrictions on Groundwater Use

Managing groundwater in accordance with other goals and objectives may at times necessitate some restrictions of groundwater use. However, groundwater is a resource that should remain available for the people of the County to use beneficially on their property. The intent of this GMP is for groundwater management to be accomplished in a way that minimizes County oversight and interference. This goal is further intended to limit the bureaucracy and associated costs required for groundwater management.

B. BASIN MANAGEMENT OBJECTIVES

A BMO relates to a physical condition that is affected by the use or management of groundwater. An effective BMO is comprised of the following:

- A specific parameter that can be scientifically measured.





- A clearly defined monitoring program through which data is obtained to assess performance.
- A process with methods for evaluating and reporting the data such that emerging problems can be detected before they become significant or irreversible.
- A process through which emerging problems can be dealt with in advance of significant or irreversible adverse impacts occurring.

It is important to highlight the fact that BMOs can only be effective as a component, albeit an important one, of a groundwater management process. This process, as proposed for Colusa County, is presented in Section IV; however, certain aspects of the process are included in this section as they are particularly relevant in implementing the BMOs. In particular, this relates to the Groundwater Commission Technical Support Team (TST) and the Water Users Group, which are described in Section IV.A.2.

The BMOs adopted by Colusa County address the following parameters:

- Groundwater Levels
- Groundwater Quality
- Inelastic Land Subsidence
- Surface Water and Wetlands

A fundamental basis for groundwater management is for groundwater users to acknowledge that they have the capability to adversely impact one another. Avoiding and mitigating adverse impacts from groundwater pumping is important to meeting the Groundwater Management Goals.

The BMOs presented herein are qualitative at this time and are intended to provide a basis for the Colusa County Groundwater Commission to determine, based upon data, appropriate hydrogeologic principles, and other relevant information, whether adverse impacts from groundwater pumping exist in specific cases. The County's groundwater management processes are a critical component of implementing the BMOs. After data have been gathered, compiled and evaluated over a 3 to 4 year period and the groundwater basins underlying the County are better-understood, it may be appropriate to formulate quantitative BMOs.

Several of the BMOs include "avoiding and mitigating" certain adverse impacts. Efforts to avoid adverse impacts help prevent them from occurring in the first place. However, the concept of mitigation is also important because it recognizes that certain adverse impacts may occur and from a resource management standpoint may be appropriate. Nevertheless, these adverse impacts need to be documented and mitigated. The County's will not be to actively engaged in mitigating the actions of others. The





groundwater management processes allow the County to assist in providing a forum for discussing groundwater issues and providing technical review and recommendations to help resolve these issues and disputes—in some sense serving as a mediator. These recommendations may include mitigation to be undertaken by some or all of the involved parties.

1. Groundwater Levels

Groundwater levels are to be managed to ensure adequate water supplies while avoiding adverse impacts and mitigating them if and when they do occur. Adverse impacts related to groundwater levels can occur from excessively high or low groundwater levels. What constitutes an excessively high or low groundwater level may change over time, and will also vary by land use and hydrologic and climatic conditions.

Excessively high groundwater levels are problematic in some areas of the County. High groundwater levels in Colusa County are often naturally occurring; however, groundwater levels can be raised by application of water to the ground surface through irrigation, surface storage, or recharge projects. When groundwater levels are high there is no storage capacity available for groundwater recharge from precipitation or excess applied irrigation water. This represents a lost opportunity to capture recharge and increase the overall water supply for the County. Adverse impacts related to high groundwater levels include:

- Damage to foundations, roads, and other infrastructure.
- Water-logging the root zone of certain crops.

Groundwater levels decline when pumping exceeds recharge, and rise when recharge exceeds pumping. It is important to note that periodic short-term declines in groundwater levels (during drought periods and/or increased pumping), which are then followed by recovery to at or near historic highs (during wet periods and/or decreased pumping), are normal and do not necessarily represent overdraft. Excessively low groundwater levels that are caused by long-term declines without recovery, thus overdraft, can be avoided by reducing pumpage or expanding the conjunctive use with surface water. Adverse impacts related to low groundwater levels include:

- Infrastructure problems when lowered groundwater levels dewater pumps or wells, so groundwater cannot be extracted using existing infrastructure even though it is available at greater depths.
- Depleted available groundwater supply.
- Inelastic land subsidence.
- Riparian and/or native vegetation destroyed.





- Reduced surface water flow due to increases in streambed infiltration, or increases in the capture of groundwater that otherwise would have contributed to increasing the base flow of a surface water system.

a. Monitoring

The existing groundwater level monitoring network is described in Section III.C.2.a. Monitoring data will be obtained from the DWR Water Data Library to support the BMO actions. When the County is able to develop a formal Groundwater Monitoring Program, as described in Section III.E, specific wells within the existing monitoring network can be identified as “preferred” monitoring locations. Until that time, the Technical Support Team (TST, described in Section IV.A.2) will use water level data from the wells shown in Figure II.5, or alternate nearby wells if appropriate, to evaluate overall compliance with BMOs.

From a review of the groundwater level hydrographs on Figure II.5, it can be seen that the extent to which the groundwater basin is utilized throughout the County varies significantly. Accordingly, the assessment of changes in groundwater levels in the respective areas must be performed with full consideration of the historic levels. It is premature to attempt to set groundwater level targets or thresholds in Colusa County. It is, however, very important to evaluate the groundwater level data in relation to historic data and report the results of that evaluation together with an assessment of overall hydrologic conditions, known changes in land use, etc.

Separate, more specific, monitoring plans will be prepared by sponsors for proposed water transfers. These monitoring plans will be reviewed by the TST on a case-by-case basis to ensure that the monitoring locations and frequency are adequate to determine compliance with BMOs and water transfer conditions.

b. BMO Actions

The County’s processes with regard to the BMOs are fully described in Section IV.A.3. In summary, the County will take the following actions related to the groundwater level BMO:

(1) Gather, Compile, Evaluate and Disseminate Groundwater Information (Public Outreach)

The following activities will be conducted on a semiannual basis at a minimum.

- The TST will compile and analyze water level monitoring data in relation to historic levels, using hydrographs, groundwater elevation contours, and/or other appropriate methods, as needed.





- The TST will identify changes in groundwater levels and potential causes for the changes and summarize the groundwater conditions as they relate to the BMO.
- The TST will report its findings to the Groundwater Commission.
- The TST will reevaluate the adequacy of the monitoring network and monitoring data. If warranted, the TST will make modifications to enhance the monitoring network.
- The Groundwater Commission will disseminate information through its Public Outreach Program to the public via newsletters, media coverage, the website, or public meeting.
- Based upon the findings of the TST, the Groundwater Commission may recommend actions for guidance for consideration by the Planning and Building and/or Environmental Health Departments.

(2) Receive and Address Groundwater Concerns/Issues

The following activities will be conducted when the TST determines that an issue exists or when a member of the public brings a concern, issue, or dispute directly to the Groundwater Commission.

- The Groundwater Commission will determine whether to dismiss the issue, refer the issue to another forum, or forward the issue to the TST for further evaluation. The following actions assume the issue is forwarded to the TST.
- The TST will review the issue (including review of relevant monitoring data), assess the issue in relation to the BMOs, and report back to the Groundwater Commission with options and recommendations for dismissal or resolution of the issue.
- The TST will reevaluate the monitoring network in light of the issue, and make modifications as warranted.
- Based upon the report of the TST, the Groundwater Commission will determine whether to dismiss the issue, recommend a resolution, and/or assist with mediation among the parties.
- If a conflict exists among parties, the Groundwater Commission will facilitate the evaluation of the issue on a technical basis, recommend or suggest potential solutions, and help the parties come to a resolution. The intent of this process is to work to resolve issues without legal action.





(3) Evaluate Water Supply Assessment and Development Proposals

The following activities will be conducted when the Planning and Building Department forwards development proposals and Water Supply Assessments to the Groundwater Commission.

- The TST will review the proposals/assessments in relation to groundwater conditions and for consistency with BMOs.
- The TST will review Water Supply Assessments for technical accuracy, completeness, and consistency with BMOs.
- The TST will prepare summaries and guidance and will report back to the Groundwater Commission.
- The Groundwater Commission will issue guidance to the Planning and Building Department.

(4) Process Proposals for Water Transfers

The following activities will be conducted for all proposed water transfers within or outside the County

- The water transfer sponsor will file a Notice of Intent (NOI) with the Groundwater Commission. If the NOI does not appear to have any “fatal flaws”, the Groundwater Commission will request that the water transfer sponsor submit a Water Transfer Plan that includes general information about the proposed monitoring and mitigation program.
- The TST will evaluate the Water Transfer Plan in relation to BMOs and will recommend initial approval of or revisions to the Water Transfer Plan. The Groundwater Commission will take the input of the TST into consideration and will request revisions to the Water Transfer Plan or grant initial approval of the plan and request that the water transfer sponsor submit a detailed water transfer proposal and any required CEQA documentation.
- The TST will confirm compliance of the water transfer proposal with the Groundwater Management Goals and BMOs. The TST will provide the Groundwater Commission with recommendations for conditional acceptance or revision of the water transfer proposal. The Groundwater Commission will conditionally accept the water transfer proposal or request that the water transfer sponsor make modifications.





- Once the water transfer proposal is conditionally accepted, the water transfer may proceed.
- During the water transfer, the Groundwater Commission will enforce the conditions of the transfer, and will have the authority to modify or suspend the water transfer at any time to comply with BMOs.
- The water transfer sponsor will conduct monitoring as specified in the water transfer proposal and will be required to submit monitoring data to the TST in a timely manner. The TST will determine if the water transfer is proceeding in compliance with the water transfer conditions and the BMOs. The TST will report these findings to the Groundwater Commission. If the water transfer is out of compliance with the water transfer conditions or BMOs, the TST will make recommendations to the Groundwater Commission for modification or suspension of the water transfer. The monitoring, submittal, and evaluation of monitoring data will be frequent enough to allow the Groundwater Commission to promptly address non-compliance.
- Taking into consideration the findings and recommendations of the TST, the Groundwater Commission will allow the water transfer to continue, require modification to the water transfer, or require suspension of the water transfer.

2. Groundwater Quality

There are two BMOs for groundwater quality: to **avoid and mitigate adverse impacts to groundwater quality** and to **maintain or improve groundwater quality**.

Adverse impacts to groundwater quality most commonly occur when degradation of groundwater quality renders groundwater unsuitable for intended uses. Accordingly, what constitutes a significant adverse impact to groundwater quality is related to the purposes for which groundwater is used, and may change over time as land uses and water quality regulations change. Groundwater quality degradation can occur when groundwater pumping causes poor quality water (surface water or groundwater) to migrate into areas with good groundwater quality. It can also occur when surface contaminants migrate into groundwater. As a consequence, it is important to coordinate land use planning and resource management activities in order not to create opportunities for water quality deterioration. Adverse impacts related to groundwater quality include:

- Degradation of groundwater quality so that yields are reduced for crops irrigated with groundwater.





- Degradation of groundwater quality so that it does not comply with drinking water quality standards.
- Degradation of groundwater quality so that it is no longer suitable for beneficial uses.

There are some areas in Colusa County that currently have problems with groundwater quality (particularly salinity and boron) that appear to be naturally-occurring. The BMO of maintaining or improving groundwater quality reflects the County's desire to improve the quality of naturally-occurring groundwater where possible, so that it is more useful as a water supply.

a. Monitoring

Locations where groundwater quality has been monitored are described in Section III.C.2.b. For the initial monitoring program, it is recommended that the wells presented in Figure II.5 be used for the BMO monitoring wells. Baseline data should be obtained for specific conductance, nitrates, manganese, arsenic, and boron. To the extent there are concerns about water quality and landowners have identified concerns, then those constituents should be included. When the County is able to develop a formal Groundwater Monitoring Program, as described in Section III.E, specific wells within the existing monitoring network can be identified as "preferred" monitoring locations. Until that time, the Technical Support Team (TST, described in Section IV.A.2) will use water quality data from the nested monitoring wells in the County, as shown in Figure III.3, to evaluate overall compliance with BMOs. Monitoring data will be obtained from the DWR Water Data Library to support the BMO actions.

Separate, more specific, monitoring plans will be prepared by water transfer sponsors for water transfers. These monitoring plans will be reviewed by the TST on a case-by-case basis to ensure that the monitoring locations and frequency are adequate to determine compliance with BMOs and water transfer conditions.

b. BMO Actions

The County's processes with regard to the BMOs are fully described in Section IV.A.3. In summary, the County will take the following actions related to the groundwater quality BMO.

(1) Gather, Compile, Evaluate and Disseminate Groundwater Information (Public Outreach)

The following activities will be conducted on a semiannual basis at a minimum.





- The TST will compile and analyze water quality monitoring data, using time-series graphs, comparison with water quality standards, and/or other appropriate methods.
- The TST will summarize groundwater conditions as they relate to the BMO.
- The TST will report its findings to the Groundwater Commission.
- The TST will reevaluate the adequacy of the monitoring network and monitoring data. If warranted, the TST will make modifications to the monitoring network.
- The Groundwater Commission will disseminate information to the public through newsletters, media coverage, the website, or a noticed public meeting.
- Based upon the findings of the TST, the Groundwater Commission may refer guidance for consideration by the Planning and Building and/or Environmental Health Departments.

Actions (2), (3), and (4) are the same as described under the Groundwater Level BMO (Section IV.B.1.b.) and, therefore, not repeated in this section.

3. Inelastic Land Subsidence

The BMO for inelastic land subsidence is to **avoid and mitigate adverse impacts from inelastic land subsidence**. Inelastic land subsidence is the permanent compaction of the subsurface. In Colusa County, the activities that have the most potential to cause inelastic land subsidence are withdrawals of groundwater or natural gas from the subsurface. Adverse impacts related to inelastic land subsidence include:

- Reduction in the volume of the subsurface that results in a permanent loss in aquifer storage.
- Damage to foundations, roads, bridges, and/or other infrastructure.
- Change in surface topography that reverses the gradients in canals and ditches, and/or changes floodplains.

a. Monitoring

The existing land subsidence monitoring network is described in Section III.C.2.c. When the County is able to develop a formal Groundwater Monitoring Program, as described in Section III.E, specific locations within the existing monitoring network can be identified as “preferred” monitoring locations. Until that time, the





Technical Support Team (TST, described in Section IV.A.2) will use land subsidence data from the extensometers in the County, as shown in Figure III.3, to evaluate overall compliance with BMOs. Monitoring data will be obtained from the DWR Water Data Library to support the BMO actions.

Separate, more specific, monitoring plans will be prepared by water transfer sponsors for water transfers. These monitoring plans will be reviewed by the TST on a case-by-case basis to ensure that the monitoring locations and frequency are adequate to determine compliance with BMOs and water transfer conditions.

b. BMO Actions

The County's processes with regard to the BMOs are fully described in Section IV.A.3. In summary, the County will take the following actions related to the inelastic land subsidence BMO.

(1) Gather, Compile, Evaluate and Disseminate Groundwater Information (Public Outreach)

The following activities will be conducted on a semiannual basis at a minimum.

- The TST will compile and analyze land subsidence monitoring data, using time-series graphs and/or other appropriate methods.
- The TST will summarize groundwater conditions as they relate to the BMO.
- The TST will report its findings to the Groundwater Commission.
- The TST will reevaluate the adequacy of the monitoring network and monitoring data. If warranted, the TST will make modifications to the monitoring network.
- The Groundwater Commission will disseminate information to the public through newsletters, media coverage, the website, or a noticed public meeting.
- Based upon the findings of the TST, the Groundwater Commission may refer guidance for consideration by the Planning and Building and/or Environmental Health Departments.

Actions (2), (3), and (4) are the same as described under the Groundwater Level BMO (Section IV.B.1.b.) and, therefore, not repeated in this section.





4. Surface Water and Wetlands

The BMO for surface water and wetlands is to **avoid and mitigate adverse impacts to surface water or wetlands from groundwater pumping**. Pumping from very shallow aquifer zones or poorly sealed wells has the potential to affect surface water or wetlands. Adverse impacts related to surface water or wetlands include:

- Depletion of surface flows and/or degradation of water quality.
- Destroying riparian and/or native vegetation and habitat.

a. Monitoring

To determine whether degradation of surface flows and/or quality is occurring as a result of groundwater pumping, it is necessary to have nested monitoring wells located in close proximity to stream gage and monitoring stations. The nested monitoring wells must be completed in the very shallow groundwater zone that is directly connected to surface water, as well as in the zones below. The existing nested monitoring wells in Colusa County are shown in Figure III.3; the locations are not suitable for evaluating stream/aquifer interactions. Further, the stream/aquifer interaction along the Sacramento River (the major river in the County) has not been well-characterized in Colusa County. The DWR's Northern District has stated that existing data is inadequate to characterize the system.

When the County is able to develop a formal Groundwater Monitoring Program, as described in Section III.E, deficiencies in the existing monitoring network can be further evaluated, and specific locations for future monitoring to support evaluations of stream/aquifer interaction can be identified. Until that time, the Technical Support Team (TST, described in Section IV.A.2) will use water level data from the nested monitoring wells in the County, as shown in Figure III.3, to evaluate overall compliance with BMOs. Monitoring data will be obtained from DWR's Water Data Library to support the BMO actions.

Separate, more specific, monitoring plans will be prepared by water transfer sponsors for water transfers. These monitoring plans will be reviewed by the TST on a case-by-case basis to ensure that the monitoring locations and frequency are adequate to determine compliance with BMOs and water transfer conditions.

b. BMO Actions

The County's processes with regard to the BMOs are fully described in Section IV.A.3. In summary, the County will take the following actions related to the surface water and wetlands BMO.





(1) Gather, Compile, Evaluate and Disseminate Groundwater Information (Public Outreach)

The following activities will be conducted on a semiannual basis at a minimum.

- The TST will compile and analyze water level monitoring data, using time-series graphs showing the vertical gradients between shallow and deeper aquifer zones, and/or other appropriate methods.
- The TST will summarize groundwater conditions as they relate to the BMO.
- The TST will report its findings to the Groundwater Commission.
- The TST will reevaluate the adequacy of the monitoring network and monitoring data. If warranted, the TST will make modifications to the monitoring network.
- The Groundwater Commission will disseminate information to the public through newsletters, media coverage, the website, or a noticed public meeting.
- Based upon the findings of the TST, the Groundwater Commission may refer guidance for consideration by the Planning and Building and/or Environmental Health Departments.

Actions (2), (3), and (4) are the same as described under the Groundwater Level BMO (Section IV.B.1.b.) and, therefore, not repeated in this section.

C. MONITORING PROGRAM

1. Role of Monitoring

The role of monitoring is essential to implementing the BMOs. Monitoring is the process of collecting data that is used to better-understand the groundwater basin underlying the County, evaluate groundwater conditions, facilitate groundwater management, and other related activities.

2. Groundwater Monitoring Network

The existing groundwater monitoring network within Colusa County includes water levels, water quality, and land subsidence. Precipitation, stream flow, and surface water quality are also monitored.





a. Water Levels

DWR and its partners monitor 91 wells in Colusa County, including 30 dedicated observation (monitoring) wells and 61 wells with other uses. The earliest recorded DWR water level measurements in Colusa County took place in 1929. Figures III.1 and III.2 show the location of DWR monitoring wells with measurements in Spring 1977 and Spring 2006, respectively. There are a number of dedicated monitoring wells in the County, which represent a network that includes 9 groups of nested and/or clustered monitoring wells (25 total well completions), and 5 single monitoring wells. Water level data is available from DWR's Water Data Library, at: <http://well.water.ca.gov>.

Also, groundwater level and groundwater quality data is available for the four counties – Butte, Tehama, Glenn, and Colusa – through the Basin Management Objective Information Center, which is managed by the Butte County Department of Water and Resources Conservation:

<http://gis.buttecounty.net/waterandresource/wellmonitoring.htm>

Data gathered for the Colusa County groundwater monitoring program can be stored and be accessible by all parties through both databases.

The 61 wells with other uses include unused wells, and wells that supply water for domestic, municipal, industrial, irrigation, and stock watering uses. Water level measurements from these wells are somewhat less reliable than from dedicated monitoring wells, for several reasons: water levels may be influenced by pumping in the well, oil-lubricated pumps may leak into the well and raise the fluid level in the well, and access to the well to make measurements on an ongoing basis may be sporadic or limited.

Water level measurements are generally made three times each year, in spring, summer, and fall. Measurements have been made at some monitoring wells on an almost-monthly basis. The 8 monitoring wells at the extensometer sites are equipped with pressure transducers and data loggers that make hourly measurements. Twice-annual (spring/fall) water level measurements are generally sufficient for the purpose of determining changes in overall groundwater conditions over time. However, these measurements should reflect the annual high (spring) and low (fall) water levels. More frequent (i.e. at most monthly) measurements are necessary to confirm that the months chosen for spring and fall measurements reflect the months with the highest and lowest groundwater elevations, on average.





(1) Vertical Groundwater Gradients – Nested and/or Clustered Monitoring Wells

The vertical gradients between aquifer zones are important because they give an indication of the direction (up or down) that groundwater will migrate if a pathway, such as a well that connects multiple aquifer zones, is present. To evaluate the vertical gradient between aquifer zones, data for different aquifer zones at a single location is needed. The preferred way to obtain this data is with nested and/or clustered monitoring wells. Nested monitoring wells have multiple wells within a single borehole, with each well isolated from the others by seals; clustered monitoring wells have a single well in each borehole, with the boreholes in close proximity to one another. Figure III.3 shows the locations of the 9 nested and/or clustered monitoring wells in Colusa County. All of these wells are dedicated monitoring wells. To simplify further discussion in this section, both nested and clustered monitoring wells will be referred to as “clustered” monitoring wells.

(2) Groundwater Flow Direction – Contour Maps

The direction of groundwater flow is evaluated with water level contour maps. Figure II.4 shows contours of equal groundwater elevation for Spring 1977 and Spring 2006. Data from the nested monitoring wells (Figure II.6) indicated very similar groundwater elevations in different aquifer zones, so groundwater elevation data from all monitoring wells (regardless of completion) was used for contouring. The current water level monitoring network spacing is not ideal for contouring because wells tend to be clustered in small areas, with large areas that have no monitoring. A more even spacing would be preferable for the purpose of contouring groundwater elevations and evaluating the direction of groundwater flow. Additionally, it would be beneficial to include data from nearby monitoring wells in Glenn, Butte, Sutter, and Yolo Counties to better characterize the groundwater flow at the County lines.

b. Water Quality

DWR has monitored 126 wells in Colusa County for water quality. Of these DWR water quality wells, only three are in the current DWR water level monitoring network. Of these, 91 wells have only been sampled once, and only 27 wells have been sampled three or more times. Fifteen wells were sampled in 2006.

The United States Geological Survey (USGS) National Water Information System (NWIS) has water quality records for 148 wells in Colusa County. One-hundred nineteen of these wells were only sampled once. The only construction information available for these wells is depth.





Figures II.7 through II.10 show locations of wells within the County that have been sampled for specific conductance, boron, nitrate, and manganese, and also provide information about the significance of these chemicals with respect to domestic and agricultural uses.

c. Land Subsidence

Land subsidence is the compaction of subsurface materials. Land subsidence can be caused by decreasing subsurface pressure from extractions of groundwater, oil, or gas that results in the removal of fluid from clay formations. There are two types of land subsidence: elastic and inelastic. Elastic land subsidence is buoyancy acting on sand grains as pressure is reduced. Elastic land subsidence is cyclical and does not result in permanent compaction of subsurface materials. One example of elastic land subsidence is seasonal fluctuations in ground surface elevation that coincide with fluctuations in groundwater elevation (and associated aquifer pressure). In elastic land subsidence, the subsurface pressures do not decrease enough so that subsurface materials permanently compact. In inelastic land subsidence, subsurface pressures decrease to a point where subsurface materials permanently compact, resulting in a permanent loss in subsurface storage capacity. Inelastic land subsidence can be caused by excessive extractions of groundwater, oil, or gas. In discussing land subsidence, it is important to note that elastic land subsidence is normal, whereas inelastic land subsidence has associated negative impacts and should be avoided.

The current land subsidence monitoring network in Colusa County consists of two extensometers. The extensometers in Colusa County are installed in dedicated monitoring wells and are designed to measure the land subsidence occurring between the bottom of the well and the ground surface. This is accomplished by measuring the distance between the bottom of the well and the ground surface. The reported accuracy of the extensometers is approximately 0.01 feet (DWR Northern District).

The extensometers in Colusa County (Figure III.3) are both located in the north part of the County and are approximately 850 feet deep, extending over a large portion of the fresh-water formations. When used in conjunction with surface subsidence survey data (which does not currently exist for Colusa County), these extensometers could identify whether subsidence is occurring over the depth of the monitoring well, or in deeper marine aquifer zones; however, if the extensometers show subsidence is occurring over the depth of the monitoring well, they cannot provide data to determine the fresh-water zone in which any subsidence occurs. Extensometers were equipped in late 2005 with automatic data recorders that record measurements hourly.





DWR is initiating its Sacramento Valley GPS Height Modernization Project, which will provide significant enhancements to a Sacramento Valley subsidence monitoring program.

3. Future Groundwater Monitoring

The County's existing monitoring network is described above. Groundwater monitoring within the County is currently conducted almost entirely by DWR. The County intends to prepare a formal Groundwater Monitoring Program consistent with the Sacramento Valley Water Resources Monitoring Data Collection and Evaluation Framework. This will be performed as funding becomes available. This task is included in the Action Program, but until funding becomes available and the formal Groundwater Monitoring Program can be developed, existing DWR monitoring will continue under protocols established by DWR. As the lead monitoring agency, DWR may make changes to the monitoring network over time.

The overall subsidence monitoring program is being enhanced substantially with implementation of the Sacramento Valley GPS Height Modernization Project by DWR and participating local, state, and federal agencies. The Sacramento Valley GPS Network incorporates existing GPS networks and monuments to create a regional network that covers part or all of Colusa, Sutter, Glenn, Butte, Yolo, Yuba, Tehama, and Placer Counties.

The monitoring of land surface elevations will allow periodic measurement of subsidence induced by pumping associated with groundwater pumping and natural processes. The surveys will be conducted in accordance with National Geodetic Survey Standards for two centimeter accuracy.

D. LOCAL AND REGIONAL GROUNDWATER MANAGEMENT COORDINATION

Coordinating local and regional groundwater management is important to meeting Colusa County's Groundwater Management Goals because groundwater, like other resources, does not respect administrative/jurisdictional boundaries, and actions outside the County can affect groundwater in the County. Further, in order to achieve the Groundwater Management Goals, the County needs to be an "effective participant" in local and regional management efforts and work cooperatively with water managers to conduct effective groundwater management. To be an "effective participant" the County needs to be informed of its groundwater conditions and activities underway or planned, which may affect the resources positively or negatively. With time and appropriate documentation of water management activities and monitoring, an understanding of the resources can be obtained so that groundwater conditions can be the result of deliberate water management choices.

Coordinating groundwater management across local and regional jurisdictions will contribute to ensuring a reliable water supply by working towards management of entire





groundwater basins, not just the portions underlying the County. Involvement in regional activities will help ensure that activities outside of Colusa County that affect the reliability of the groundwater supply in the County can be addressed through regional management actions. This involvement will also help protect water rights because the County's involvement with regional groundwater management will allow it to be part of a larger group that can exert more influence in preserving water rights north of the Delta. Finally, regional coordination will help the County maintain local control by ensuring that the County's interests are represented in regional groundwater management activities.

Colusa County recognizes the importance of regional coordination, collaboration, and communication and is signatory to the "Four-County Group," which also includes Butte, Glenn, and Tehama Counties. Participation, however, is hampered by the absence of staff time currently dedicated to this function. Subsequent to establishing the Four-County Group, it was recognized that this regional effort would be enhanced with the participation of special districts, governmental entities, and regulated water purveyors. Thus the partnership was expanded with the execution of a "Multi-Party Water Resources MOU." Implementation of this GMP will allow the County, and other participants from the County, to be more effective in working with the respective groups.

In addition to the water management coordination addressed above, which is more at a technical and operational level, it is important that coordination occur at the policy level as well. This is especially important for effective and consistent operations within water purveyors whose geographic jurisdiction extends beyond Colusa County. The more prominent water purveyors in this category include: RD 108, which extends into Yolo County; and GCID, Princeton-Codora-Glenn Irrigation District, Provident Irrigation District, and Reclamation District No. 1004, which extends into Glenn County. The processes to addressing water transfers, in particular, are different in each of the three counties. It would be important that as the GMP is implemented and the institutional structure and management processes become solidified, that a dialogue be established with the neighboring counties to address developing consistency in processes that affect the management and operation of the respective water purveyors.

E. ACTION PROGRAM

During the course of preparing this GMP, a number of Actions and Studies were identified that will help implement the BMOs to aide in achieving the Groundwater Management Goals. The Action Program is comprised of the following Actions and Studies:

- Structural and Procedural Actions – These Actions form the structural and procedural foundation for groundwater management in Colusa County. These Management Actions must be completed in order for the Groundwater Management Plan to be fully implemented.





- Monitoring-Related Actions – These Actions formalize and expand Colusa County’s monitoring network. These Management Actions must be completed to provide the data necessary for meaningful groundwater management decision-making.
- Technical Studies – These Actions consist of completing specific studies that will enhance the technical and managerial understanding of groundwater and improve Colusa County’s ability to manage groundwater. These studies will all provide important information and should be completed as funding is available.

Each of the respective Actions is described below. The order in which the Management Actions and Studies are presented is not intended to reflect a ranking of importance or to indicate a specific order in which they should be completed. The implementation will be influenced largely by the availability of funds and the conditions or subject matter to which the funding is allocated.

1. Structural and Procedural Actions

a. Adopt Groundwater Management Plan

The purpose of the GMP being adopted by the County Board of Supervisors is for it to be the guiding document for groundwater management in the County. In order for the GMP to be an effective countywide plan, it is important that the water purveyors within the County support and participate in the implementation of the GMP.

As noted in Section II.B.1, of the 26 water purveyors in the County, only two (GCID and RD 108) have adopted groundwater management plans in compliance with the California Water Code. Both agencies have expressed interest in participating in the County’s GMP.

Important to highlight here is that the other 24 water purveyors could become compliant, by virtue of executing agreements of MOU’s with the County, thereby making them eligible for participation in future DWR-sponsored programs. Accordingly, agreements need to be executed with as many of the 26 water purveyors as possible to have an effective countywide GMP.

b. Update County Groundwater Ordinance

As noted in the Introduction, having an adopted GMP with sound BMOs and a monitoring program established and supported by all parties would facilitate revising the County Groundwater Ordinance to support implementation of the GMP.

Updating the Groundwater Ordinance will consist of following the required procedures to replace the existing ordinance with the GMP.





c. Obtain Funding and Implement Groundwater Management Plan

The purpose of obtaining funding and implementing the GMP is to actually manage groundwater within the County as described in the GMP.

The ability to implement the GMP is contingent upon the availability of funding. As such the scope for this Action is largely related to securing funding for GMP implementation, which will then proceed as described in the GMP.

Possible funding sources are identified in Section IV.A.6, and a plan should be developed to secure the necessary funding for GMP implementation from these or other sources. The County should aggressively pursue grant funding for GMP implementation, and should also partner with other entities to pursue funding.

d. Periodically Revise and Update Groundwater Management Plan

The purpose of periodically revising and updating the GMP is to ensure that it functions as a “living” document and meets the changing needs for groundwater management in the County.

It is anticipated that the Groundwater Commission and the Technical Support Team will work together to determine when revisions or updates to the GMP are warranted. These revisions/updates may take any of the following forms:

- Policy memorandums that provide additional detail about or procedures related to elements already included in the GMP.
- Addenda to the GMP that revise, add, or eliminate BMOs or sections of the GMP.
- Complete revision of the GMP document.

The Groundwater Commission may develop policy memorandums as needed without a public input process. More extensive revisions to the GMP should be noticed to the public and public input should be considered.

e. Formalize Public Outreach Program

The purpose of formalizing a Public Outreach Program is to establish an ongoing program to inform the public and solicit public input about activities related to GMP implementation.

A formal Public Outreach Program should be developed that describes the ways in which the Groundwater Commission will notify the public about activities related to GMP implementation. This would include presentations at public meetings and to community organizations, the media (newspapers, radio, etc.),





Website, etc. The Public Outreach Program should also describe the role of the Water Users Group with respect to GMP implementation, and formalize a plan for communications with the Water Users Group. The Public Outreach Program should include other public entities and agencies (both within and outside the County) that also overlie the groundwater basins underlying Colusa County. This Public Outreach Program can be a means for water purveyors to disseminate information and over time be of significant assistance.

f. Coordinate Local and Regional Groundwater Management

The purpose of this Management Action is to maintain the communication and involvement necessary to coordinate groundwater management within and outside of Colusa County on an ongoing basis.

The scope of this Action is as follows:

- Coordinate with other County departments to ensure that County policies and actions with regard to land use, zoning, well standards, and other groundwater-related items are consistent with the GMP.
- Develop relationships with and communicate regularly with state and federal regulatory agencies.
- Continue involvement in the Four-County MOU and the Multi-Party Water Resources MOU and participate actively with adjacent counties and partners to share information and keep current on various projects and groundwater management efforts in the region.
- Work within and outside the County to ensure that groundwater management efforts are consistent across administrative/jurisdictional boundaries, and establish protocols to address adverse impacts that take place across administrative/jurisdictional boundaries.
- Coordinate with managers and interest groups within and outside the County to agree on a common understanding of the groundwater system across administrative/jurisdictional boundaries.

2. Monitoring-Related Actions

a. Formalize Groundwater Monitoring Program

The Groundwater Monitoring Program is critical for implementation of the BMOs. The Program needs to be formalized to ensure that monitoring provides adequate data to support groundwater management, to establish monitoring protocols, to ensure that resources for monitoring are used efficiently, and to identify needs for additional monitoring. The Groundwater Monitoring





Program should also provide guidelines for developing monitoring programs associated with water transfers and other water project proposals.

A formal Groundwater Monitoring Program should be developed, expanding on the discussion of groundwater monitoring presented in this GMP and the Sacramento Valley Water Resource Monitoring, Data Collection and Evaluation Framework that was developed to support the Sacramento Valley IRWMP. The Monitoring Program should be designed to detect changes in: groundwater levels, groundwater quality, inelastic surface subsidence, and flow and quality of surface water that directly affect groundwater levels/quality or are caused by groundwater pumping in the basin. For each of these parameters, the location of monitoring stations, suitability of monitoring station, and frequency of monitoring should be considered. An evaluation should be made of the adequacy of existing monitoring for each parameter, and recommendations should be made for additional monitoring locations or increased monitoring frequency if needed to provide adequate data. The evaluation of the existing monitoring network should also include an analysis of whether any current monitoring locations are redundant and could be eliminated, or whether monitoring frequency could be reduced in some cases, to free up resources for monitoring in other areas.

The Monitoring Program should consider the different needs of countywide and project-specific monitoring (i.e. monitoring during a water transfer or other project). The County's Groundwater Monitoring Program should cover all countywide monitoring for long-term evaluation of overall groundwater conditions. Project-specific monitoring will not be the responsibility of the County, but the Monitoring Program should provide guidelines that the County will use in evaluating the adequacy of proposed monitoring programs for water transfers and other projects.

b. Improve Monitoring Network

The purpose of improving the monitoring network is to ensure that it provides the data needed to evaluate groundwater conditions and to support groundwater management and other activities.

Improvements to the monitoring network should be based upon the Groundwater Monitoring Program, which will recommend additional monitoring locations or increased monitoring frequency if needed to provide adequate data. Potential improvements to the monitoring network should be conducted on an as-needed basis, and may include:

- Construction of new monitoring wells, extensometers, or surface water gages.
- Replacement of aged or inadequate existing monitoring locations.





- Equipping monitoring locations with data loggers to make automatic measurements on a frequent interval.
- Preparing grant applications to obtain funding for monitoring network improvements.
- Updating the Groundwater Monitoring Program.

3. Technical Studies

a. Study Hydrogeology of Colusa County

The ability to effectively manage groundwater in Colusa County is currently limited by the lack of understanding of the hydrogeology underlying the County. Studying the hydrogeology of the County would provide information needed to support groundwater management decisions.

The hydrogeologic study should cover the Sacramento Valley Groundwater Basin portion of the County. The Stonyford Town Area Groundwater Basin is the only other basin in the County where groundwater is widely used, and a separate study is proposed for that area. Outside of groundwater basins, in hard rock settings, large-scale hydrogeologic studies are less useful because groundwater occurs in fractures that are irregular and often disconnected, so that groundwater conditions can vary widely in a small area.

The hydrogeologic study should begin with the development of geologic cross-sections running roughly east-west from the Coast Ranges to the Sacramento River. The geologic cross-sections should be developed using lithologic and geophysical data from water and gas wells, as well as published studies and cross-sections. Special attention should be given to the geologic deposits associated with the Sutter Buttes, especially as they relate to the occurrence of groundwater. Based upon the geologic cross-sections, aquifers should be described. Data from existing wells, as well as published studies, should be used to describe the characteristics of each aquifer, including well yields, water levels, general water quality, and any known problems. Special emphasis should be given to variations in aquifers by area, recharge areas, and the interconnections among aquifers and between surface water and groundwater.

b. Study Groundwater Quality of Colusa County

A number of water quality problems are known to exist in Colusa County, with regard to salinity, manganese, arsenic, and possibly other constituents. The reasons for variations in water quality and the occurrence of poor water quality are not well-understood. A groundwater quality study is necessary to support groundwater management, by identifying aquifer zones with poor water quality and recommending policies to help prevent the migration of poor quality water into areas with good water quality.





The groundwater quality study should be based upon the hydrogeologic study of the County, and should focus on the occurrence of poor quality water within the County. The study should identify the areas and depths where poor groundwater quality is found, and identify potential sources/causes for the poor groundwater quality. Recommendations should be made for how to avoid poor quality water when new wells are constructed. The study should also recommend policies that the County should implement to help prevent the migration of poor water quality into areas/aquifer zones with good water quality.

c. Study Hydrogeology of Stonyford Town Area Groundwater Basin

The Stonyford Town Area Groundwater Basin, which is located in the Coast Ranges, covers approximately 10 square miles in both Colusa and Glenn Counties. Groundwater supplies are poorly-understood and are limited. Residents have expressed concerns about water quality, groundwater reliability, and the ability of demands associated with new development to be met with groundwater. Currently, there is no known monitoring program that covers the Stonyford Town Area Groundwater Basin. A study of the hydrogeology of the area is a necessary precursor to managing the Stonyford Town Area Groundwater Basin in accordance with this GMP.

This study should be coordinated with Glenn County so that it covers the entire Stonyford Town Area Groundwater Basin. To the extent possible based upon existing data, the study should include a description of the extent and depth of the Basin, characterize water levels and water quality by area and depth, describe aquifer characteristics and well yields, summarize existing well construction, and establish a monitoring network for the Basin.

d. Study Hydrogeology West of Williams

Detention basins have been considered on Salt Creek, Spring Creek, and Freshwater Creek west of Williams to help reduce flooding potential. Concerns have been raised about the effect of water detention on shallow groundwater levels and quality near permanent crops. Characterization of groundwater water quality and vertical groundwater gradients in this area will help determine if future groundwater detention should be considered.

This study will consist of evaluating the geology, water levels, and water quality in the vicinity of the detention basins. The study should include drilling two shallow test holes at the location of the proposed detention basins. Continuous cores should be obtained during test hole drilling to allow for detailed site-specific geologic characterization. The tests holes should be completed into shallow monitoring wells to identify water levels and water quality. A deep multiple-completion monitoring well should be constructed in the vicinity of the detention basins to help assess the interconnections among the shallow and deep





aquifers, with regard to water levels and water quality. The new monitoring locations should be incorporated into the Colusa County monitoring network for ongoing monitoring.

e. Investigate Opportunities for Utilizing Available but Unused Water Supplies

There has been an expressed concern among water users in the County, particularly those who irrigate, about the reliability of the water supply during drought conditions. This concern has increased as the plantings of permanent crops within the County has increased. Maintaining a reliable irrigation water supply during a variety of water conditions is important to the economic well-being of the County. If opportunities exist for utilizing available but unused water supplies, the irrigation water supply reliability could be enhanced.

The investigation of unused available water supplies should focus on characterizing the available unused water supplies and cost associated with using these supplies. Opportunities for using Tier 2 and Tier 3 water should be fully investigated. The investigation should consider the cost of unused available water supplies, the reliability of these supplies in various water year types, and the timing and duration of the availability of supplies. The investigation should also consider the feasibility of different uses of available but unused water supplies, for example irrigation, industrial, environmental, municipal, and other.

f. Conduct Groundwater Monitoring Down-Gradient from Proposed Cortina Landfill Project

The Cortina Band of the Wintum Indians has formed the Cortina Integrated Waste Management, Inc. (CIWMI) with the intent of constructing landfills on tribal lands in southwestern Colusa County. The landfills would cover approximately 100 acres in the foothills of the Coast Ranges, southwest of the Town of Williams. Portions of the landfills would be constructed on recharge areas of the Tehama Formation, the primary groundwater resource in Colusa County. Although extensive groundwater monitoring has been proposed for the project to help ensure early detection of contamination, the potential of this project to contaminate Colusa County's primary groundwater resource warrants additional monitoring by the County.

In addition to monitoring conducted by CIWMI as part of the landfill operation, the County should construct at least two multiple-completion monitoring wells within the Tehama Formation down-gradient of the landfill. The monitoring wells should be constructed within 1/2 mile of the landfill, if possible. These monitoring wells should be completed in each of the freshwater aquifer zones encountered, and should not extend into the marine sediments below the Tehama Formation. Ideally, the wells should be constructed prior to construction of the landfill, so that baseline readings can be obtained. Water



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level measurements in the monitoring wells should be made on a semiannual basis (spring/fall). Water samples should be analyzed by a certified environmental laboratory for general minerals, general physical, drinking water metals, VOC's, and CAM17 metals. Sampling should also be performed for any contaminant that has been detected in monitoring wells at the landfill. Once the landfill begins operation, samples should be collected and analyzed as part of the County groundwater monitoring program with the data evaluated and reported through the groundwater management process described in Section IV. If any of the landfill's monitoring wells detect the presence of contaminants, those contaminants should be added to the list of analysis for the monitoring wells.





IV. PLAN IMPLEMENTATION

This GMP cannot be implemented successfully with the institutional framework that exists currently. Accordingly, a process is presented herein to provide the initial steps towards more effective groundwater management in Colusa County. The process outlined is not the only way that groundwater management can be enhanced; however, it is a way that can provide positive results.

Presented on Table IV.1 is a preliminary schedule to serve as a guide for Colusa County to initiate implementation of the GMP.

A. GROUNDWATER MANAGEMENT PROCESS

The groundwater management process described herein is intended to enhance the understanding of water resources in the County for those interested and to facilitate collaborative relationships to more effectively monitor and manage water resources. For successful implementation of the GMP, the following elements are essential:

- A sound technical program.
- A functional institutional structure.
- Ongoing funding for implementation.

Each of these elements is discussed below.

1. Technical Program

The preparation of this GMP, which was made possible by DWR, has laid the foundation for Colusa County, not so much as a political jurisdiction but more as a community of water interests, to become actively involved in the coordination and management of water resources within the County and the Sacramento Valley and State of California as well. The County is in its formative stages in relation to participation in broader water resource matters, the importance of which will become greater with time.

Section III of this GMP outlined an Action Program that, if implemented, will significantly advance the state-of-knowledge of the groundwater resources in the County and their interaction with surface water as well.

2. Institutional Structure

The institutional structure for groundwater management should function to facilitate management of the available water resources, surface water as well as groundwater, within the County. Recognizing that the physical management of water in the County is performed by a broad mix of water purveyors and individual landowners, it is important that this understanding be considered when implementing policies





and activities, to sustain the economic activity of the County, which is largely an agricultural base.

The current institutional structure for groundwater-related activities in the County consists of the County Board of Supervisors, who appoint the Groundwater Commission. The Groundwater Commission is supported by the County Planning and Building Department.

To implement the GMP, an expanded structure will be necessary. The institutional structure envisioned for GMP implementation is shown in Figure IV.1, and includes the Board of Supervisors, TST, Water Users Group, and Administrative Support. A brief description of each element of this structure is provided below.

a. Board of Supervisors

Under this structure, the Board of Supervisors would continue to appoint members of the Groundwater Commission, and would hear appeals of decisions made by the Groundwater Commission.

b. Groundwater Commission

In its expanded role, the Groundwater Commission would:

- Serve as a forum for reviewing and disseminating groundwater information on a regular basis.
- Receive and address groundwater concerns/issues.
- Evaluate Water Supply Assessments and development proposals.
- Process proposals for groundwater substitution water transfers.
- Interpret the GMP as it applies to various scenarios.
- Make recommendations on water policy for consideration by the Board of Supervisors

The responsibilities of the Groundwater Commission are discussed further in the following section entitled Institutional Processes.

c. Technical Support Team

The Technical Support Team would consist of County personnel (a Water Resources Coordinator) and DWR personnel, and likely also hydrogeologic consultants to provide technical input and assistance on an as-needed basis. The primary role of the TST will be to utilize appropriate geologic and hydrogeologic principles to support groundwater management decision-making.





The TST will provide analysis and interface with the Water Users Group on the gathering and review of data, progress on implementation of the Action Program, updates to the Action Program, Community Outreach, and the formulation and review of potential water management programs and projects. The TST will make recommendations to the Groundwater Commission, but the Groundwater Commission will make the decisions about what guidance will be issued.

From time to time, specific items or issues will emerge that warrant being addressed by a broader group of stakeholders than is represented by the Water Users Group alone. Accordingly, it will be an important role of the TST, in coordination with the Water Users Group, to acknowledge the need to have particular stakeholders or specialized expertise involved and to recommend establishing a single-purpose task-oriented committee to the Commission. For example, this could be appropriate in dealing with such items as refinement or establishing more specific BMOs, refining water transfer guidelines and inter- and intra-county processes, formulating supplemental water supply alternatives for a proposed development, etc.

d. Water Users Group

This group is identified as a Water Users Group rather than a groundwater users group to acknowledge that both surface water and groundwater need to be dealt with in a conjunctive manner. The Water Users Group would be comprised of a “core” group of individuals representing a cross-section of landowners and managers representing water purveyors and non-organized areas. It is the intent that over time there would be a nucleus of water users interested in water management that would monitor and review elements of the Action Program as they are performed and become increasingly informed of the water resources and factors affecting the resources. The Water Users Group would become engaged in identifying, discussing, and reviewing programs and/or projects that could enhance water management in the County. It is suggested that the core group be comprised of 8 individuals with representation as follows.

Tehama Colusa Canal Service Area	2 Members
Non-Organized Areas	2 Members
Cities and PUDs.....	2 Members
Sacramento River Settlement Contract Area	2 Members

The individuals of the Water Users Group would be volunteers, but would be approved by the Board of Supervisors.

Meetings of the Water Users Group, as with all meetings under this program, would be noticed and open to the public. For the Water Users Group to be





effective and maintain continued interest, it is extremely important that the Water Resources Coordinator formulate and schedule meetings with meaningful agendas. The Water Users Group would receive information about the activities of the Groundwater Commission and the Technical Support Team and provide input and feedback to these bodies.

e. Administrative Support

Administrative support will be needed to assist in the scheduling and notification of meetings; the preparation of materials for meetings of the Board of Supervisors, the Groundwater Commission, the Technical Support Team, and the Water Users Group; the preparation of meeting notes and communications as a follow-up to meetings will be required as well. Keeping a designated website updated with information on the program will also be an important administrative activity.

3. Institutional Processes

The institutional process for the various roles of the Groundwater Commission are outlined and described below. The mechanics of how “business” is conducted can be refined with time and experience; however, it is deemed important at this point to outline a process that can be used to initiate this important activity.

a. Forum for Reviewing and Disseminating Groundwater Information (Public Outreach)

In this role (shown in Figure IV.2), the TST will perform most technical evaluation, and will inform the Groundwater Commission on a periodic basis, with semiannual reporting as a minimum. The TST will be responsible for compiling and analyzing monitoring data, summarizing groundwater conditions as they relate to BMOs, and reporting to the Groundwater Commission. The TST will review the data and information with the Water Users Group in advance of presenting it to the Groundwater Commission.

The Groundwater Commission will disseminate information to the public through newsletters, media coverage, the website, or a noticed public meeting. Based upon the findings of the TST, the Groundwater Commission may refer guidance for consideration by the Planning and Building and/or Environmental Health Departments. Guidance to these departments could include recommendations to modify or add additional conditions on new well construction (for example, requiring deeper sanitary seals in certain areas), guidelines for well testing for the purpose of determining if adequate water supply exists at a site to issue a building permit, or other guidance as appropriate.





As recommended in DWR's Bulletin 118, the information provided to the public will include at a minimum:

- A summary of monitoring data, including discussion of historic trends.
- A summary of management actions during the period covered by the report.
- A discussion of whether management actions are contributing to achievement of BMOs.
- A summary of proposed future management actions.
- A summary of any changes to the GMP (including modifications to BMOs) during the reporting period.
- A summary of actions taken to coordinate with other water management, land use, and government agencies.

At the conclusion of each reporting cycle, the TST will reevaluate the adequacy of the monitoring network, and of the data obtained. If warranted, modifications will be made to the monitoring network in order that the overall monitoring program is enhanced over time.

This process can be used effectively by water purveyors also to facilitate a coordinated effort for public outreach.

b. Receive and Address Groundwater Concerns/Issues

In this role (shown in Figure IV.3), a member of the public may bring a concern or issue (or a "dispute") directly to the Groundwater Commission. The Groundwater Commission will have the option of dismissing the issue directly, referring the issue to another forum, or forwarding the issue to the TST for further evaluation. If the issue is forwarded to the TST, the TST will review the issue (including review of relevant monitoring data), assess the issue in relation to BMOs, and report back to the Groundwater Commission with options and recommendations for dismissal or resolution of the issue. The TST will also reevaluate the monitoring network in light of the issue, and make modifications as warranted.

Based upon the report of the TST, the Groundwater Commission may dismiss the issue, recommend a resolution, and/or assist with mediation among parties. If a conflict exists among parties, the role of the Groundwater Commission will be to facilitate the evaluation of the issue on a technical basis, recommend or suggest potential solutions, and help the parties come to a resolution. The intent of this process is to work to resolve issues without legal action. If resolution





cannot be successfully obtained, parties could appeal to the Board of Supervisors for a decision within the framework of the Groundwater Management Plan and implementing ordinance. Again, the intent is to work to keep legal action as a last resort.

c. Evaluate Water Supply Assessments and Development Proposals

In this role (as shown in Figure IV.4), the Groundwater Commission would serve as an advisor to the Planning and Building Department. The Planning and Building Department would forward development proposals and Water Supply Assessments to the Groundwater Commission. The Groundwater Commission would forward the proposals/assessments to the TST, which will review them in relation to groundwater conditions and for consistency with BMOs. Water Supply Assessments will be reviewed for technical accuracy, completeness, and consistency with BMOs. The TST will prepare summaries and guidance and will report back to the Groundwater Commission. The Groundwater Commission will then issue guidance to the Planning and Building Department.

d. Process Proposals for Water Transfers

In this role (shown in Figures IV.5, IV.6, and IV.7), the Groundwater Commission will process proposals for groundwater substitution water transfers. Groundwater substitution water transfers occur when surface water is transferred and the transferred water is replaced by pumping groundwater (groundwater substitution transfer). With respect to the Groundwater Management Goals and BMOs, there is no difference between an in-county groundwater substitution transfer and an out-of-county groundwater substitution transfer. Regardless of whether the surface water is being transferred within or outside the County, the groundwater pumping component of the transfer has the same potential to create adverse impacts. This GMP is not intended to apply to surface water transfers that have no groundwater pumping component.

In addressing water transfers, it is important to distinguish between short-term (one year) water transfers and long-term (multi-year) water transfers. Water transfers can be a very effective program, if designed and monitored properly, for obtaining information on the groundwater basin that otherwise would not be available. For this reason, it is appropriate for entities that have been involved or potentially may be involved in water transfers to define their prospective program well in advance of its implementation. Generally, the water transfer programs involving groundwater substitution are fairly well identified and efforts to implement a monitoring program can and should be initiated early. This would apply to both short-term and long-term water transfers. Early discussion of such programs can greatly facilitate the process and ensure the opportunity to obtain important data.





The process described below is focused to a greater extent on long-term water transfers where the potential for adverse impacts cannot be easily determined at the onset of the water transfer. Short-term water transfers on the other hand pose less threat to long-term adverse impacts and the differences need to be recognized. The process, however, for the short-term water transfers can be generally the same as described herein and illustrated on Figure IV-5. However, the documentation and review, especially if discussed early, would be much less onerous. The County's process, performed in tandem with the process and principles outlined in DWR's documents, "Groundwater Substitution Transfers, How to Make Them Work in the Sacramento Valley in 2009," and "Water Transfers in 2009 Involving the California Department of Water Resources and Bureau of Reclamation, Mid-Pacific Region," can be managed efficiently with the appropriate documentation.

The finalizing of decisions for short-term water transfers often occurs within a relatively short time due to the emergency nature of most transfers. Thus, the process needs to be responsive. Here again, the design of short-term water transfer proposals can, to a great extent, be accomplished well in advance of implementation.

The GMP process encourages prospective sponsors of water transfer proposals to be proactive in bringing a potential water transfer forward for discussion without jeopardizing the sponsor's authority to implement the proposed water transfer where the principles and monitoring requirements are respected.

The intent of the application process is for the water transfer sponsor to work collaboratively with the Groundwater Commission and the TST from the early stages of the proposed water transfer with the objective of developing a mutually acceptable project that is consistent with BMOs. It is not required that water transfer sponsors work collaboratively with the Groundwater Commission, but it is encouraged because the likelihood of approval will increase if this approach is used, and because it may be possible to determine if a proposal is inconsistent with BMOs and consequently unacceptable in the early stages of project planning, saving the water transfer sponsor unnecessary expense in preparing an application that will be rejected. The intent of this process is to facilitate sound water management proposals that are consistent with the BMOs on a technical basis.

There are three documents that will be submitted by the water transfer sponsor to the Groundwater Commission, representing three levels of detail. The Notice of Intent will provide a very basic description of what the water transfer sponsor envisions the project to consist of: the "who, what, when, where" description of the project. The Water Transfer Plan will be a more complete overview of all of the elements of the project, but will not include all of the detail that will be required in the final water transfer proposal. The water transfer proposal will be the final document that, once approved, will fully describe and guide the





implementation of all elements of the proposed project, including monitoring and mitigation. Each of the documents is intended to include an increasing level of detail, and expand upon the previous document. The intent of this process is to facilitate a collaborative process so that by the time the final water transfer proposal is prepared, the water transfer sponsor and the Groundwater Commission and TST are in agreement about all of the major elements the project.

The first step for the water transfer sponsor will be to file a Notice of Intent (NOI) with the Groundwater Commission. The NOI will include basic information about the project location, planned duration, and amount to be transferred. The NOI will initiate an iterative process whereby the Groundwater Commission will seek input from the TST, and may request modifications to the proposed project at any stage. The Groundwater Commission may also recommend that the water transfer sponsor work directly with the TST.

If the description of the proposal as presented in the NOI does not appear to have any “fatal flaws”, the water transfer sponsor may proceed with developing a Water Transfer Plan, and submit the plan to the Groundwater Commission. The Water Transfer Plan will include a more detailed description of the proposed project, including general information about the proposed monitoring and mitigation program. The TST will evaluate the Water Transfer Plan in relation to BMOs and may recommend initial approval of or revisions to the Water Transfer Plan. The Groundwater Commission will take the input of the TST into consideration and either request revisions to the Water Transfer Plan or grant initial approval of the plan.

Once initial approval of the Water Transfer Plan has been granted, the water transfer sponsor will prepare a detailed water transfer proposal, will complete CEQA documentation in the case of a groundwater substitution transfer, and will submit the water transfer proposal and CEQA documentation to the Groundwater Commission. The Groundwater Commission will forward the documents to the TST for confirmation of compliance with the GMP and BMOs. The TST will provide the Groundwater Commission with recommendations for conditional acceptance or revision of the water transfer proposal. Again, this process is anticipated to be collaborative between the TST and the water transfer sponsor. The Groundwater Commission may conditionally accept the water transfer proposal or request that the water transfer sponsor make modifications.

Once the water transfer proposal is conditionally accepted, the water transfer, as proposed, may proceed. The conditional acceptance will explicitly state the conditions that the water transfer sponsor must maintain during the water transfer, and under what conditions the water transfer must be modified or suspended. During the water transfer, the Groundwater Commission will enforce these conditions, and will also have the authority to modify or suspend





the water transfer at any time to comply with BMOs. The water transfer sponsor will conduct monitoring as specified and will submit monitoring data to the TST in a timely manner. The TST will determine if the water transfer is proceeding in compliance with the water transfer conditions and BMOs. The TST will report these findings to the Groundwater Commission. If the water transfer is out of compliance with the water transfer conditions or BMOs, the TST will make recommendations to the Groundwater Commission for modification or suspension of the water transfer. The monitoring, submittal, and evaluation of monitoring data shall be frequent enough to allow the Groundwater Commission to promptly address non-compliance. Based upon the findings of the TST, the Groundwater Commission may allow the water transfer to continue, require modification to the water transfer, or require suspension of the water transfer. The Groundwater Commission's decision does not have to be solely based upon the findings and recommendations of the TST.

e. Interpret the GMP as it Applies to Various Scenarios

The GMP describes a number of roles of the Groundwater Commission, and how different scenarios will be addressed under the GMP. However, it is anticipated that as the GMP is implemented, scenarios will arise that are not explicitly addressed in the GMP. In these cases, the Groundwater Commission may interpret the GMP and provide guidance describing how the GMP should be interpreted and applied in various scenarios.

f. Make Recommendations on Water Policy for Consideration by the Board of Supervisors

The Groundwater Commission can be an effective vehicle for formalizing water policies aimed at improving the overall management of water resources in the County. As more data is compiled, evaluated, and reviewed by the Groundwater Commission, and unforeseen issues are dealt with, it may be appropriate for the Groundwater Commission to formulate water policies for consideration by the Board of Supervisors. When the County General Plan is updated, it would be appropriate for the Groundwater Commission, including the TST and Water Users Group, to formulate water policies that should be considered for inclusion in the General Plan.

4. Role of County with Regard to Mitigation

The BMOs and institutional framework for GMP implementation include "protecting against and mitigating" certain adverse impacts. Protecting against adverse impacts helps prevent them from occurring in the first place. However, the concept of mitigation is also important because it recognizes that certain adverse impacts may occur, and may be capable of being effectively offset through mitigation measures. The County's role with regard to mitigation will not be to actively undertake mitigation to offset the actions of others. The institutional





framework for GMP implementation establishes a structure whereby the County can provide technical review and recommendations to help resolve groundwater issues and disputes. These recommendations may include mitigation to be undertaken by some or all of the involved parties.

5. Staffing Needs for GMP Implementation

To implement the GMP, it is anticipated that a full-time staff person will be needed to serve as the County water Resources Coordinator. Part-time administrative support will also be needed. Each of these needs is described below.

a. County Water Resources Coordinator

The County Water Resources Coordinator will be a full-time position. The duties and responsibilities of the position will include:

- Attending meetings and coordinating with other water management interests within and outside of the County.
- Seeking funding for GMP implementation, including grant funding for specific Actions.
- Coordinating with water purveyors within the County to support project proposals that are consistent with the goals and BMOs of the GMP, particularly those that will further the understanding of water resources in the County.
- Identifying and utilizing the technical resources needed for GMP implementation.
- Coordinating the efforts of the Groundwater Commission, Technical Support Team, Water Users Group, and Administrative Support.
- Conducting public outreach.

The role of the Water Resources Coordinator will not be to personally complete the tasks associated with implementing the GMP, but rather to act as a coordinator and facilitator to manage a diverse team that will need to work cohesively to implement the GMP. As such, the desired qualifications for the Water Resources Coordinator are more managerial than technical. Desired qualifications include:

- “People skills” to work successfully with and build consensus among a wide variety of individuals and groups representing sometimes conflicting interests.
- Background in water resources or similar natural resources areas.





- Proven success in coordinating diverse groups to cooperatively accomplish tasks.
- Experience with conducting public outreach and serving as the public “face” of an agency or entity.
- Ability to effectively communicate technical information to the layperson.
- Successful background in preparing grant applications and obtain grant funding for projects.

b. Administrative Support

Part-time administrative support will be needed on a regular basis to assist the Groundwater Management Coordinator, the Groundwater Commission, and the Technical Support Team. Tasks will include:

- Assisting with scheduling and providing notice for meetings.
- Preparing and distributing materials for meetings.
- Preparing and distributing meeting notes and other follow-up items.
- Updating and maintaining the GMP website (may be provided by a separate staff person).

6. Funding

Water Code §10754 gives local agencies that adopt GMPs the authority to “fix and collect fees and assessments for groundwater management.” A majority vote within the area of the local agency covered by the GMP is required to authorize the agency to fix and collect fees. As described previously, the actual area to which this authority could apply is relatively small in relation to the area over which groundwater management should occur.

To implement the GMP within the institutional framework described in this section may require from approximately \$150,000 to \$200,000 per year. Possible funding sources include: assessments, sales tax, additional fees for well drilling, development fees, water transfer fees, grant funding. None of these are deemed feasible for funding the basic program; thus, the Board of Supervisors will need to develop a funding strategy to sustain the basic program outlined in this GMP. The GMP, when implemented, benefits the community of Colusa County as a whole. Therefore, no single stakeholder or group of stakeholders should be targeted to fund the program.





The various options or sources for funding are evaluated herein to provide a comparative perspective for each.

a. Assessments

Revenue for implementation of the GMP could be generated through assessments; however, assessments could only be levied with a successful Proposition 218 process. Assessments could be based upon well ownership and type of well, with a higher assessment for municipal, industrial and irrigation wells as opposed to domestic wells. Monitoring wells would not be assessed, since implementation of the GMP would primarily benefit groundwater pumpers. A number of property owners within the County own more than one well, and might not benefit more from implementation of the GMP than an owner of fewer wells, so assessing well owners the same amount regardless of the number of wells they own seems to make more sense than having a per-well assessment.

According to DWR records, there are approximately 1200 domestic wells, 800 irrigation or industrial wells, and 45 municipal wells within the County. There are approximately 900 domestic well owners, 600 irrigation or industrial well owners, and 30 municipal well owners in the County. To generate \$150,000 per year, an assessment of nearly \$100 per year per owner per type of well would be required. It is likely that these fees will be viewed by well owners as excessive. Additionally, there is no up-to-date and complete list of well owners in the County, so enacting an assessment of well owners would be difficult.

Assessments alone are probably not a good option to fund implementation of the GMP, but they could be used to provide a portion of funding on an annual basis. For example, if a smaller assessment of \$15 per year for domestic well owners and \$30 per year for irrigation/industrial/municipal well owners would generate approximately \$32,000 per year. The maximum assessment per well owner would be \$45, for a well owner with both a domestic and an irrigation well. In addition to other benefits of GMP implementation, well owners could be provided with an annual or semi-annual newsletter update on groundwater conditions and GMP implementation.

b. Sales Tax

A small increase in sales tax could be used to fund implementation of the GMP. Colusa County has a sales and use tax rate of 7.25%; only the City of Williams has a higher rate of 7.75% (California Board of Equalization, 2007). During 2006, the most recent fiscal year with available data, there were approximately \$291 million of taxable sales in Colusa County (California Board of Equalization). Based upon this, a 1/8th cent tax increase, to 7.375% and 7.875%, would generate approximately \$363,000 per year. This is equal to a per-capita annual cost of slightly more than \$17. The revenue that would be





generated from a 1/8th cent tax increase is more than is needed to fund GMP implementation, so the excess could be used to build up a fund for implementing Actions within this GMP.

c. Additional Fees for Well Drilling

The Colusa County Environmental Health Department (EHD) currently charges \$263 for well permit applications for production wells (including domestic, irrigation, industrial, municipal, etc.). This fee helps pay for the cost for EHD personnel to process well permit applications and inspect sanitary seal placement. According to records from DWR, on average 35 production wells were constructed per year from 1950 to present. The amount of revenue that could be generated by even doubling the production well permit application fee would be less than \$10,000 per year. Additionally, increasing well permit application fees burdens new well owners more than existing well owners, though both would benefit from GMP implementation. For these reasons, increasing the fee for production well permit applications is not recommended to provide revenue to fund GMP implementation.

d. Development Fees

Fees on new development could help fund GMP implementation. If these developments are supplied by groundwater, they would clearly benefit from GMP implementation. The amount of revenue that could be generated through development fees is unknown and could fluctuate significantly from year to year depending upon the demand for new housing, so it may not be an appropriate source for stable funding. Development fees, however, are appropriate to cover staff and consultant time required to review and process development proposals in relation to the GMP.

e. Water Transfer Fees

Revenue for GMP implementation could be raised by imposing a transaction fee on groundwater substitution water transfers. One institutional function established by the GMP is processing groundwater substitution water transfer applications and enforcing water transfer conditions, so it is reasonable that fees generated from water transfers be used to cover these costs. As previously discussed, from the perspective of groundwater management there is no difference between in-county and out-of-county groundwater substitution water transfers. Each has the same potential for causing adverse impacts associated with groundwater extraction. Fees generated from groundwater substitution water transfers would be used to fund groundwater management activities that are related to the monitoring and mitigation of adverse impacts from the water transfers.





The amount of revenue that could be generated from imposing fees on groundwater substitution water transfers is unknown and could fluctuate from year to year, so it is not an appropriate source of funding for the basic program.

f. Grant Funding

With the adoption of this GMP, the County will be eligible to apply for DWR grant funding for groundwater-related programs and projects, including many of the Actions described in this GMP. The available funding varies from year to year based upon the state budget. The program is extremely competitive, and the applications total more than the available funding. Nevertheless, the County should pursue grant funding for technical studies identified in this GMP and others that will be identified as the GMP is implemented. Grant funding is not an appropriate source of funding for the basic program.

B. PUBLIC OUTREACH

Ongoing public outreach will be an important component of GMP implementation, and the Action Program includes an Action to formalize an ongoing public outreach program. The public outreach should include an annual compilation of activities and accomplishments of activities implemented under the GMP, and relevant programs and projects of participating water entities as well.

C. GROUNDWATER SUBSTITUTION WATER TRANSFERS

The role of GMP with regard to groundwater substitution water transfers is largely addressed by the institutional structure and processes established by the GMP. The role of the Groundwater Commission in processing proposals for groundwater substitution water transfers is detailed in Section IV.A.3.d. This process is intended to be collaborative, with the Groundwater Commission and Technical Support Team working with water transfer sponsors to ensure that their plan for transferring water is consistent with the GMP and BMOs. A procedure has also been developed to receive and address concerns and issues related to groundwater, including those that may arise during a water transfer. This GMP is not intended to cover surface water transfers that do not include a groundwater pumping component.

This GMP strives to balance the need to ensure that groundwater substitution water transfers comply with BMOs. Through implementation of a project-specific monitoring program, the intent is to prevent unnecessary restrictions on groundwater use and to facilitate sound water management. The established procedures should achieve this, but this GMP is a “living” document that will need to be revised or expanded as it is implemented and the understanding of the resources is enhanced. The Action Program includes an Action to periodically revise and update the GMP, which will help address the need for changes over time.





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Tables

Tables



TABLE I.1**COMPLIANCE OF COLUSA COUNTY GMP WITH COMPONENTS TO BE INCLUDED IN A GMP**

Description	Discussed in GMP?	GMP Section	How Addressed
Voluntary Components (CWC, AB 3030)			
Control saline water intrusion.	YES	App. B III.B	Discussed in Appendix B. Not a direct concern, but addressed through water quality BMOs.
Identify/manage wellhead protection areas.	YES	App. B	Discussed in Appendix B. Covered under existing County Well Standards; no need for separate management under GMP.
Regulate migration of contaminated groundwater.	YES	App. B III.B	Discussed in Appendix B. Regulated and managed by RWQCB; no need for separate management under GMP, but covered by water quality BMOs.
Administer well abandonment/destruction program.	YES	App. B	Discussed in Appendix B. Covered under existing County Well Standards; no need for separate management under GMP.
Mitigate conditions of overdraft.	YES	App. B III.A,B	Discussed in Appendix B. Not a direct concern, but addressed through Groundwater Management Goal of Ensuring Long-Term Groundwater Sustainability. Also addressed in water level, water quality, and inelastic land subsidence BMOs.
Replenish groundwater.	YES	App. B	Discussed in Appendix B. High groundwater levels are a concern. Inadequate hydrogeologic understanding to evaluate necessity or feasibility; Actions will help further characterize County hydrogeology.
Monitor groundwater levels/storage.	YES	III.C,E	Changes in groundwater in storage are evaluated via groundwater levels. Existing monitoring program includes extensive groundwater level measurement. Actions to Formalize Groundwater Monitoring Program and Improve Monitoring Network.
Facilitate conjunctive use operations.	YES	III.A	Groundwater management goal to Optimize Conjunctive Use of Surface Water and Groundwater.
Identify well construction policies.	YES	App. B	Discussed in Appendix B. Covered under existing County Well Standards; no need for separate management under GMP.

TABLE I.1

COMPLIANCE OF COLUSA COUNTY GMP WITH COMPONENTS TO BE INCLUDED IN A GMP

Description	Discussed in GMP?	GMP Section	How Addressed
Construct/operate groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.	YES	App. B	Discussed in Appendix B. This GMP does not include the construction or operation of any specific groundwater projects.
Develop relationships with state and federal regulatory agencies.	YES	III.A,D,E IV.A	Groundwater Management Goal and Action to Coordinate Local and Regional Groundwater Management. Process for coordination.
Review land use plans/ coordinate with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.	YES	III.A-E IV.A App. B	Groundwater Management Goal to Coordinate Local and Regional Groundwater Management. Addressed in water quality BMOs. Action for Groundwater Management Coordination. Process for coordination. General Plan includes policy to discourage these land uses.
Required Components (CWC, SB 1938)			
Prepare BMOs, including monitoring/management of: <ul style="list-style-type: none"> • Groundwater levels, • Groundwater quality degradation, • Inelastic land surface subsidence, • Changes in surface flow/quality that directly affect groundwater levels or quality or are caused by groundwater pumping. 	YES	III.B,C,E	Water level BMO. Existing monitoring program includes extensive groundwater level measurement. Actions to Formalize Groundwater Monitoring Program and Improve Monitoring Network.
	YES	III.B,C,E	Water quality BMOs. Actions to Formalize Groundwater Monitoring Program and Improve Monitoring Network.
	YES	III.B,C,E	Inelastic land subsidence BMO. Actions to Formalize Groundwater Monitoring Program and Improve Monitoring Network.
	YES	III.B,C,E	Surface Water and Wetlands BMO. Actions to Formalize Groundwater Monitoring Program and Improve Monitoring Network.

TABLE I.1**COMPLIANCE OF COLUSA COUNTY GMP WITH COMPONENTS TO BE INCLUDED IN A GMP**

Description	Discussed in GMP?	GMP Section	How Addressed
Prepare a plan to involve other agencies that enables the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin.	YES	III.A,D,E IV.A	Groundwater Management Goal to Coordinate Local and Regional Groundwater Management. Actions for Groundwater Management Coordination and to Formalize Public Outreach Program. Process for coordination.
Prepare a map that shows the groundwater basin, the area that will be subject to the GMP, the boundaries of other local agencies that overlie the basin and that have or are developing GMPs.	YES	I.E	Figures I.1 and I.2.
Adopt monitoring protocols that are designed to detect changes in: groundwater levels, groundwater quality, inelastic surface subsidence, and flow and quality of surface water that directly affect groundwater levels/quality or are caused by groundwater pumping in the basin.	YES	III.C,E	Existing groundwater monitoring network and protocols described. Actions to Formalize Groundwater Monitoring Program and Improve Monitoring Network.
For areas outside a groundwater basin, prepare the plan using geologic and hydrologic principles appropriate to those areas.	YES	I.E II.E IV.A	The GMP covers areas within and outside of a groundwater basin. Hydrogeology of the County, including areas outside a groundwater basin, is described. Groundwater management process included technical support to apply BMOs using appropriate geologic and hydrogeologic principles.

TABLE I.1

COMPLIANCE OF COLUSA COUNTY GMP WITH COMPONENTS TO BE INCLUDED IN A GMP

Description	Discussed in GMP?	GMP Section	How Addressed
Recommended Components (DWR Bulletin 118, Appendix C)			
Document public involvement.	YES	I.F	Description of public involvement is provided with supporting documentation in Appendices.
Form a Plan Advisory Committee.	YES	I.F	Description of Plan Advisory Committee is provided with supporting documentation in Appendices.
Describe the hydrogeology underlying the GMP area.	YES	II.E	Hydrogeology underlying the GMP area (the County) is described.
Describe historical data related to: groundwater levels, groundwater quality, inelastic land subsidence, and changes in surface flow/quality that directly affect groundwater levels/quality or are caused by groundwater pumping.	YES	II.E	Historic data related to groundwater levels, groundwater quality, inelastic land subsidence, and surface water flow and quality are described.
Discuss issues of concern related to groundwater in the GMP area.	YES	I.G	Main issues of concern raised during development of the GMP are discussed.
Discuss general historic and projected water demands and supplies.	YES	II.D App. H	Water use discussed in GMP, Water Use and Supply Technical Memorandum provides detailed discussion (Appendix H).
Describe how meeting each BMO will “contribute to a more reliable supply for long-term beneficial uses of groundwater in the [GMP] area, and describe existing or planned management actions to achieve [BMOs].”	YES	III.A,B,E	Groundwater Management Goals and BMOs include discussion. Action Program included.

TABLE I.1

COMPLIANCE OF COLUSA COUNTY GMP WITH COMPONENTS TO BE INCLUDED IN A GMP

Description	Discussed in GMP?	GMP Section	How Addressed
Describe the monitoring program, including: Location of monitoring sites, and summary of monitoring sites by type and frequency of monitoring.	YES	III.C,E	Current monitoring network is described, including location of monitoring sites, types of sites, and frequency of monitoring. Actions to Formalize Groundwater Monitoring Program and Improve Monitoring Network.
Describe “current or planned actions by the local management entity to coordinate with other land use, zoning, or water management planning agencies or activities.”	YES	III.A,D,E IV.A	Groundwater Management Goal to Coordinate Local and Regional Groundwater Management. Action Item for Groundwater Management Coordination. Process for coordination.
Provide for periodic reports describing groundwater basin conditions and groundwater management activities, including: <ul style="list-style-type: none"> • Summary of monitoring data, including discussion of historic trends. • Summary of management actions during the period covered by the report. • Discussion, based on monitoring data, of whether management actions are contributing to achievement of BMOs. • Summary of proposed future management actions. 	YES	IV.A	Describes role of Groundwater Commission as a forum for presenting and discussing groundwater information, and describes reporting of the listed items.

TABLE I.1

COMPLIANCE OF COLUSA COUNTY GMP WITH COMPONENTS TO BE INCLUDED IN A GMP

Description	Discussed in GMP?	GMP Section	How Addressed
<ul style="list-style-type: none">• Summary of any plan changes (including modifications to BMOs) during the period covered by the report.• Summary of actions taken to coordinate with other water management, land use, and government agencies.			
Provide for periodic reevaluation of the entire GMP.	YES	III.E	Action Item to Periodically Revise and Update the GMP.

TABLE I.2

COMPLIANCE OF COLUSA COUNTY GMP WITH PROCEDURES FOR GMP DEVELOPMENT

Description	Completed	Evidence of Completion	
<p>GMP area is either:</p> <ul style="list-style-type: none"> • Not served by another local agency. • Served by a local agency, when the majority of the agency’s governing body declines to exercise its authority to manage groundwater <i>and</i> enters into an agreement with the local agency developing the GMP. 	N/A	N/A	<p>Areas outside other local agencies are shown in Figure I.1. Applicability of Plan discussed in I.E.</p> <p>As discussed in I.E, agreements will need to be executed with other local agencies to formalize their participation in the GMP.</p>
<p>The County published notice and held a public hearing about whether or not to adopt a resolution of intention to draft a GMP.</p>	YES	Appendix I	
<p>The County published the resolution of intention to draft a GMP, and provided a copy to any person who requested a copy in writing.</p>	YES	Appendix I	
<p>The County prepared and made available a written description of how interested parties could participate in the development of the GMP.</p>	YES	Appendix D	Public Outreach Program

TABLE I.2

COMPLIANCE OF COLUSA COUNTY GMP WITH PROCEDURES FOR GMP DEVELOPMENT

Description	Completed	Evidence of Completion	
The GMP was prepared within two years of the adoption of the resolution of intention.	YES	Appendix I	Resolution of intent adopted 6/12/2007
The County published notice and held a second public hearing about whether or not to adopt the GMP.			This and subsequent items are forthcoming following public availability of the Draft GMP.
The agency considered protests at the second hearing.			
The County verified land ownership of any written protests filed before the conclusion of the second hearing that included the landowner's signature and a description of the land owned.			
A "majority protest" occurred.			
The County adopted rules and regulations to implement and enforce the adopted GMP.			
The County considered the potential impact of rules and regulations on business activities, including agricultural operations, and minimized adverse impacts on these business activities.			

TABLE II.1

BREAKDOWN OF WATER MANAGEMENT ENTITIES/AREAS

Water Management Entity/Area	Area (ac)	Percent of Subtotal (%)	Percent of Total Water Management Entities/Areas (%)	Percent of Total County Area (%)
Water Purveyors				
Tehama-Colusa Canal Service Area				
4-M Water District	19,391	21		
Colusa County Water District	46,384	51		
Cortina Water District	615	1		
Davis Water District	1,954	2		
Glenn Valley Water District	2,139	2		
Holthouse Water District	2,043	2		
La Grande Water District	1,471	2		
Myers-Marsh Mutual Water Company	278	0		
Westside Water District	17,492	19		
Subtotal	91,767		23	12
Sacramento River Service Area				
Arbuckle Public Utility District	535	0		
Carter Mutual Water Company	2,115	1		
City of Colusa Water System	1,536	1		
Colusa Drain Mutual Water Company	36,406	16		
Glenn Colusa Irrigation District ¹	94,933	43		
Maxwell Irrigation District	7,148	3		
Maxwell Public Utility District	237	0		
Mehrhof & Montgomery	71	0		
Princeton-Codora-Glenn Irrigation District ¹	5,529	2		
Provident Irrigation District ¹	2,142	1		
Reclamation District No. 1004 ¹	21,399	10		
Reclamation District No. 108 ²	33,188	15		
Roberts Ditch Irrigation Company	1,909	1		
Sycamore Family Trust	8,565	4		
Willow Creek Mutual Water Company ¹	6,346	3		
Subtotal	222,059		55	30
Total (Water Purveyors)	313,826		78	42
Non-Organized Areas				
NOA-1	997	1		
NOA-2	14,113	19		
NOA-3	1,453	2		
NOA-4	38,749	51		
NOA-5	3,079	4		
NOA-6	17,308	23		
Total (Non-Organized Areas)	75,699		19	10
National Wildlife Refuges				
Colusa National Wildlife Refuge	4,132	34		
Delevan National Wildlife Refuge	5,459	45		
Sacramento National Wildlife Refuge ¹	2,428	20		
Total (Wildlife Refuges)	12,019		3	2
TOTAL (Water Management Entities/Areas)	401,544		100	54

TABLE II.1

BREAKDOWN OF WATER MANAGEMENT ENTITIES/AREAS

Water Management Entity/Area	Area (ac)	Percent of Subtotal (%)	Percent of Total Water Management Entities/Areas (%)	Percent of Total County Area (%)
Areas Outside of Water Purveyor Boundaries, Non-Organized Areas, and Wildlife Refuges				
All Land Uses (Primarily Native and Riparian Vegetation; Western Portion of Colusa County)	338,454		100	
Total (Other Areas)	338,454		100	46
COUNTY TOTAL	739,998			100

Notes:

1. These water purveyors or national wildlife refuges serve or include land in both Colusa and Glenn Counties. Only the area in Colusa County is shown.
2. This water purveyor serves land in both Colusa and Yolo Counties. Only the area in Colusa County is shown.
3. Stony Creek Water District is not addressed in detail in this analysis. The boundaries of the district contain only one acre in Colusa County, which is not currently irrigated. A total of 27 acre-feet of surface water was used over the last five years (Westcamp, 2007).

Source: DWR, 2003a.

TABLE II.2
COLUSA COUNTY LAND USE (1993, 1998, 2003)
(acres)

Land Use	1993	1998	2003	1993-2003 Change	
				ac	%
Within Water Purveyor Boundaries, Non-Organized Areas, and Wildlife Refuges					
Permanent Crops (Irrigated)					
Almonds	19,948	26,681	30,232	10,284	52
Citrus and Subtropical	213	118	46	-167	-78
Other Deciduous	9,564	9,835	8,923	-641	-7
Pistachios	968	1,455	1,365	397	41
Vineyard	1,291	1,878	2,115	823	64
Subtotal	31,985	39,966	42,680	10,696	33
Non-Permanent Crops (Irrigated)					
Alfalfa and Alfalfa Mixtures	7,921	7,818	8,449	529	7
Beans (dry)	7,192	6,790	4,574	-2,618	-36
Corn (field and sweet)	4,613	4,793	2,397	-2,217	-48
Cotton	316	6,334	3,442	3,126	990
Grain	42,272	30,376	33,741	-8,531	-20
Onions and Garlic	53	1,085	398	345	644
Other Field Crops	2,394	3,110	3,176	782	33
Other Pasture	4,679	3,265	3,985	-694	-15
Other Truck Crops	14,354	14,642	9,683	-4,671	-33
Rice	134,500	136,132	136,405	1,905	1
Safflower	14,584	15,107	10,287	-4,297	-29
Sugar Beets	4,756	1,161		-4,756	-100
Tomatoes	24,817	25,645	18,950	-5,867	-24
Subtotal	262,452	256,258	235,487	-26,965	-10
Total (Irrigated)	294,437	296,224	278,168	-16,269	-6
Other Land Uses (Non-Irrigated)					
Barren	44	478	548	504	1144
Fallow/Idle	22,611	15,482	19,318	-3,293	-15
Not Surveyed	220	3		-220	-100
Semi-agricultural and Incidental to Agriculture	2,455	2,348	1,974	-481	-20
Urban	4,057	4,865	4,881	824	20
Vacant	1,421	7,827	5,601	4,181	294
Vegetation	70,639	67,052	82,071	11,432	16
Water	5,775	7,379	8,985	3,210	56
Total (Non-Irrigated)	107,221	105,434	123,378	16,157	15
Total	401,659	401,659	401,546	-113	0
Outside of Water Purveyor Boundaries, Non-Organized Areas, and Wildlife Refuges					
All Land Uses (Primarily Native and Riparian Vegetation; Western Portion of Colusa County)	338,341	338,341	338,454	113	0
Total	338,341	338,341	338,454	113	0
COUNTY TOTAL (APPROXIMATE)	740,000	740,000	740,000	0	0

Note:

Due to varying land use classifications for each surveyed year, in addition to the differing boundaries of the "Not Surveyed" classification, the methodologies, and the datasets in each survey year, the total land use was adjusted using land in the western part of the County. No totals in the water purveyor boundaries were adjusted.

Sources: DWR, 1993; DWR, 1998; and DWR, 2003a.

TABLE II.3

COLUSA COUNTY IRRIGATED CROPS (2003)

Crop	Area	
	ac	%
Rice	136,405	49
Grain	33,741	12
Almonds	30,232	11
Tomatoes	18,950	7
Safflower	10,287	4
Other Truck Crops	9,683	3
Other Deciduous	8,923	3
Alfalfa and Alfalfa Mixtures	8,449	3
Beans (dry)	4,574	2
Other Pasture	3,985	1
Cotton	3,442	1
Other Field Crops	3,176	1
Corn (field and sweet)	2,397	1
Vineyard	2,115	1
Pistachios	1,365	0
Onions and Garlic	398	0
Citrus and Subtropical	46	0
TOTAL	278,168	100

TABLE II.4

AGRICULTURAL LAND USE BY WATER MANAGEMENT ENTITY/AREA (2003)
(acres)

Water Management Entity/Area	Total Area	Predominant Crops				Area in Predominant Crops		Area in Other Land Uses	
		Almonds	Grain	Rice	Tomatoes	ac	%	ac	%
Water Purveyors									
Tehama-Colusa Canal Service Area									
4-M Water District	19,391	261	429	0	0	690	4	18,701	96
Colusa County Water District	46,384	21,438	4,559	326	3,385	29,707	64	16,677	36
Cortina Water District	615	496	0	0	496	81	119	19	
Davis Water District	1,954	111	337	5	234	687	35	1,267	65
Glenn Valley Water District	2,139	3	236	158	0	397	19	1,742	81
Holthouse Water District	2,043	199	169	95	0	463	23	1,580	77
La Grande Water District	1,471	0	49	1,128	0	1,177	80	294	20
Myers-Marsh Mutual Water Company	278	0	74	0	68	142	51	136	49
Westside Water District	17,492	4,689	2,708	1,250	1,822	10,469	60	7,024	40
Subtotal	91,767	27,195	8,560	2,962	5,509	44,227	48	47,540	52
Sacramento River Service Area									
Arbuckle Public Utility District	535	56	3	0	0	59	11	476	89
Carter Mutual Water Company	2,115	0	520	667	187	1,374	65	741	35
City of Colusa Water System	1,536	0	125	0	0	125	8	1,411	92
Colusa Drain Mutual Water Company	36,406	36	3,201	20,493	683	24,414	67	11,992	33
Glenn-Colusa Irrigation District	94,933	378	5,872	52,771	3,008	62,030	65	32,903	35
Maxwell Irrigation District	7,148	0	70	4,516	0	4,586	64	2,562	36
Maxwell Public Utility District	237	0	0	3	0	3	1	234	99
Mehrfhof & Montgomery	71	0	0	0	0	0	0	71	100
Princeton-Codora-Glenn Irrigation District	5,529	0	94	3,900	0	3,994	72	1,535	28
Provident Irrigation District	2,142	0	0	1,951	0	1,951	91	191	9
Reclamation District No. 1004	21,399	0	2,553	15,962	2,315	20,830	97	569	3
Reclamation District No. 108	33,188	0	27	12,840	0	12,868	39	20,320	61
Roberts Ditch Irrigation Company	1,909	0	331	507	0	838	44	1,071	56
Sycamore Family Trust	8,565	0	604	5,186	222	6,013	70	2,552	30
Willow Creek Mutual Water Company	6,346	0	0	2,161	0	2,161	34	4,185	66
Subtotal	222,059	471	13,403	120,958	6,415	141,247	64	80,812	36
Total (Water Purveyors)	313,826	27,666	21,963	123,920	11,925	185,474	59	128,352	41

TABLE II.4

AGRICULTURAL LAND USE BY WATER MANAGEMENT ENTITY/AREA (2003)
(acres)

Water Management Entity/Area	Total Area	Predominant Crops				Area in Predominant Crops		Area in Other Land Uses	
		Almonds	Grain	Rice	Tomatoes	ac	%	ac	%
Non-Organized Areas									
NOA-1	997	0	24	0	0	24	2	973	98
NOA-2	14,113	2,434	3,692	135	3,080	9,341	66	4,772	34
NOA-3	1,453	0	604	86	397	1,087	75	366	25
NOA-4	38,749	131	3,447	9,076	1,091	13,746	35	25,003	65
NOA-5	3,079	0	0	1,333	0	1,333	43	1,746	57
NOA-6	17,308	0	3,986	1,713	2,458	8,156	47	9,152	53
Total (Non-Organized Areas)	75,699	2,566	11,752	12,344	7,026	33,688	45	42,011	55
National Wildlife Refuges									
Colusa National Wildlife Refuge	4,132	0	26	3	0	29	1	4,103	99
Delevan National Wildlife Refuge	5,459	0	0	0	0	0	0	5,459	100
Sacramento National Wildlife Refuge	2,428	0	0	138	0	138	6	2,290	94
Total (Wildlife Refuges)	12,019	0	26	141	0	167	1	11,852	99
TOTAL	401,544	30,232	33,741	136,405	18,950	219,328	55	182,216	45

TABLE II.5

**ESTIMATED WATER APPLIED FROM SURFACE WATER AND GROUNDWATER
SOURCES (2003)
(acre-feet)**

Water Management Entity/Area	Amount	Surface Water		Groundwater	
	ac. ft	ac. ft	%	ac. ft.	%
Water Purveyors					
Tehama-Colusa Canal Service Area					
4-M Water District	2,370	1,361	57	1,009	43
Colusa County Water District	93,588	65,475	70	28,113	30
Cortina Water District	1,557	1,546	99	11	1
Davis Water District	1,925	1,900	99	25	1
Glenn Valley Water District	1,102	1,084	98	18	2
Holthouse Water District	1,662	1,225	74	437	26
La Grande Water District	6,966	6,882	99	84	1
Myers-Marsh Mutual Water Company	197	111	56	86	44
Westside Water District	37,525	32,602	87	4,923	13
Subtotal	109,367	79,584		29,783	
Percent of Subtotal			73		27
Sacramento River Service Area					
Arbuckle Public Utility District	173	0	0	173	100
Carter Mutual Water Company	6,211	832	13	5,379	87
City of Colusa Water System	354	0	0	354	100
Colusa Drain Mutual Water Company	138,654	95,284	69	43,370	31
Glenn Colusa Irrigation District ¹	333,660	311,172	93	22,488	7
Maxwell Irrigation District	28,235	28,092	99	143	1
Maxwell Public Utility District	18	0	0	18	100
Mehrhof & Montgomery	193	189	98	4	2
Princeton-Codora-Glenn Irrigation District ¹	22,595	22,256	98	339	2
Provident Irrigation District ¹	10,649	7,997	75	2,652	25
Reclamation District No. 1004 ¹	70,866	70,668	100	198	0
Reclamation District No. 108 ²	120,350	113,382	94	6,968	6
Roberts Ditch Irrigation Company	5,416	2,972	55	2,444	45
Sycamore Family Trust	34,986	25,194	72	9,792	28
Willow Creek Mutual Water Company ¹	10,647	5,324	50	5,323	50
Subtotal	783,007	683,362		99,645	
Percent of Subtotal			87		13
Total (Water Purveyors)	892,374	762,946		129,428	
Percent of Total (Water Purveyors)			85		15
Non-Organized Areas					
NOA-1	97	11	11	86	89
NOA-2	27,329	8,910	33	18,419	67
NOA-3	2,808	1,308	47	1,500	53
NOA-4	101,690	40,595	40	61,095	60
NOA-5	8,263	8,230	100	33	0
NOA-6	30,782	13,135	43	17,647	57
Total (Non-Organized Areas)	170,969	72,189		98,780	
Percent of Subtotal			42		58

TABLE II.5

**ESTIMATED WATER APPLIED FROM SURFACE WATER AND GROUNDWATER
SOURCES (2003)
(acre-feet)**

Water Management Entity/Area	Amount	Surface Water		Groundwater	
	ac. ft	ac. ft	%	ac. ft.	%
National Wildlife Refuges					
Colusa National Wildlife Refuge	455	453	100	2	0
Delevan National Wildlife Refuge	1,057	1046	99	11	1
Sacramento National Wildlife Refuge	896	890	99	6	1
Total (Wildlife Refuges)	2,408	2,389		19	
Percent of Subtotal			99		1
COUNTY TOTAL	1,065,751	837,524		228,227	
Percent of Total			79		21

Notes:

1. These water purveyors or national wildlife refuges serve or include land in both Colusa and Glenn Counties. Only water applied in Colusa County is shown.
2. This water purveyor serves land in both Colusa and Yolo Counties. Only water applied in Colusa County is shown.

Source: DWR, 2003.

TABLE II.6

**U.S. BUREAU OF RECLAMATION CENTRAL VALLEY PROJECT
SACRAMENTO RIVER SETTLEMENT CONTRACTORS AND CONTRACT AMOUNTS
(acre-feet)**

Contractor	Base Supply	Project Water	Total Contract Amount	Percent of Subtotal (%)	Percent of Total (%)
Water Purveyors					
Carter Mutual Water Company	6,450	672	7,122	1	
Glenn-Colusa Irrigation District ¹	376,270	54,873	431,143	61	
Maxwell Irrigation District	11,980	6,000	17,980	3	
Mehrhof, Susan and Montgomery, John	164	16	180	0	
Princeton-Codora-Glenn Irrigation District ¹	10,347	2,939	13,286	2	
Provident Irrigation District ¹	3,942	396	4,338	1	
Roberts Ditch Irrigation Company	4,140	300	4,440	1	
Reclamation District No. 1004 ¹	49,085	13,055	62,140	9	
Reclamation District No. 108 ²	112,274	18,618	130,892	19	
Sycamore Family Trust	22,000	9,800	31,800	5	
Subtotal	596,652	106,669	703,321		92
Percent of Subtotal (%)	85	15	100		
Non-Organized Areas					
Anderson Properties, R and J, L.P.	34	13	47	0	
Anderson Properties, R and J, L.P.	115	75	190	0	
Anderson, Arthur et al (formerly Westfall, Mary)	445	45	490	1	
Baber, Jack, et al	3,630	2,630	6,260	10	
Beckley, Ralph and Ophelia	165	135	300	0	
Butte Creek Farms, Inc.	20	16	36	0	
Butte Creek Farms, Inc.	196	8	204	0	
Butte Creek Farms, Inc.	40	55	95	0	
Butte Creek Farms, Inc.	300	340	640	1	
Cachil Dehe of Wintun Indians of the Colusa Indian Community	80	100	180	0	
Driver, Gary, et al.	8	22	30	0	
Eastside Mutual Water Company	2,170	634	2,804	5	
Ehrke, Allen A. and Bonnie E.	220	160	380	1	
Fedora, Sibley G. and Margaret L.	190	20	210	0	
Forry, Laurie E.	2,285	0	2,285	4	
Gillaspy, William F.	120	90	210	0	
Gomes, Judith A.	168	78	246	0	
Green Valley Corporation	680	210	890	1	
Green Valley Corporation	555	325	880	1	
Griffin, Joseph, and Prater, Sharon	1,610	1,150	2,760	5	
Jansen, Peter and Sandy	150	40	190	0	
King, Benjamin and Laura	12	7	19	0	
King, Laura	13	13	26	0	
Locvich, Loyd	0	0	0	0	
Nene Ranch, LLC	1,360	200	1,560	3	
Otterson, Mike	1,515	300	1,815	3	
Pleasant Grove-Verona M.W.C.	23,790	2,500	26,290	44	
Seaver, Charles W. and Barbara J.	210	270	480	1	
Tisdale Irrigation & Drainage Co.	7,900	2,000	9,900	16	
Tuttle, Charles W. and Noack, Sue T.	120	270	390	1	

TABLE II.6

**U.S. BUREAU OF RECLAMATION CENTRAL VALLEY PROJECT
SACRAMENTO RIVER SETTLEMENT CONTRACTORS AND CONTRACT AMOUNTS
(acre-feet)**

Contractor	Base Supply	Project Water	Total Contract Amount	Percent of Subtotal (%)	Percent of Total (%)
Wisler, John W. Jr.	8	27	35	0	
Zelmar Ranch, Inc.	112	52	164	0	
Subtotal	48,221	11,785	60,006		8
Percent of Subtotal (%)	80	20	100		
TOTAL CONTRACT AMOUNT	644,873	118,454	763,327		100
Percent of Total (%)	84	16	100		
Critical Year Reduction³	-161,218	-29,613	-190,832		
CRITICAL YEAR CONTRACT AMOUNT³	483,655	88,840	572,495		

Notes:

1. These water purveyors serve land in both Colusa and Glenn Counties. The Base Supply and Project Water amounts shown are equal to the total supply for the water purveyor, multiplied by the percentage of the water purveyor's area that is in Colusa County.
2. This water purveyor serves land in both Colusa and Yolo Counties. The Base Supply and Project Water amounts shown are equal to the total supply for the water purveyor, multiplied by the percentage of the water purveyor's area that is in Colusa County.
3. In a Critical Year, the Base Supply and Project Water could be reduced by 25%.

Source: USBR, 2007.

TABLE II.7

**U.S. BUREAU OF RECLAMATION CENTRAL VALLEY PROJECT
LONG-TERM RENEWAL CONTRACTORS AND CONTRACT AMOUNTS
(acre-feet)**

Contractor and Subcontractor	Base Allocation	Tier 1	Tier 2	Total Contract Amount	Percent of Subtotal (%)	Percent of Total (%)
County of Colusa (via Subcontractors)						
4-M Water District	4,560	570	570	5,700	29	
Colusa County Water District	4,772	597	597	5,966	30	
Cortina Water District	1,360	170	170	1,700	9	
Glenn Valley Water District	1,384	173	173	1,730	9	
Holthouse Water District	1,960	245	245	2,450	12	
La Grande Water District	1,760	220	220	2,200	11	
Myers-Marsh Mutual Water Company	204	26	26	256	1	
Subtotal (County of Colusa)	16,000	2,000	2,000	20,000		9
Colusa County Water District	49,760	6,220	6,220	62,200		28
Colusa Drain Mutual Water Company ¹	56,000	7,000	7,000	70,000		31
County of Colusa ²	32	4	4	40		0
Davis Water District	3,200	400	400	4,000		2
Stony Creek Water District	2,676	335	335	3,346		1
Westside Water District ³	52,000	6,500	6,500	65,000		29
TOTAL CONTRACT AMOUNT	179,668	22,459	22,459	224,586		100
Percent of Total (%)⁴	80	10	10	100		
Maximum Reduction⁵	-179,668	-22,459	-22,459	-224,586		
MINIMUM CONTRACT AMOUNT⁵	0	0	0	0		

Notes:

1. The language of the contract states that, "the quantity of Project Water released by the US pursuant to this Contract shall: (i) not exceed the sum of 30,000 acre-feet plus the product of 1.832 acre-feet per acre times the number of acres, in excess of 16,000, within the Contractor's Service Area ordering water from the Contractor; and (ii) be reduced by the quantity of water acquired by the Contractor pursuant to Article 12..." The amount shown reflects 30,000 ac. ft. + (1.863 x (36,406 ac. - 16,000 ac.)), or 67,384 ac. ft., as a minimum.
2. Providing Project Water to the Town of Stonyford from the Black Butte Project.
3. Contract was previously under a partial assignment with the County of Colusa Contract, with a 40,000 ac. ft. allocation.
4. Base Allocation is less than 80% of project allocation. Tier 1 greater than 80% but less than 90% of total project allocation. Tier 2 is greater than 90% of the total project allocation.
5. In a water shortage year, the water supply available from the Project will be allocated among the contractors. There is no minimum allocation, thus it is conceivable that no water would be supplied under extremely dry conditions.

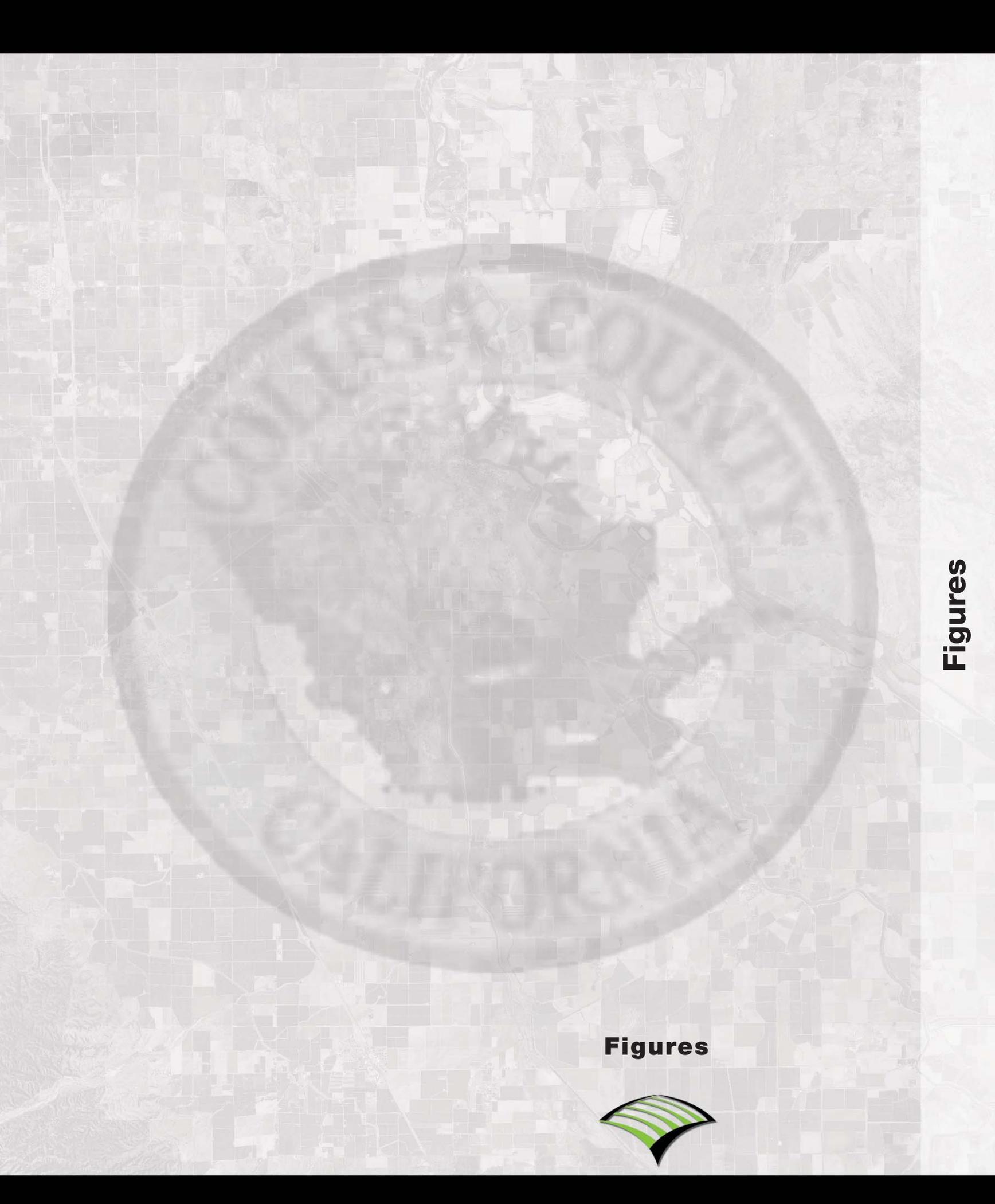
Source: USBR, 2007a.

TABLE IV.1

COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN (GMP)

PRELIMINARY IMPLEMENTATION SCHEDULE

Activity	Description	Timing
1. Obtain Funding to Implement GMP	Sustainable funding as indicated in the GMP to support staff and technical/legal assistance is critical to the success of this effort. It is imperative that the Board of Supervisors develop a strategy to fund the base program.	Funding and availability of staff to support the GMP is essential to initiate implementation of the GMP.
2. Revise Groundwater Ordinance	The County's Groundwater Ordinance needs to be revised to be consistent with and to facilitate implementation of the GMP.	Efforts to revise the Ordinance should be initiated upon adoption of the GMP. This should be accomplished by April 2009.
3. Execute MOU's with Water Purveyors	GCID, RD 108, and the City of Colusa have expressed interest in participating with the County in implementing the GMP. MOUs need to be executed with the three parties and the participation of others should be solicited. The MOU's developed for the respective parties can be used as a template for other purveyors.	The MOU's should be executed by June 2009.
4. Reaffirm Groundwater Commission Members	The demands of the Commission members will be increasing during this "start-up" period for implementing the GMP and revising the Ordinance. Accordingly, the willingness of the existing members to participate should be reaffirmed given the increased time commitments.	This reaffirmation on the part of Commission members should be done before the end of 2008.
5. Establish Technical Support Team	Staffing by the County and participation by DWR is critical to the success of the program. The job description for prospective staff needs to be developed from information in the GMP and the position filled. The extent of DWR's participation on the TST should be resolved with DWR also.	County staff assignments and the working relationship with DWR should be established by the end of March 2009.
6. Establish Water Users Group	The Water Users Group is an important component of the water management process. Participation from organized entities that have executed MOU's with the County should be included.	The Water Users Group should be established by June 2009.
7. Formalize Groundwater Monitoring Program	Once established, the TST should obtain baseline water quality samples for the wells suggested in the GMP for use in the initial groundwater monitoring program. The TST should also formalize the monitoring program in collaboration with DWR, the USGS, and water purveyors with the goal of having the database being as comprehensive as possible. The protocols for obtaining data from local agencies to populate the DWR and BMOIC databases on a regular basis should be established.	The initial monitoring program should be developed for implementation in advance of the BMO assessment report in the Fall 2009.
8. Improve Monitoring Network	Improvements to the monitoring network should be an ongoing objective. As more knowledge of the basin is acquired, efforts should be made to enhance the network with a goal of installing strategically-located "nesting" monitoring wells.	This is an ongoing activity, but should be given attention as part of the BMO assessment in the Fall 2009.
9. Formalize Public Outreach Program	A formal outreach program should be viewed as an annual presentation of the BMO-related water facts, as well as some information on regional and statewide issues affecting the County.	The public outreach should be conducted following receipt and evaluation of spring groundwater data or as appropriate to address emerging issues in a timely manner.
10. Conduct Groundwater Commission Meetings	The Groundwater Commission will be actively involved in reviewing and acting on material being developed to implement the GMP.	The Groundwater Commission will likely need to meet quarterly for the initial two years and then possibly two times each year, or as frequently as necessary to remain informed of current conditions or to address particular issues that may arise.
11. Prepare BMO Assessment Report	A formalized effort to address the BMOs is a critical aspect of the GMP and will need to be prepared and reported on annually. This would include an evaluation of groundwater levels in the BMO wells and the County generally, water quality, and status reports on DWR's Sacramento Valley GPS Height Modernization Project.	The BMO report should be reported to the Groundwater Commission mid-year.
12. Participate in Four-County MOU and Multi-Party Water Resources MOU	The activities of the respective MOU groups are tending to increase and participation by the County is important. It is important that staff report the results of these meetings to the Groundwater Commission.	Participate as scheduled.
13. Seek Funding for Special Studies	The TST must remain informed of opportunities for funding technical studies. These may be County-only efforts or joint efforts with participating water purveyors.	Monitor opportunities on an ongoing basis.
14. Update Groundwater Management Plan	The primary elements of the groundwater management plan may warrant modification or refinement as the implementing parties address data evaluation and various processes.	A deliberate assessment of the program should be performed after three years. This includes a review of the BMOs, the outreach program, water transfers processes, etc.

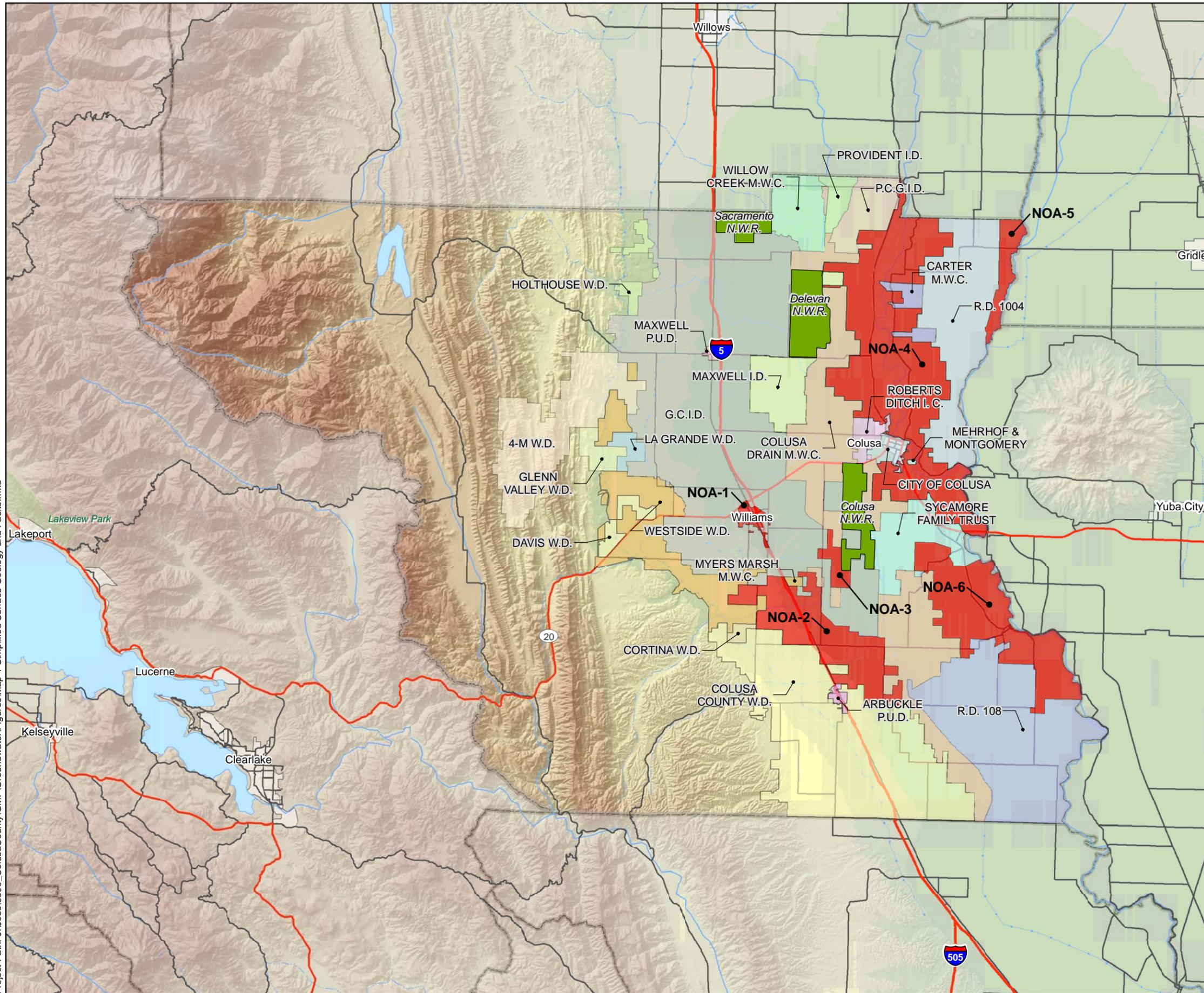


Figures

Figures



Project Path: J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Map 1 Simplified Surface Geology and Faults.mxd



LEGEND

- Wildlife Refuges
- Non-Organized Areas

SOURCES: USBR, USGS

0 5 10 Miles



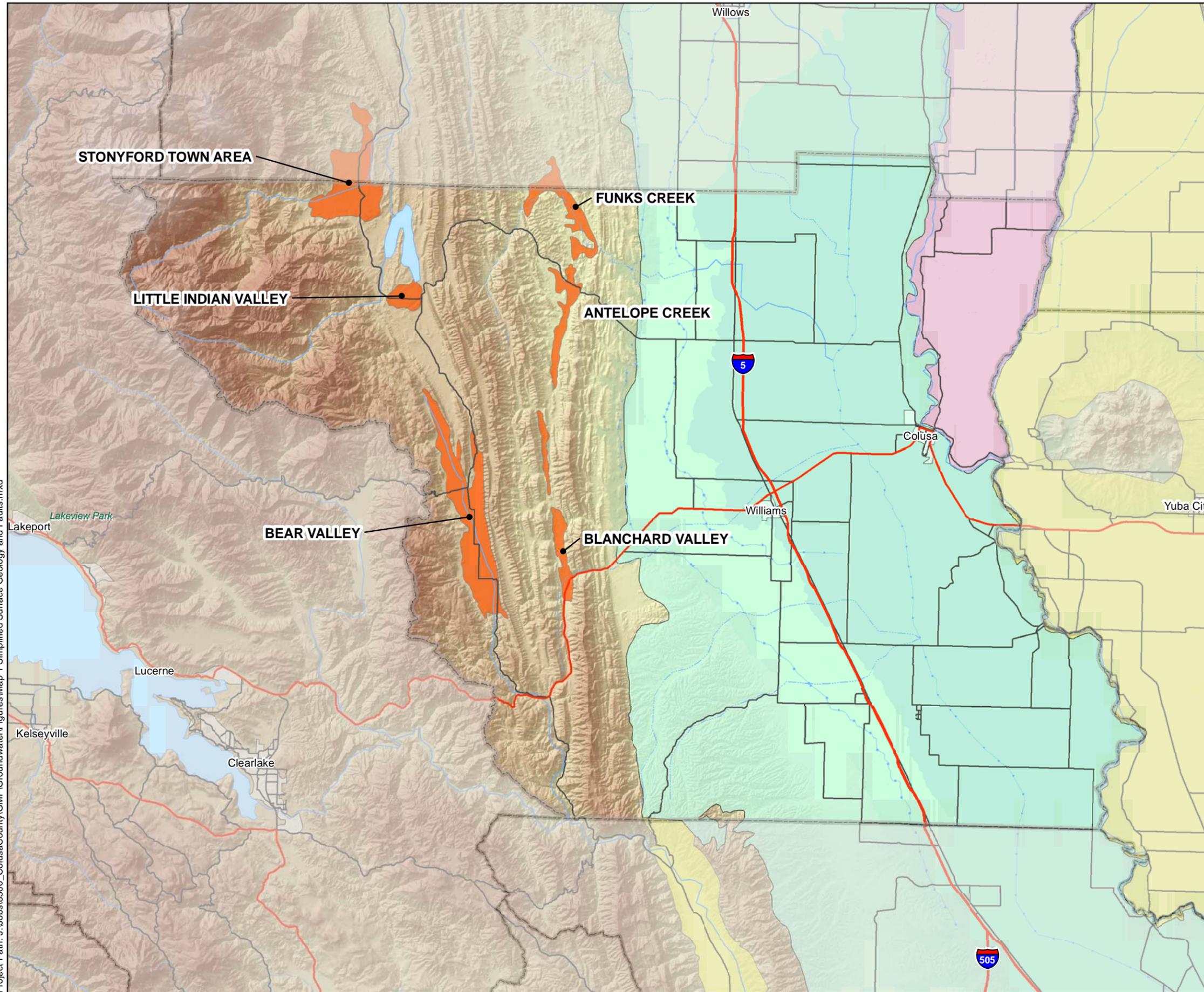
**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

WATER MANAGEMENT ENTITIES/AREAS



FIGURE I.1

Project Path: J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Map 1 Simplified Surface Geology and Faults.mxd



Legend

Groundwater Basin/Subbasin

- Sacramento Valley/Colusa
- Sacramento Valley/West Butte
- Sacramento Valley/Other
- Other Groundwater Basin

SOURCES: DWR

0 5 10 Miles



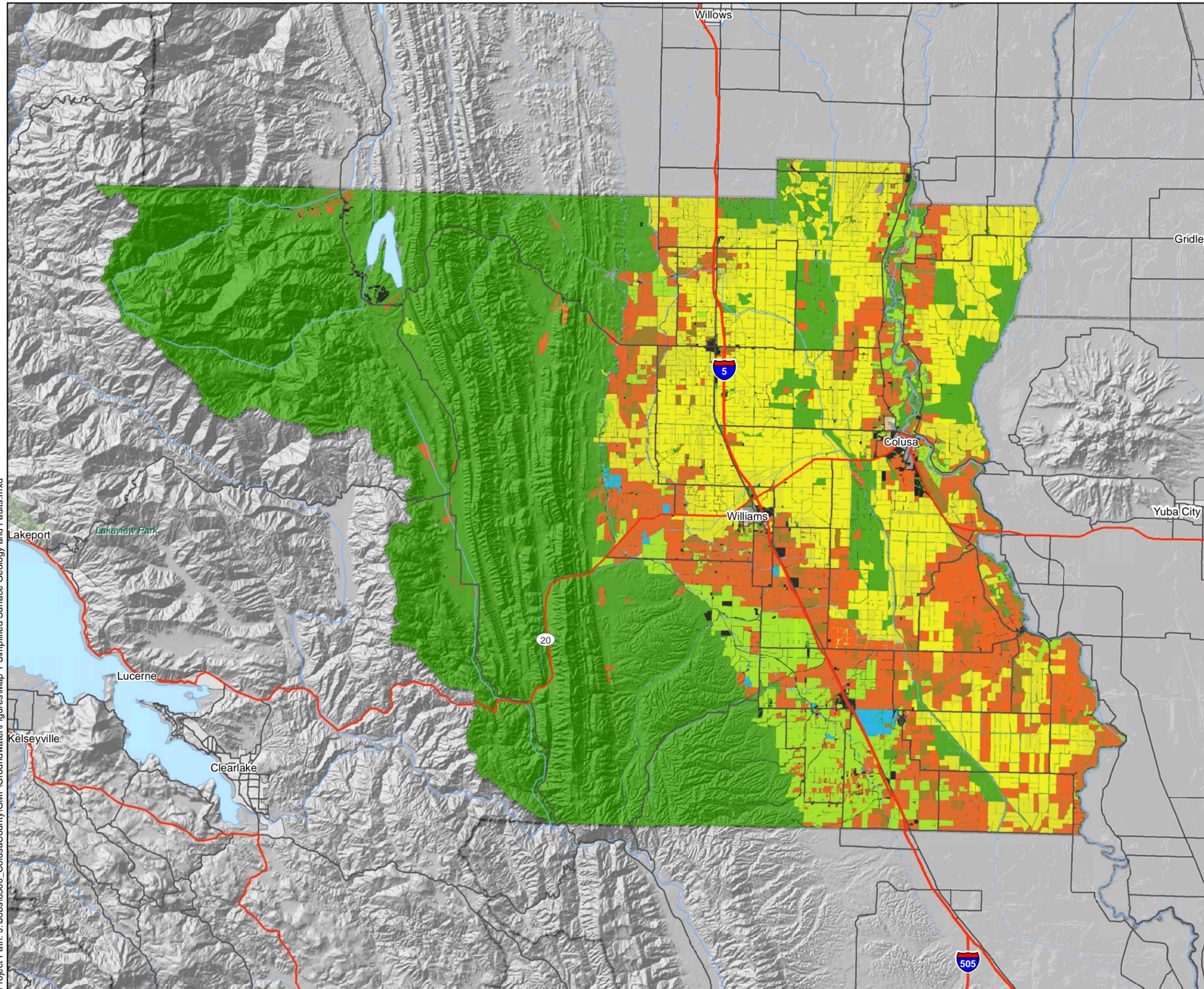
**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

GROUNDWATER BASINS
IN COLUSA COUNTY



FIGURE I.2

Project Path: J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Map 1 Simplified Surface Geology and Faults.mxd



Legend

- Vineyard
- Native and Riparian Vegetation
- Urban
- Rice
- Pasture, Farmsteads, Dairies, and Livestock
- Orchard
- Field and Truck Crops
- Barren and Wasteland

SOURCES: DWR, USGS

0 5 10 Miles



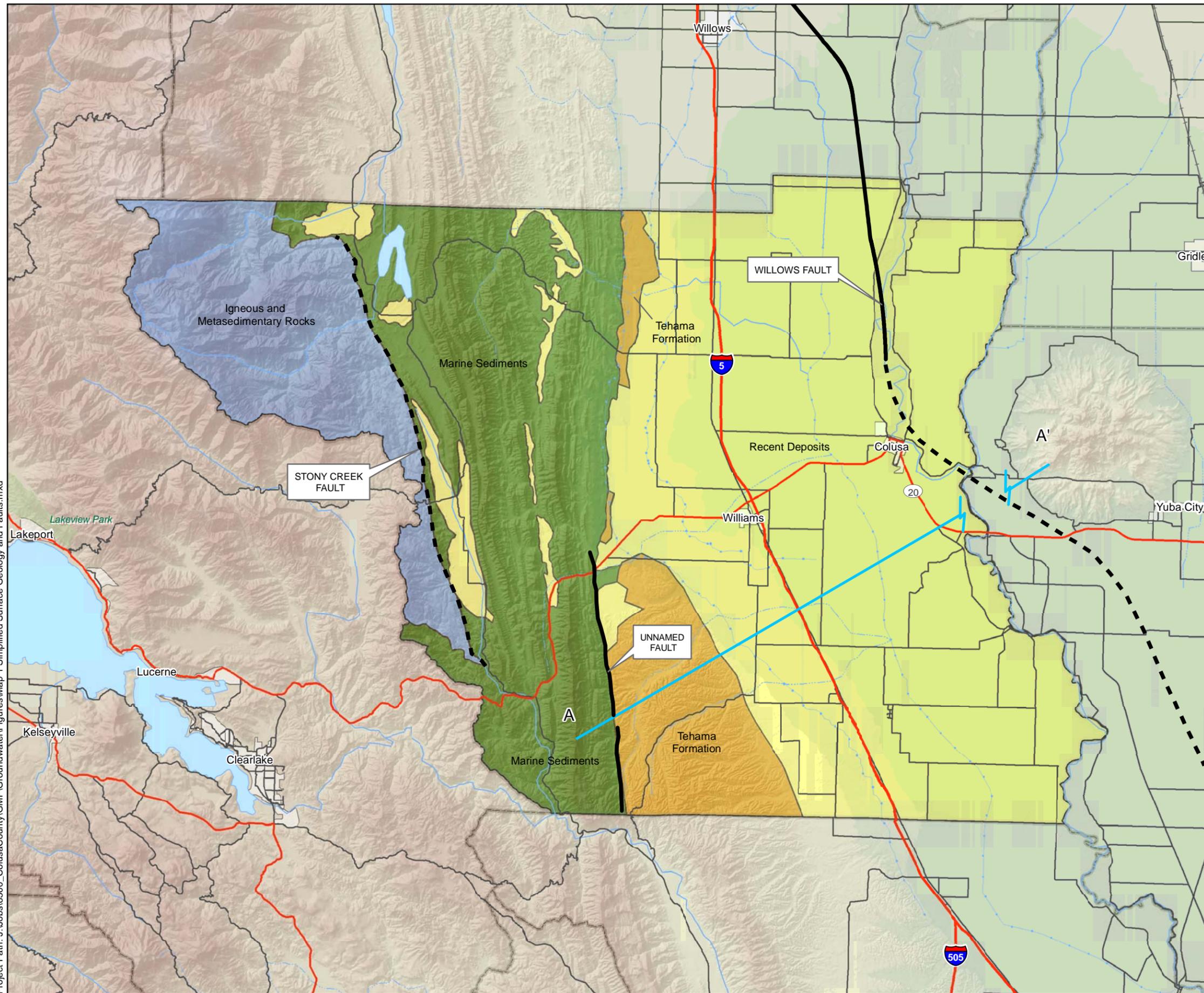
**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

COLUSA COUNTY LAND USE (2003)



FIGURE II.1

Project Path: J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Map 1 Simplified Surface Geology and Faults.mxd



LEGEND

Geologic Structure

- Fault
- Fault - Dashed Where Inferred
- Conceptual Cross Section Line

Geologic Formations

- Recent Deposits
- Tehama Formation
- Marine Sediments
- Igneous and Metasedimentary Rocks

SOURCES: GEOLOGIC MAP OF CALIFORNIA, UKIAH SHEET,
REGIONAL GEOLOGIC MAP OF THE
SANTA ROSA QUADRANGLE

0 5 10 Miles



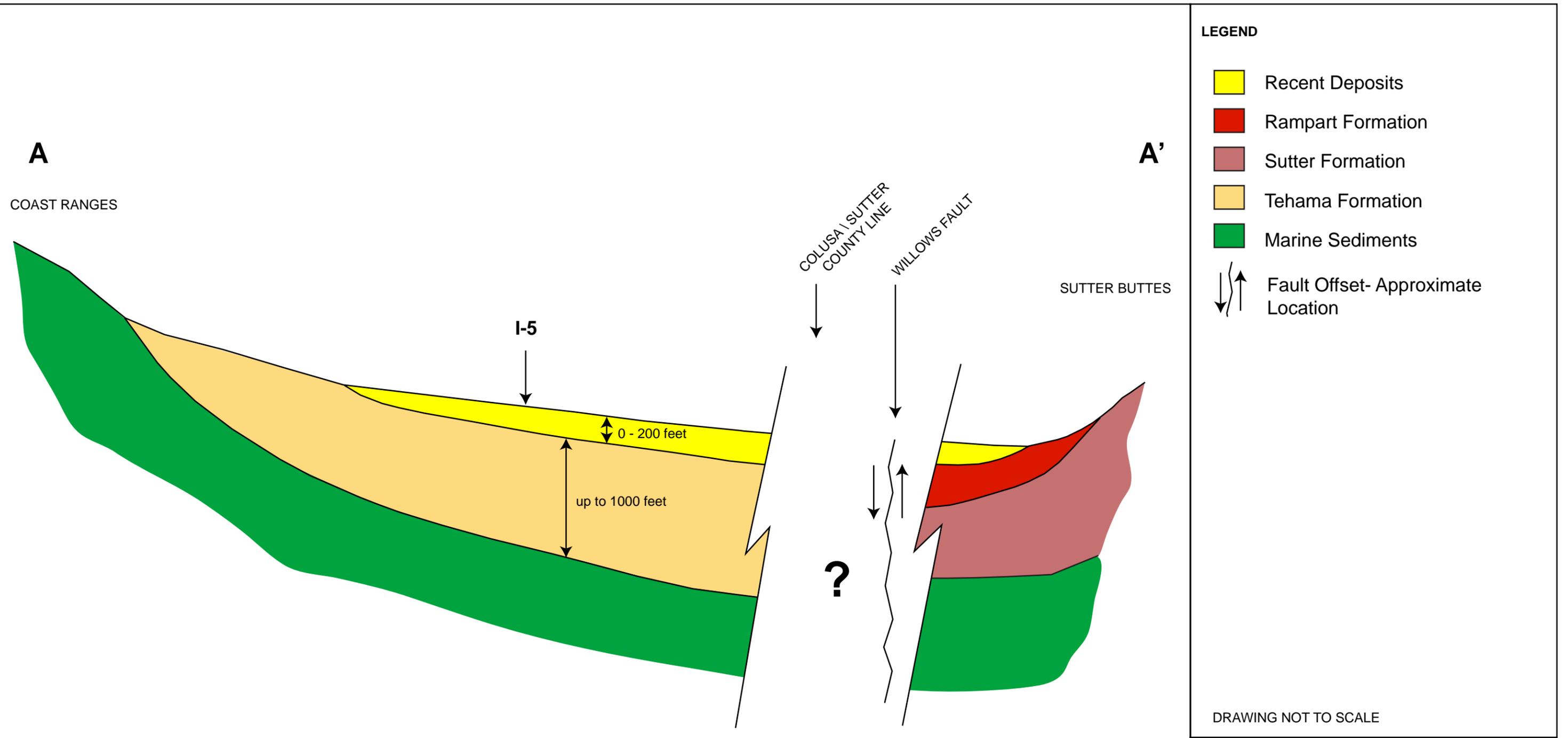
COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN

SIMPLIFIED SURFACE GEOLOGY AND FAULTS



FIGURE II.2

Project Path: J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Figure 1 Simplified Geologic Cross Section.ai

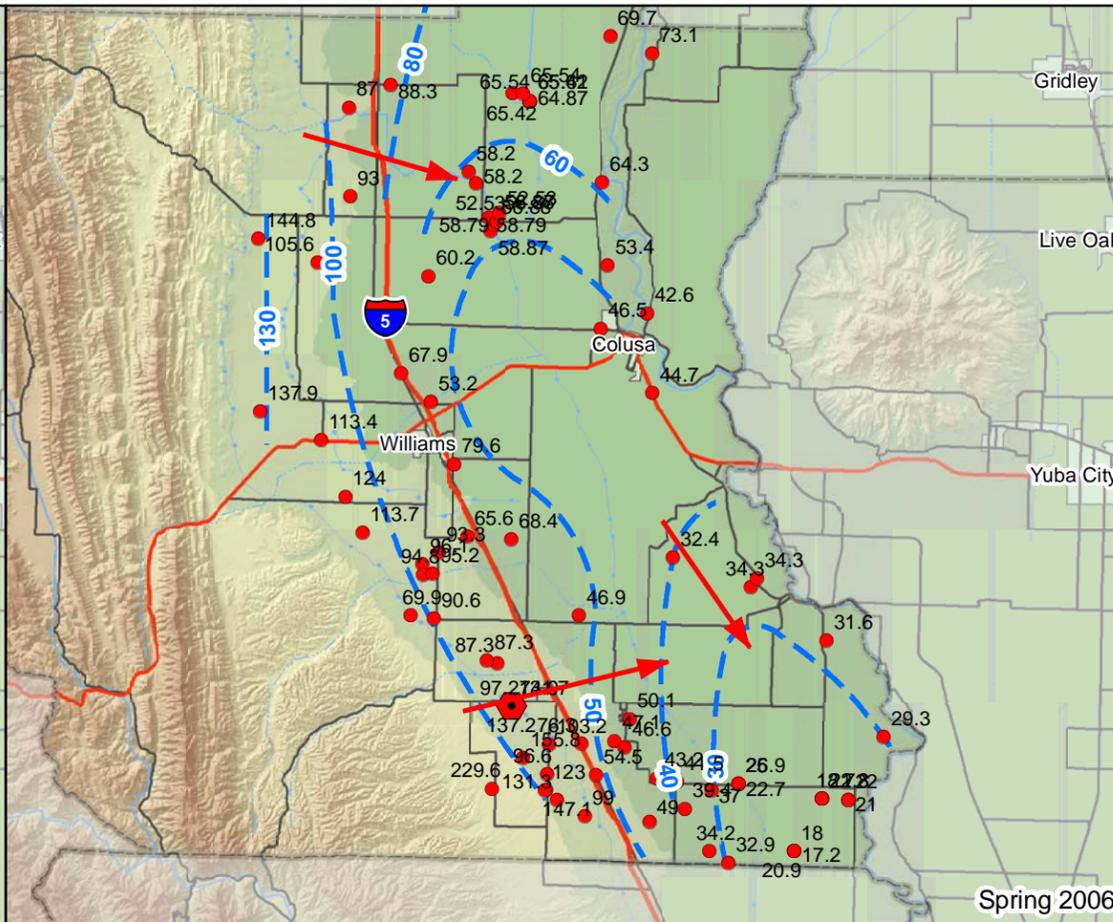
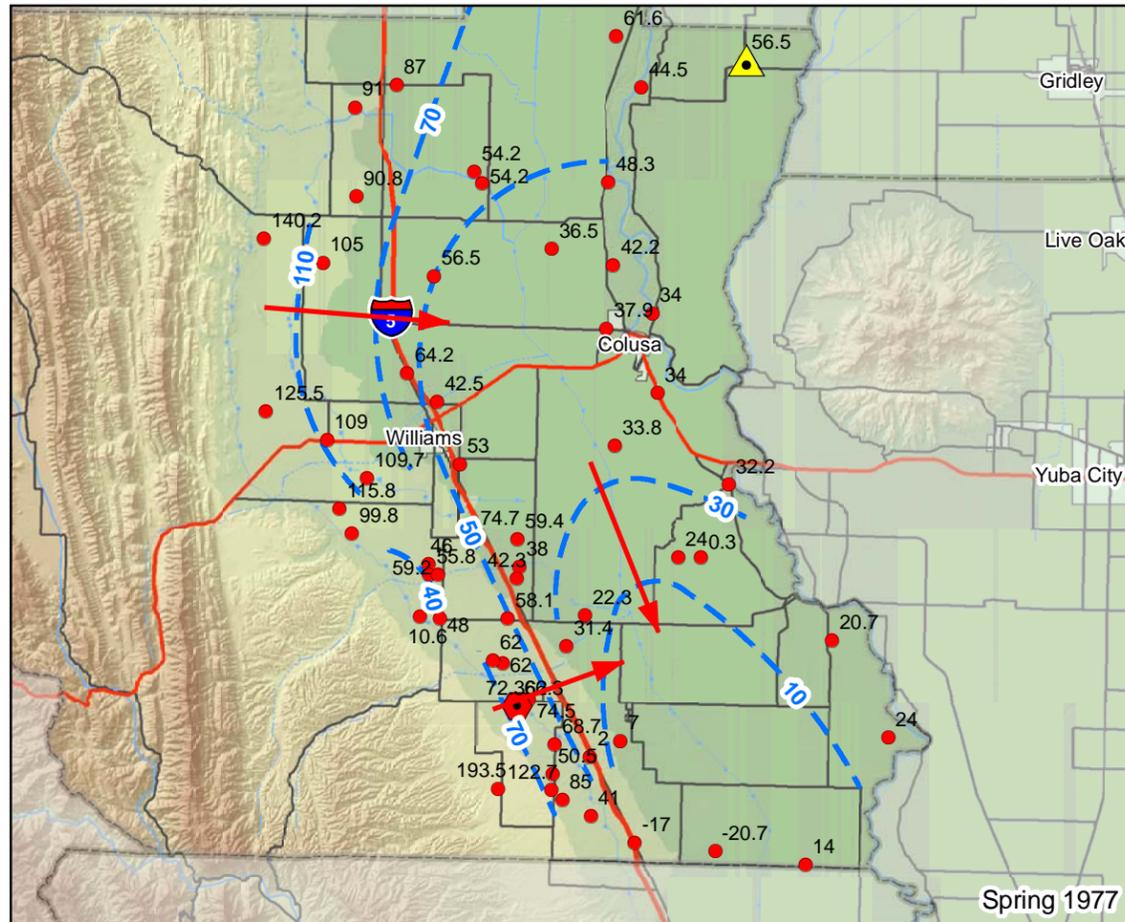


**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

SIMPLIFIED GEOLOGIC CROSS SECTION



FIGURE II.3

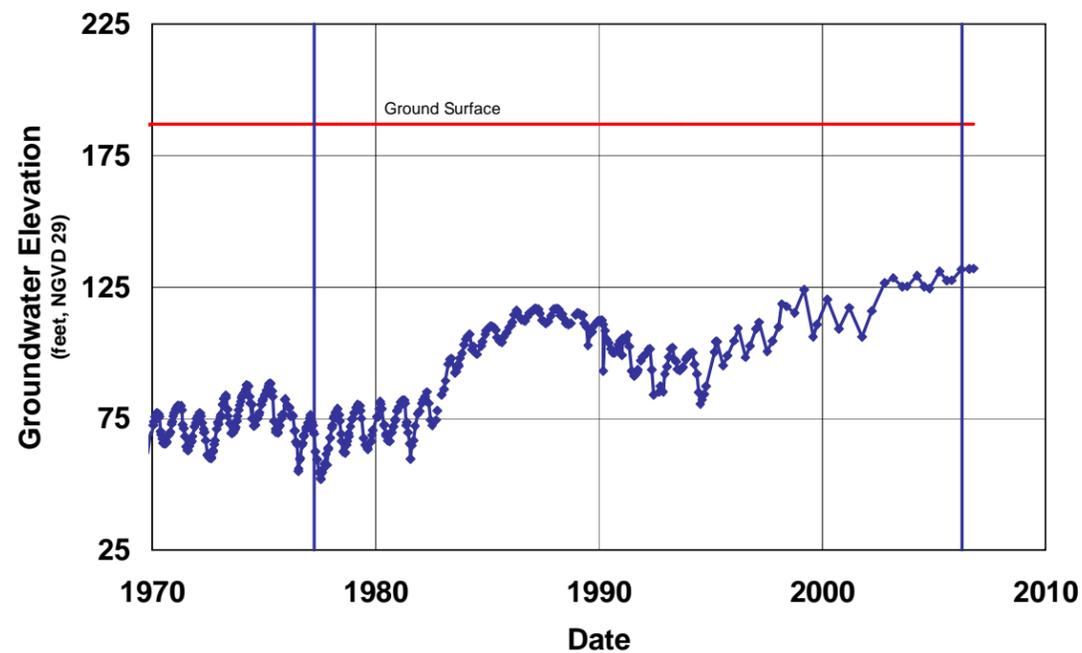


LEGEND

- Well with Water Level Measurement
- Well with Hydrograph Shown
 - ◆ 13N/2W-4G3
 - ▲ 18N/1W-35K1
- Groundwater Elevation
 - Contour of Equal Groundwater Elevation (feet above mean sea level)
 - Direction of Groundwater Flow

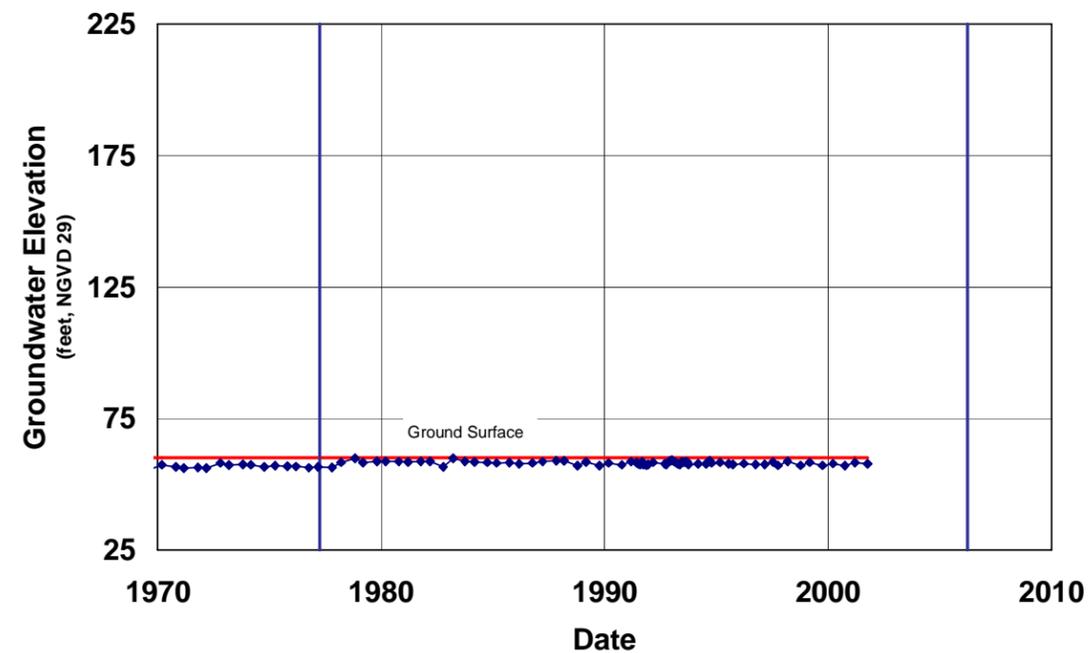
Note: Number shown to next to well location indicates groundwater elevation in feet above mean sea level.

Groundwater Elevation in 13N/2W-4G3 ◆



Well 13N/2W-4G3 is 252 feet deep.

Groundwater Elevation in 18N/1W-35K1 ▲



Well 18N/1W-35K1 is 99 feet deep.

SOURCES: DWR, USGS
0 7 Miles

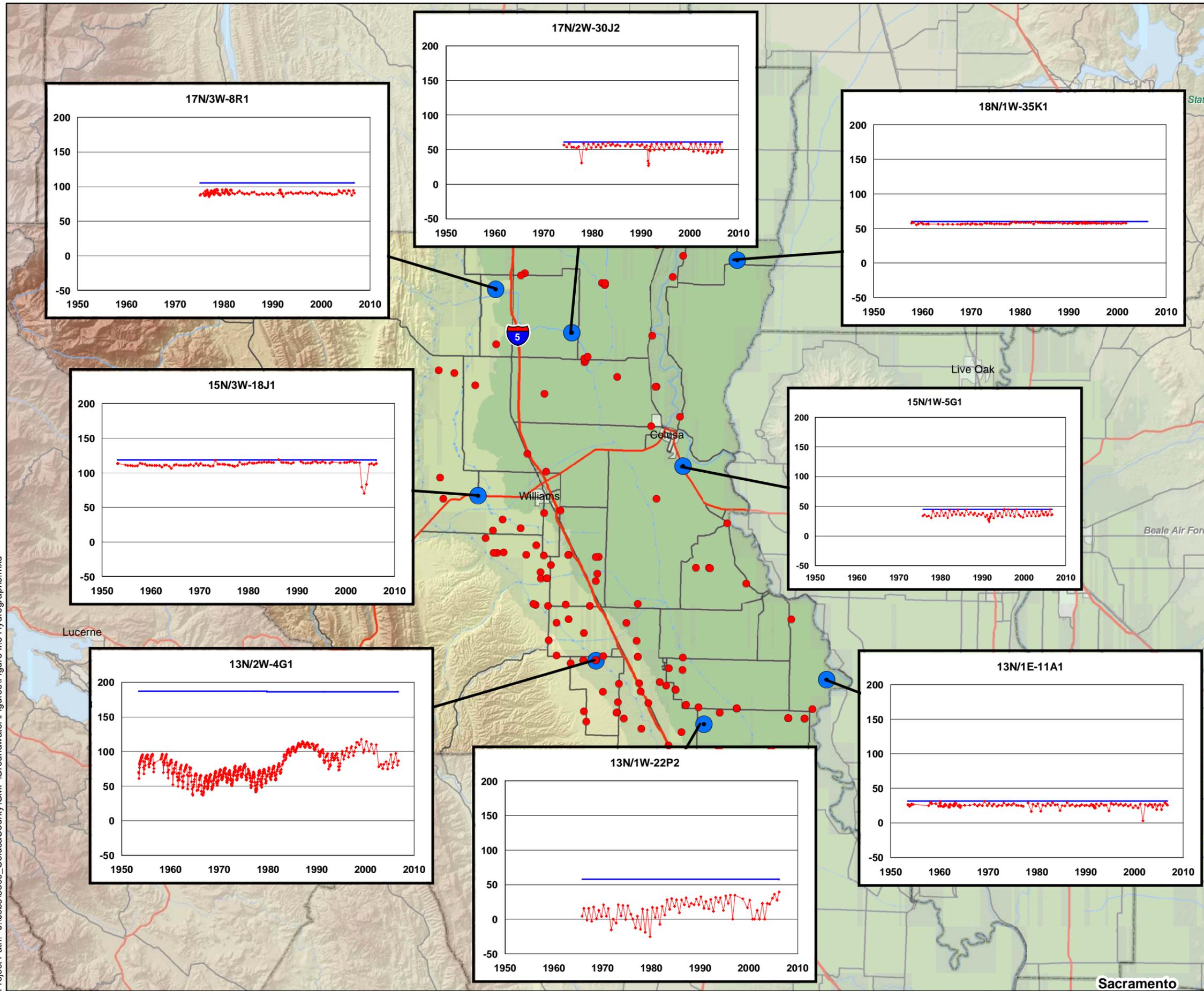


**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

GROUNDWATER ELEVATION
HYDROGRAPHS AND CONTOURS



FIGURE II.4



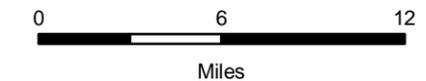
LEGEND

Monitoring Wells

- Well with Hydrograph Shown
- Other Monitoring Well
- Groundwater Elevation (feet, NGVD 29)
- Ground Surface Elevation (feet, NGVD 29)

Note: Figures show groundwater elevation and ground surface elevation in feet, NGVD 29.

SOURCES: DWR



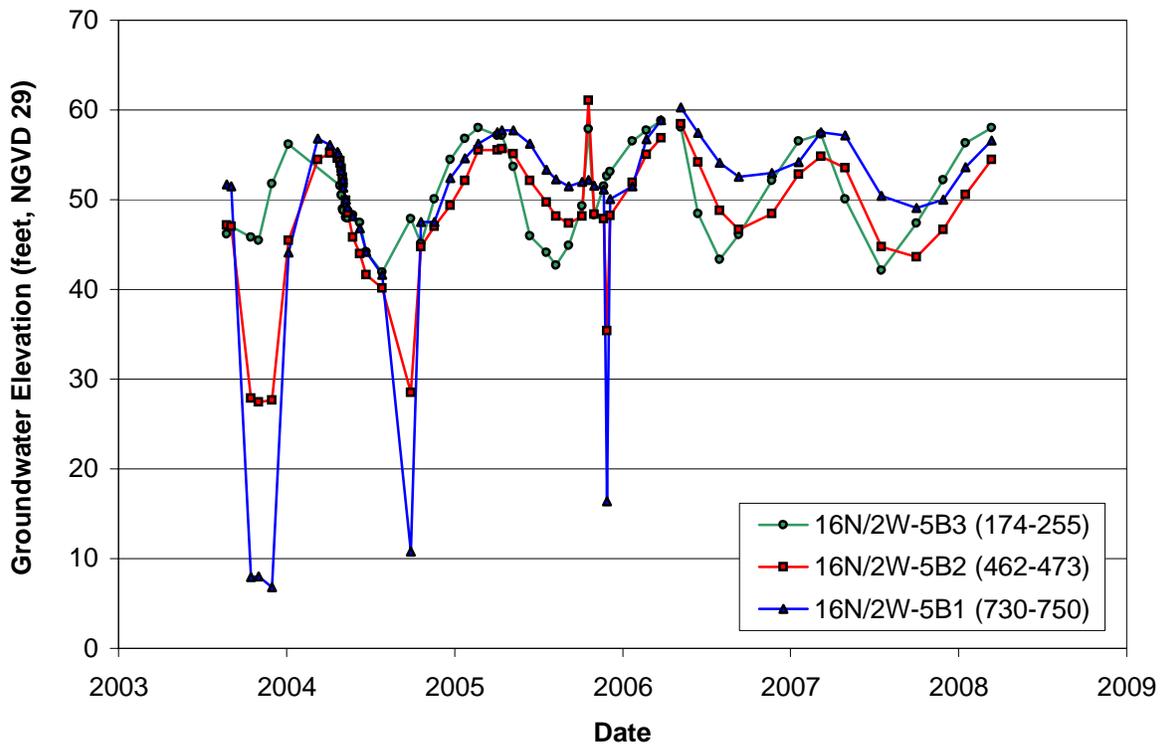
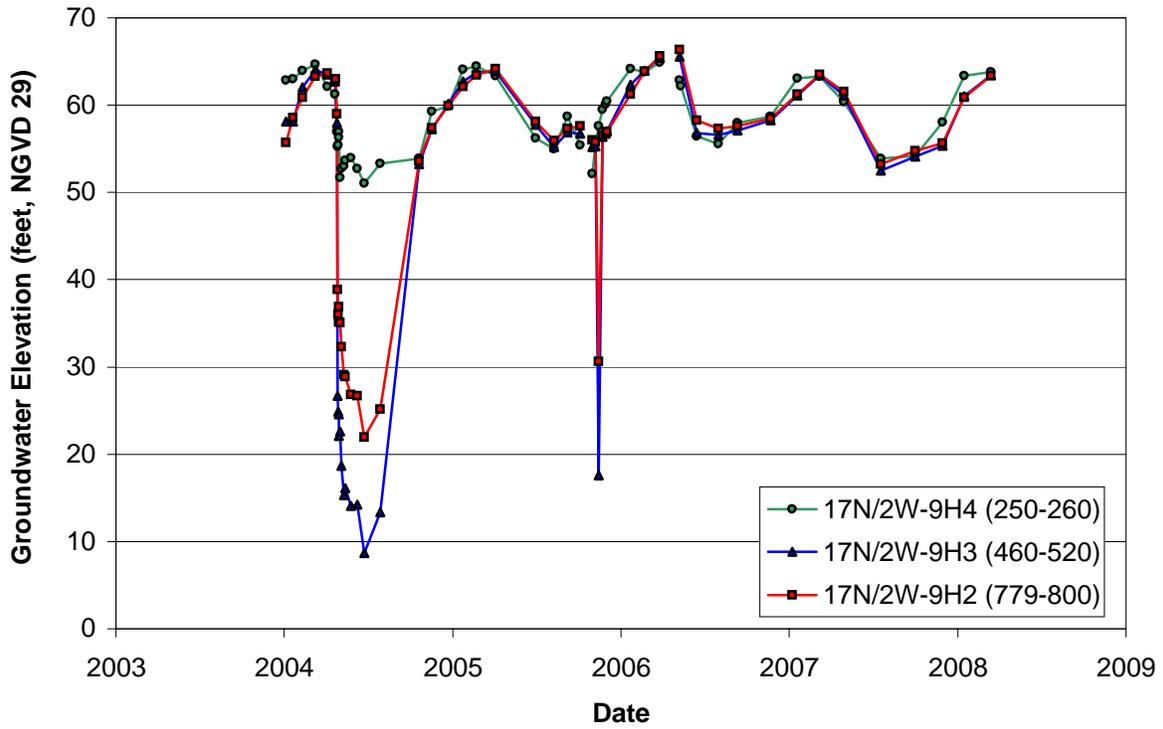
COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN
 GROUNDWATER ELEVATION BY AREA



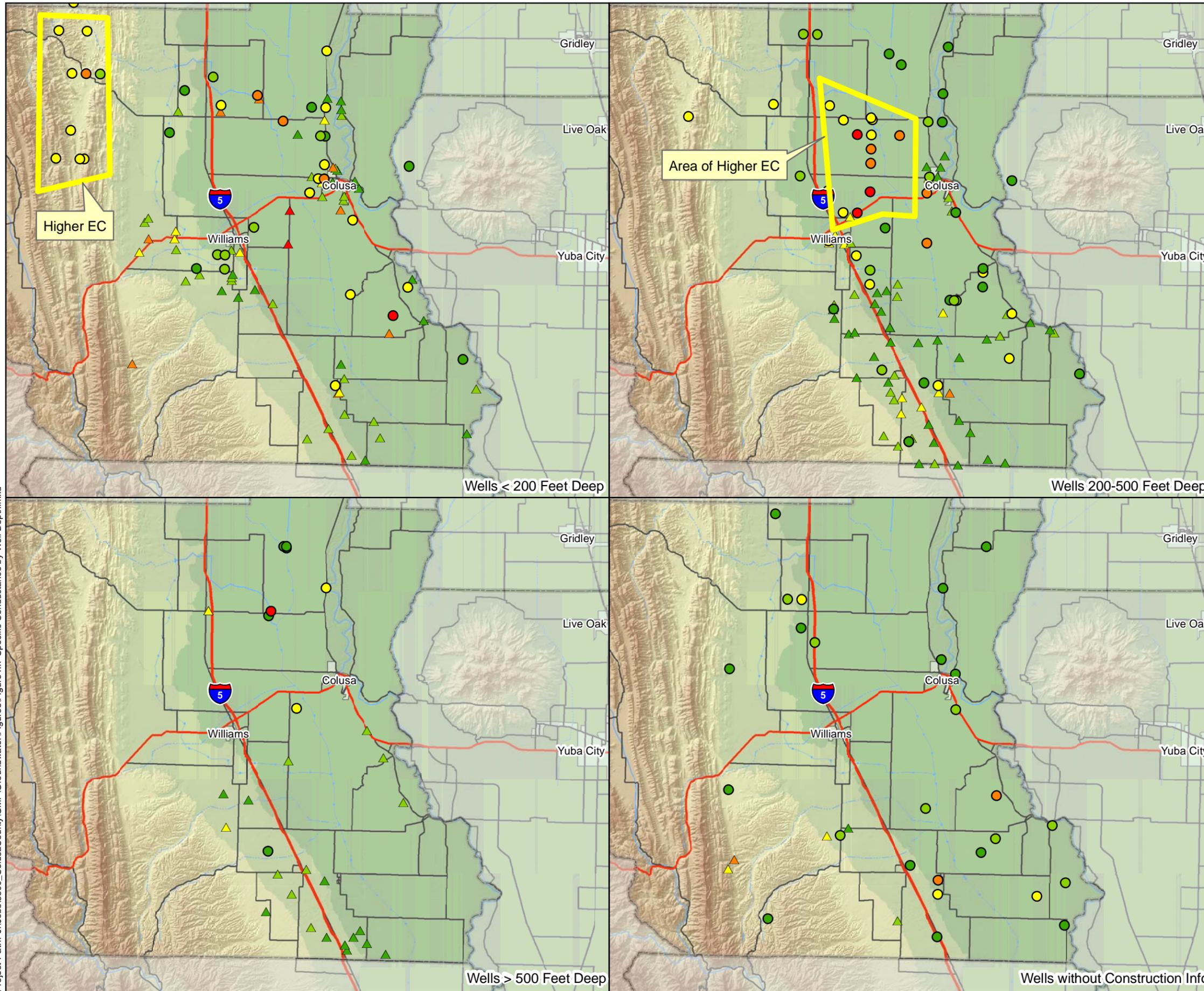
Sacramento

FIGURE II.5

Figure II.6
Groundwater Elevation in Nested Monitoring Wells
Colusa County



Project Path: J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\II.7 Specific Conductance by Well Depth.mxd



LEGEND

EC in USGS Wells (µmhos/cm)

- ▲ < 600
- ▲ 600 - 900
- ▲ 900 - 1600
- ▲ 1600 - 2650
- ▲ > 2650

EC in DWR Wells (µmhos/cm)

- < 600
- 600 - 900
- 900 - 1600
- 1600 - 2650
- > 2650

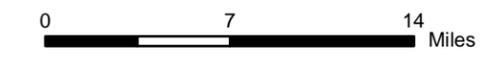
Note:
"EC" is an abbreviation for specific conductance, which is related to the salt content of a water sample.

For public drinking water systems, the secondary (aesthetic) maximum contaminant levels for EC are 900 umhos/cm (recommended), 1600 umhos/cm (upper), and 2200 umhos/cm (short-term).

For irrigation, crop yields decrease above a threshold EC value, which is crop-dependent. Crop yield potential decreases above these threshold levels:

- Almonds - 1000 umhos/cm
- Beans - 700 umhos/cm
- Rice - 2000 umhos/cm
- Squash - 2100-3100 umhos/cm
- Tomatoes - 1700 umhos/cm
- Wheat - 4000 umhos/cm

SOURCES: DWR, USGS, DHS, FAO



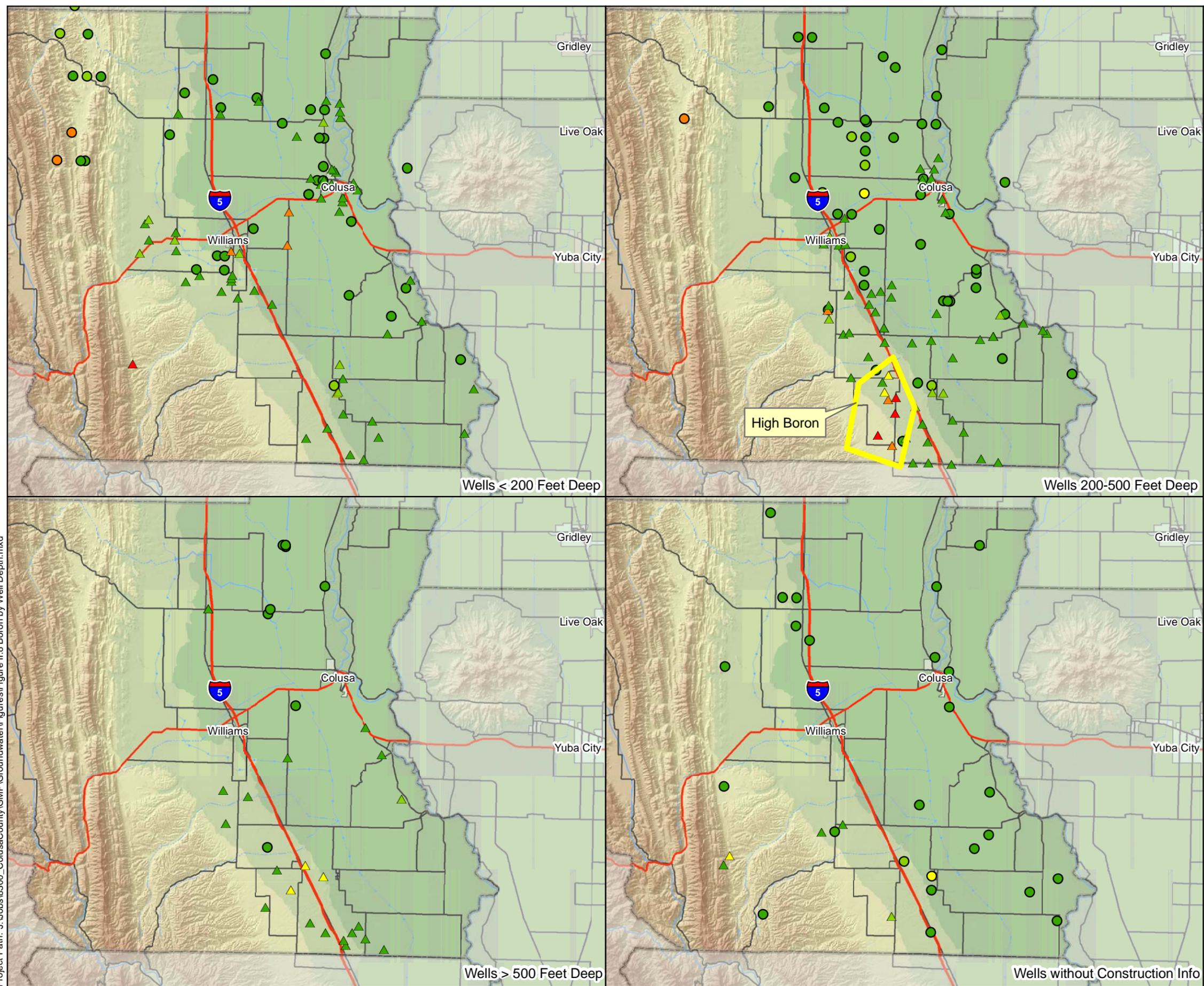
**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

SPECIFIC CONDUCTANCE BY WELL DEPTH



FIGURE II.7

Project Path: J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Figure II.8 Boron by Well Depth.mxd



LEGEND

Boron in USGS Wells (µg/l)

- ▲ < 500
- ▲ 500 - 750
- ▲ 750 - 1000
- ▲ 1000 - 2000
- ▲ > 2000

Boron in DWR Wells (µg/l)

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Note:
Boron is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, there is a notification level for boron of 1000 µg/L.

For irrigation, boron is necessary for crop growth but becomes toxic to the point that yields may decrease above these threshold levels:

- Beans - 750 - 1000 µg/L
- Grapes - 500 - 750 µg/L
- Squash - 2000 - 4000 µg/L
- Tomatoes - 4000 - 6000 µg/L
- Walnuts - 500 - 750 µg/L
- Wheat - 750 - 1000 µg/L

Many other trees are vulnerable to boron toxicity above 500 - 750 µg/L.

SOURCES: DWR, USGS, DHS, FAO

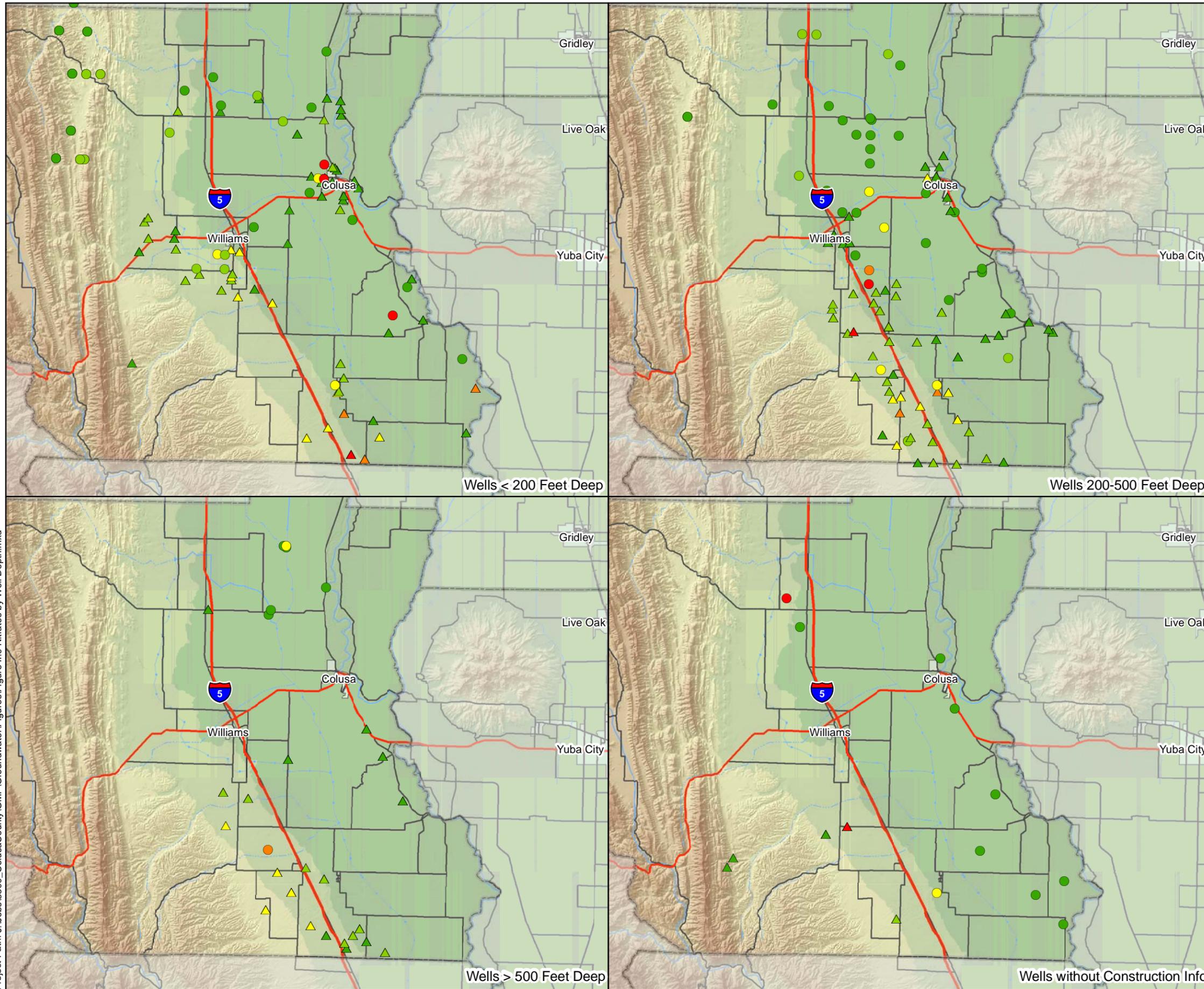


**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

BORON BY WELL DEPTH



FIGURE II.8



LEGEND

Nitrate in USGS Wells (mg/L, as NO3)

- ▲ < 5
- ▲ 5 - 15
- ▲ 15 - 30
- ▲ 30 - 45
- ▲ > 45

Nitrate in DWR Wells (mg/L, as NO3)

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Note:
Nitrate is generally introduced into groundwater by septic systems, fertilizers, or confined animal operations.

For public drinking water systems, the primary (health-based) maximum contaminant level for nitrate as NO3 is 45 mg/L.

At concentrations exceeding the maximum contaminant level, nitrate can interfere with the blood's ability to carry oxygen. This effect can be especially pronounced in infants, where it is known as "blue baby syndrome".

SOURCES: DWR, USGS, DHS, FAO

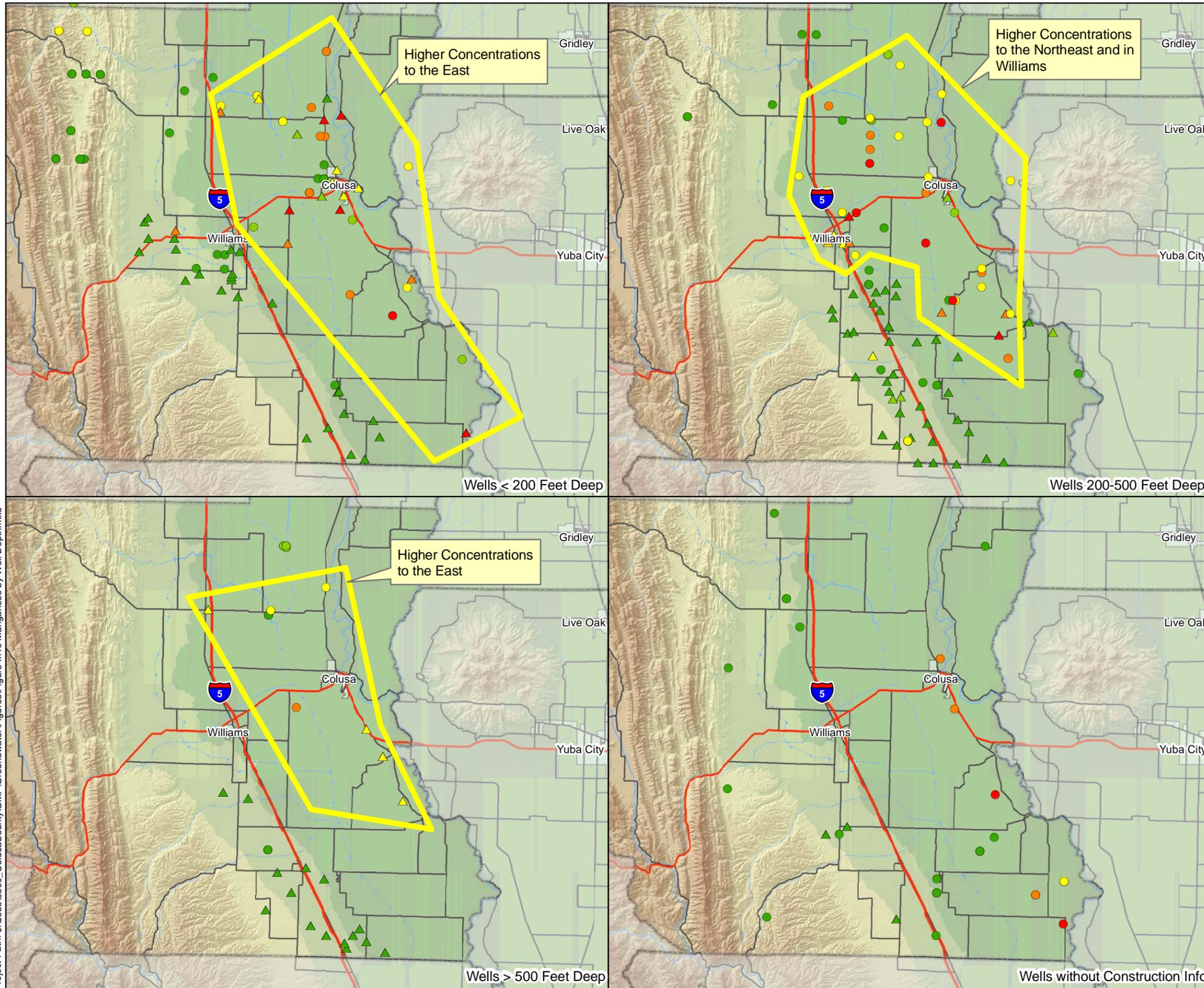


**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

NITRATE BY WELL DEPTH



FIGURE II.9



LEGEND

Manganese in USGS Wells (µg/l)

- ▲ < 25
- ▲ 25 - 50
- ▲ 50 - 150
- ▲ 150 - 500
- ▲ > 500

Manganese in DWR Wells (µg/l)

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Note:
Manganese is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the secondary (aesthetic) maximum contaminant level for manganese is 50 ug/L. There is also a notification level for manganese of 500 ug/L. Notification levels are health-based advisory levels for chemicals that do not have primary maximum contaminant levels.

Manganese can cause staining of plumbing and fixtures, and can contribute a metallic odor to water. At very high concentrations (above the notification level) manganese may cause neurologic problems.

Analysis for manganese is very sensitive to turbidity of samples - turbid samples will often have artificially high results for manganese.

SOURCES: DWR, USGS, DHS, FAO



**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

MANGANESE BY WELL DEPTH



FIGURE II.10

Figure II.11
Number of DWR Well Completion Reports Filed Annually
Colusa County

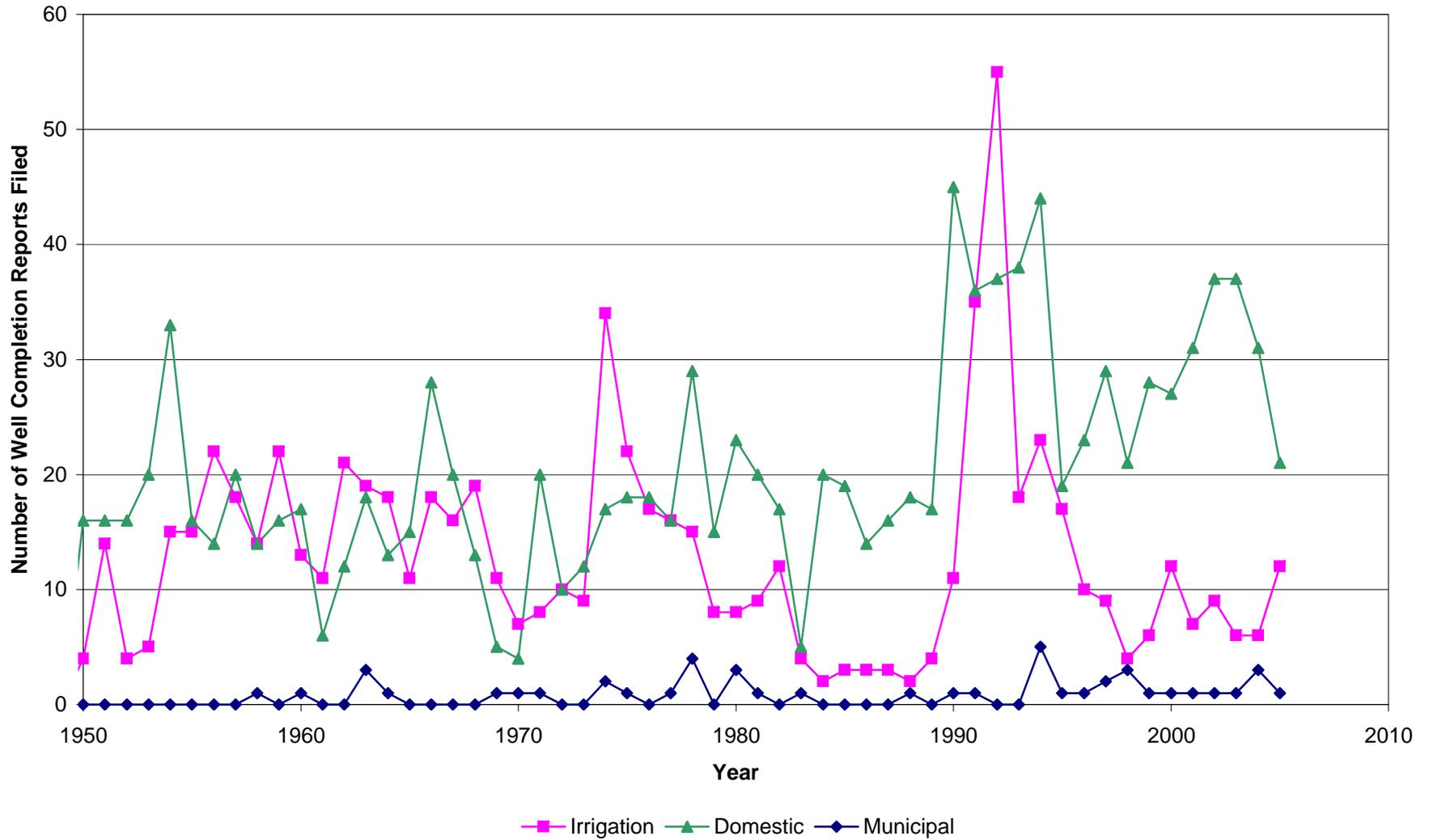
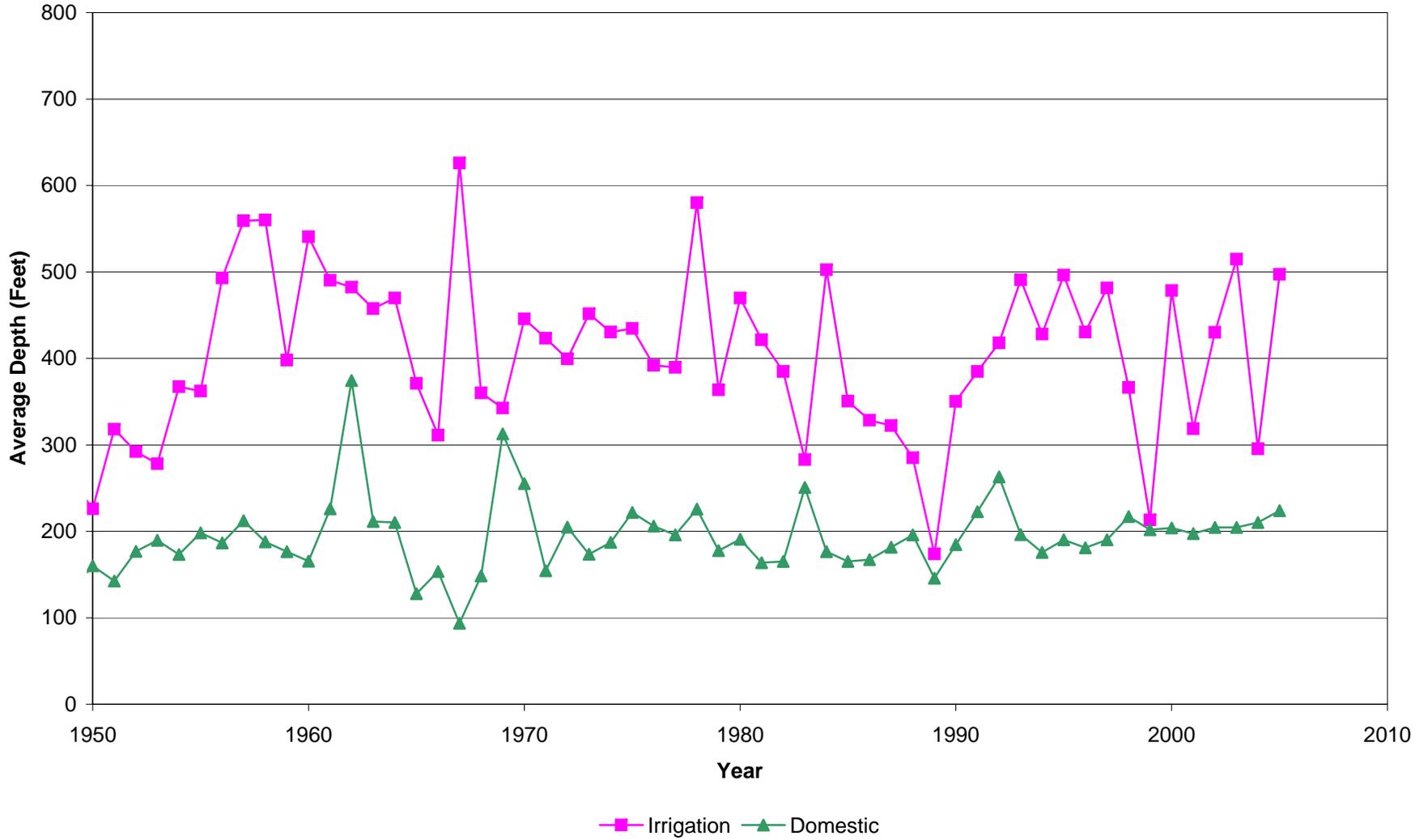
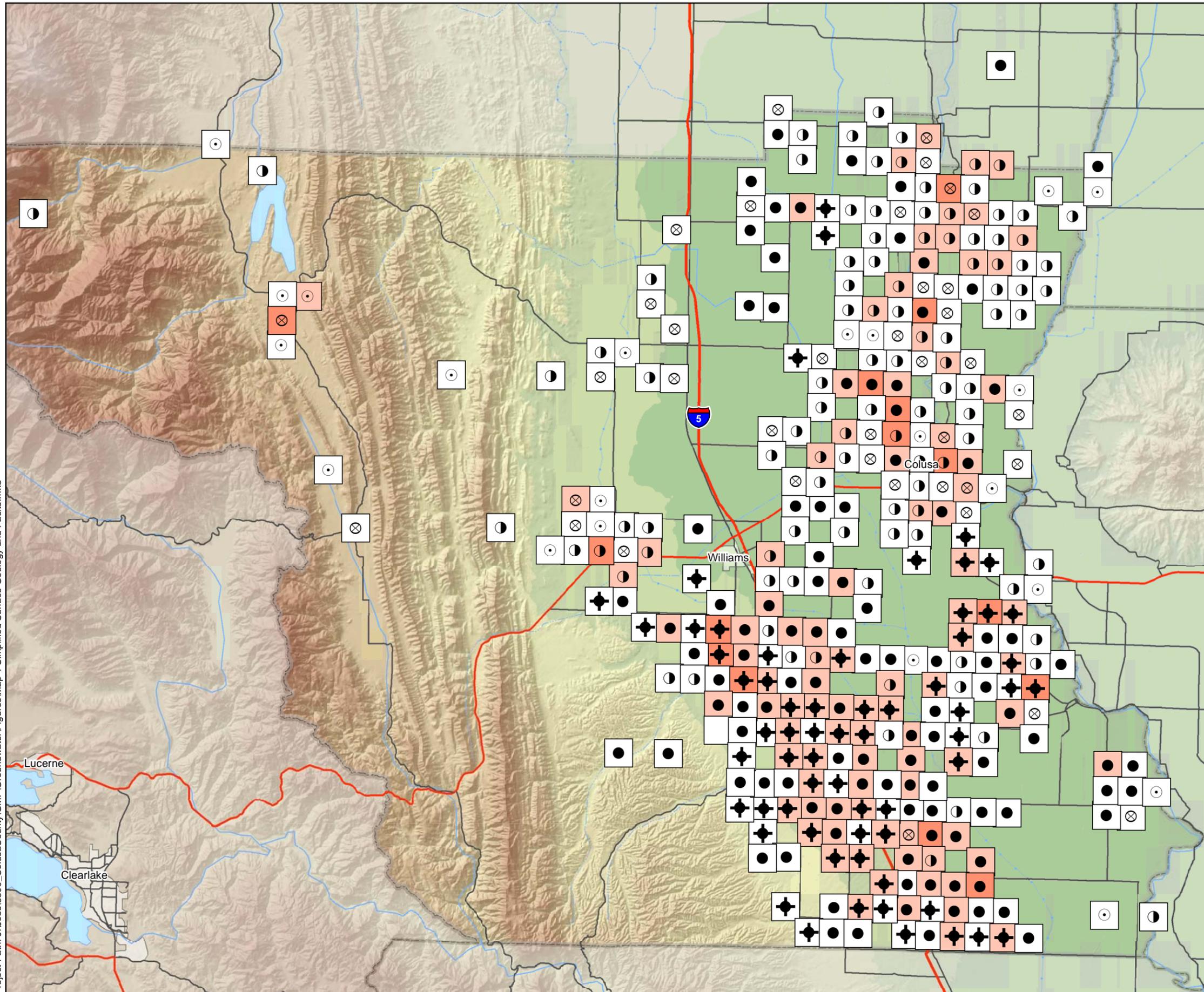


Figure II.12
Average Depth of New Wells
Colusa County





Legend

Maximum Well Depth (Feet)

- < 150
- ⊗ 151 - 250
- ◐ 251 - 450
- 451 - 750
- ⊕ > 750

Number of Wells per Section

- 1 - 2
- 3 - 5
- 6 - 10
- 11 - 20
- > 20

SOURCES: USGS, DWR, STREETMAP USA

0 4 8 Miles

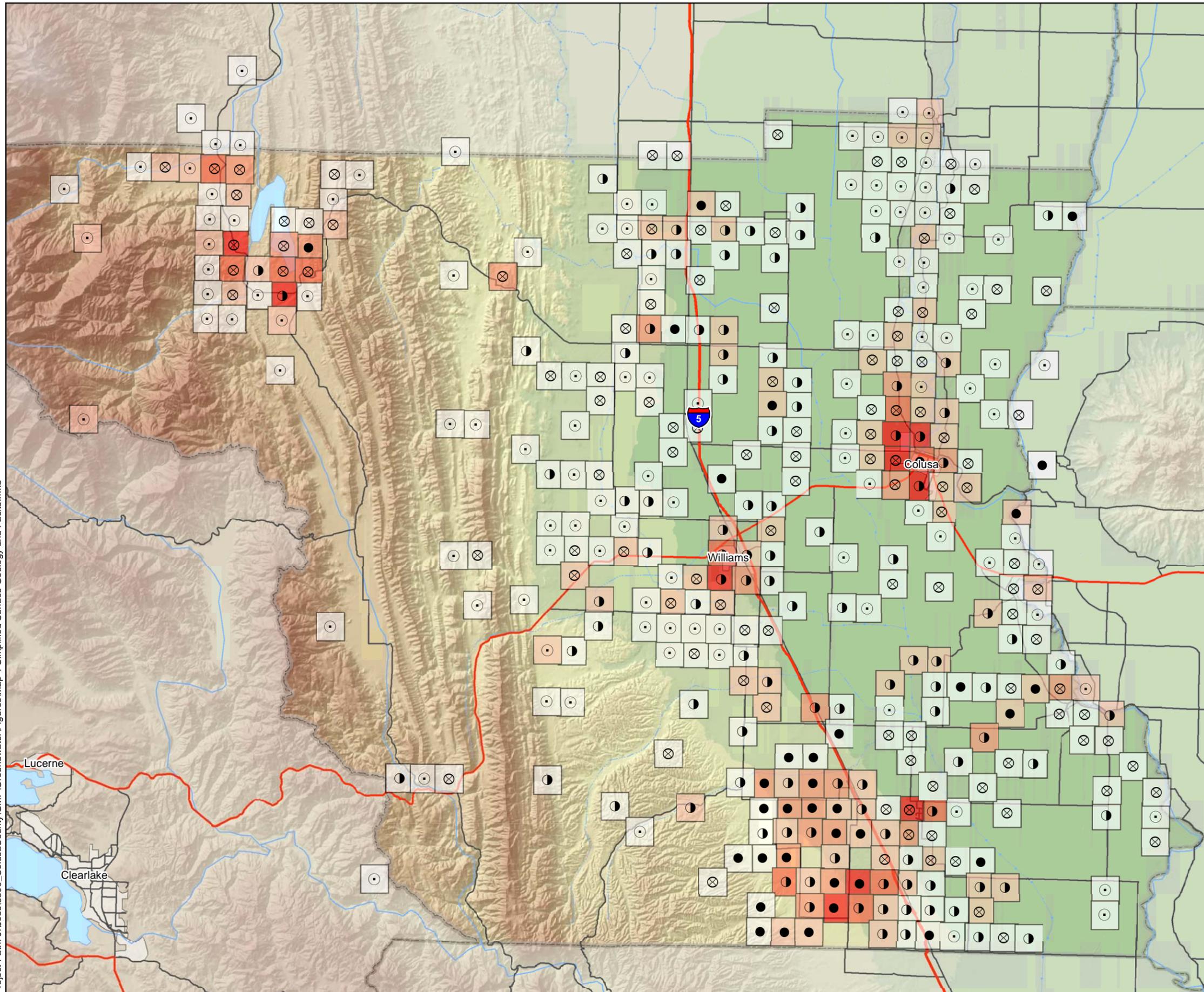


**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

DISTRIBUTION OF IRRIGATION WELLS



FIGURE II.13



Legend

Maximum Well Depth (Feet)

- < 150
- ⊗ 151 - 250
- ◐ 251 - 450
- > 450

Number of Wells per Section

- 1 - 2
- 3 - 5
- 6 - 10
- 11 - 20
- 21 - 41

SOURCES: USGS, DWR, STREETMAP USA

0 4 8 Miles



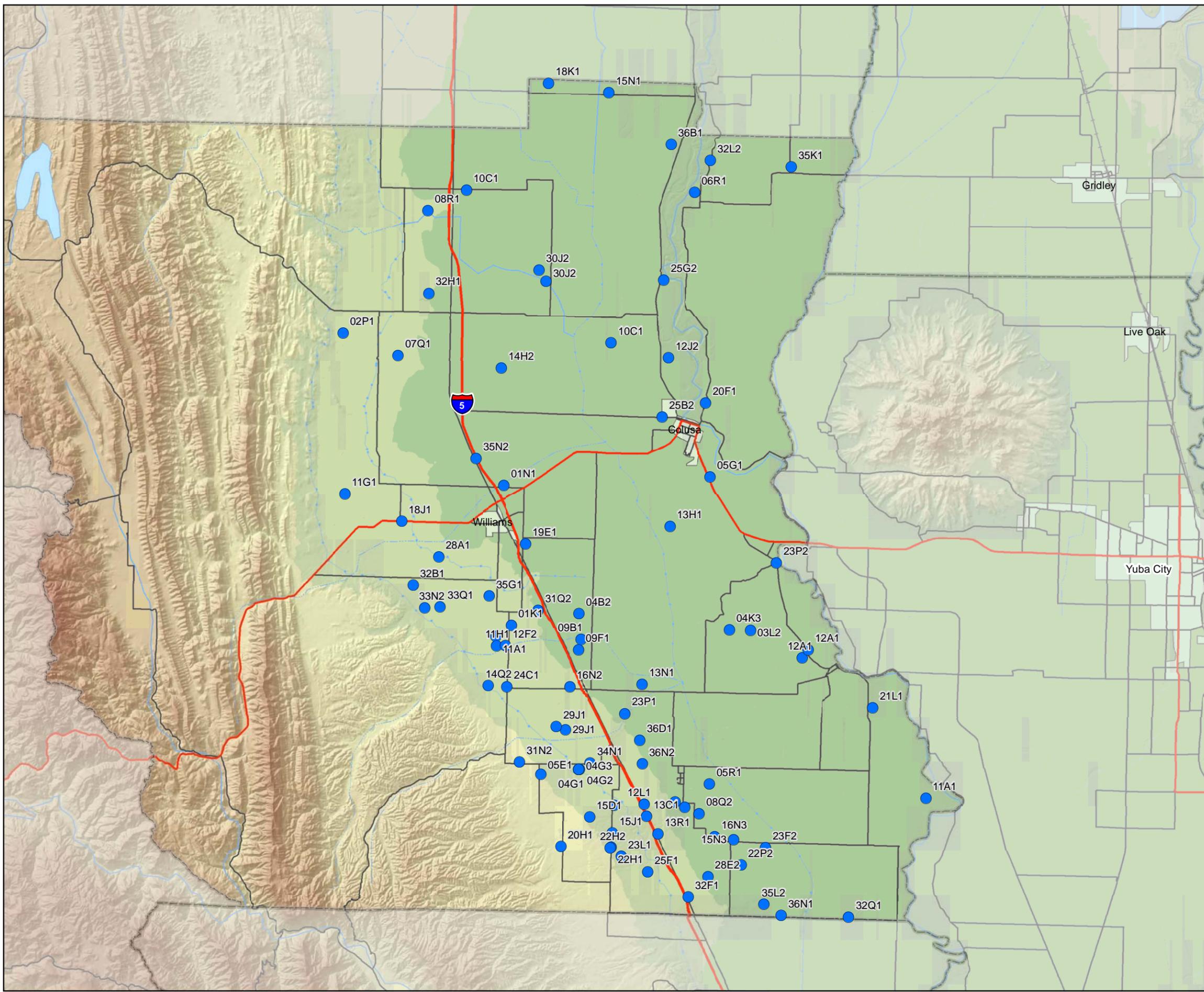
**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

DISTRIBUTION OF DOMESTIC WELLS



FIGURE II.14

J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Figure III.1 1977 Water Level Monitoring Locations.mxd



LEGEND
 ● Monitoring Well

SOURCES: DWR
 0 4 8
 Miles

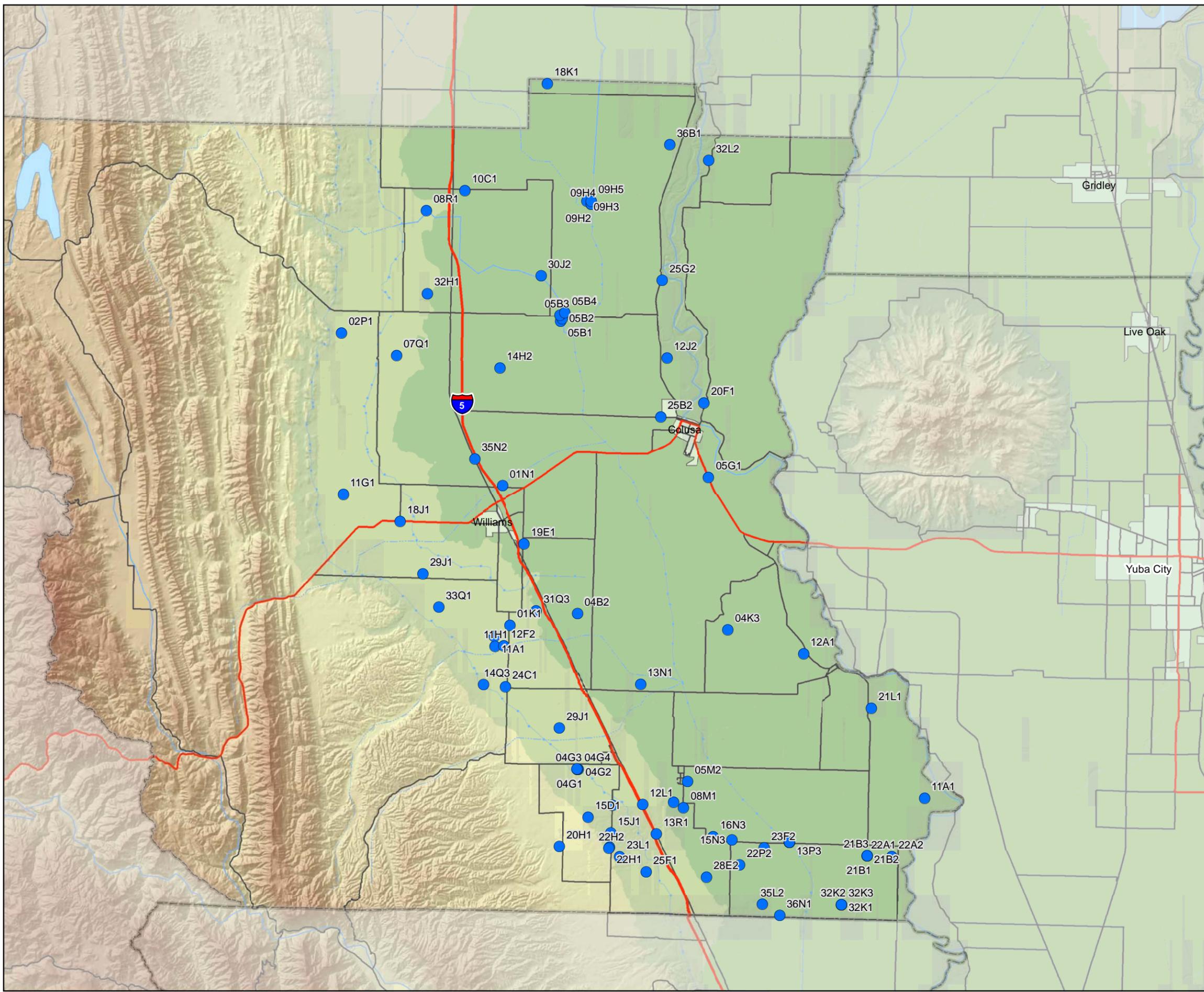


COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN
 1977 WATER LEVEL MONITORING NETWORK



FIGURE III.1

J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Figure III.2 2006 Water Level Monitoring Locations.mxd



LEGEND
 ● Monitoring Well

SOURCES: DWR

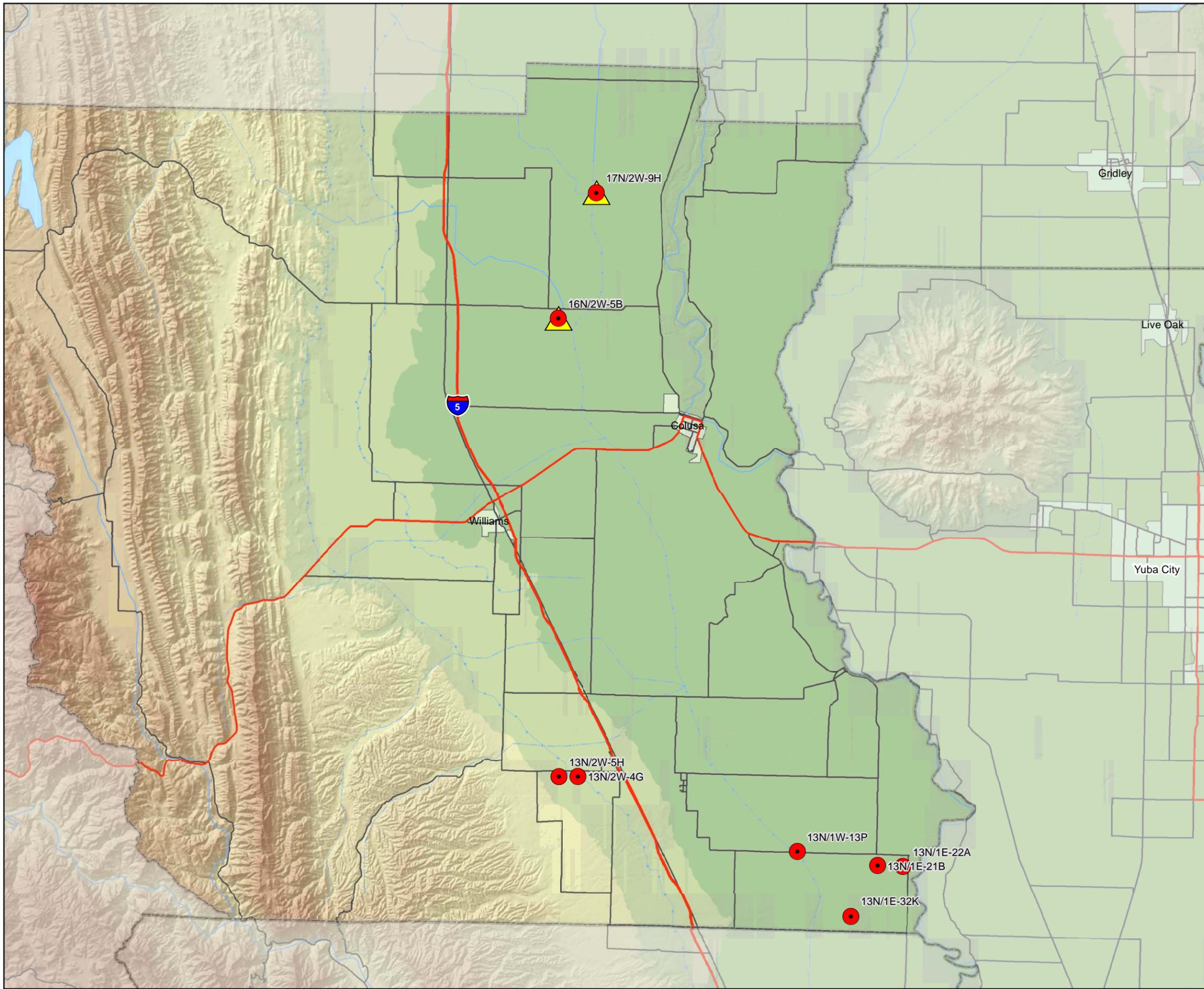


COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN
 2006 WATER LEVEL MONITORING NETWORK



FIGURE III.2

J:\Jobs\8300_ColusaCounty\GMP\Groundwater\Figures\Figure III.3 Nested MWs and Extensometers.mxd



LEGEND

-  Nested Monitoring Well
-  Extensometer

SOURCES: DWR



**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN**

NESTED MONITORING WELLS
AND EXTENSOMETERS



FIGURE III.3

FIGURE IV.1

**COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN
INSTITUTIONAL STRUCTURE FOR GMP IMPLEMENTATION**

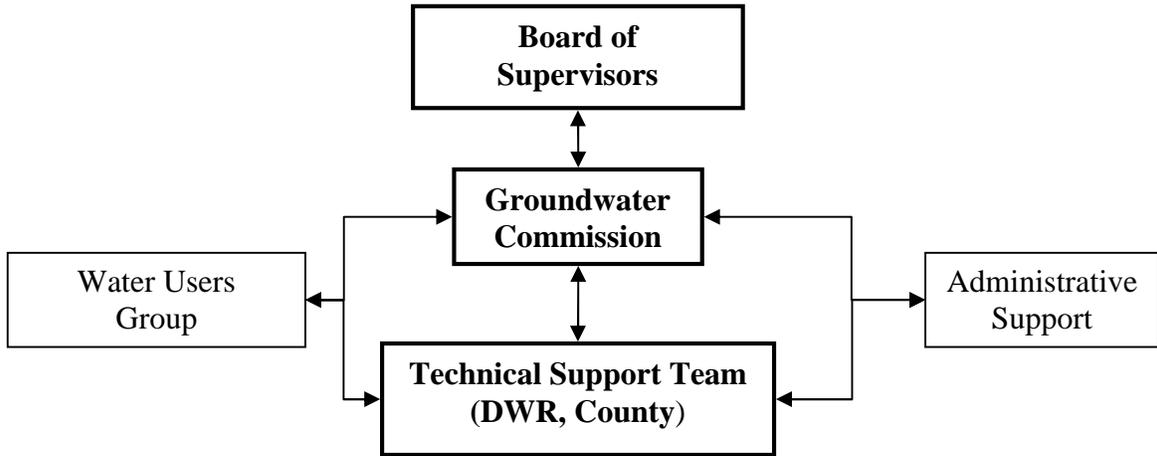


FIGURE IV.2

COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN

**FORUM FOR REVIEWING AND
DISSEMINATING GROUNDWATER INFORMATION**

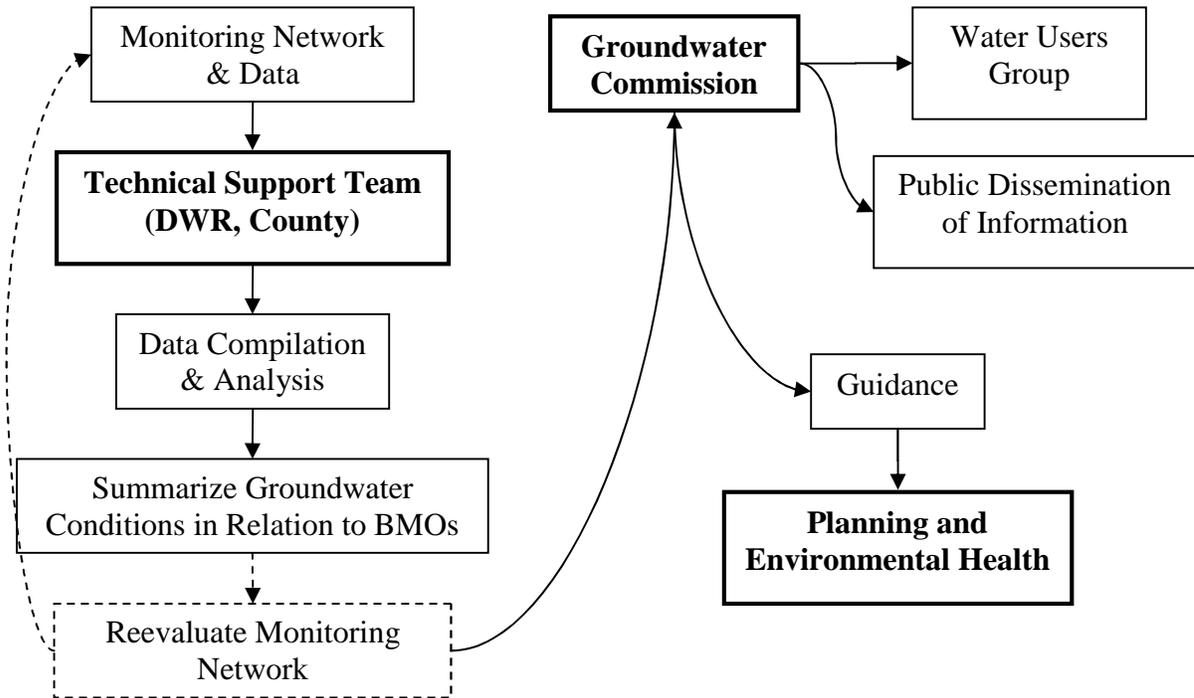


FIGURE IV.3

COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN

RECEIVE AND ADDRESS GROUNDWATER CONCERNS/ISSUES

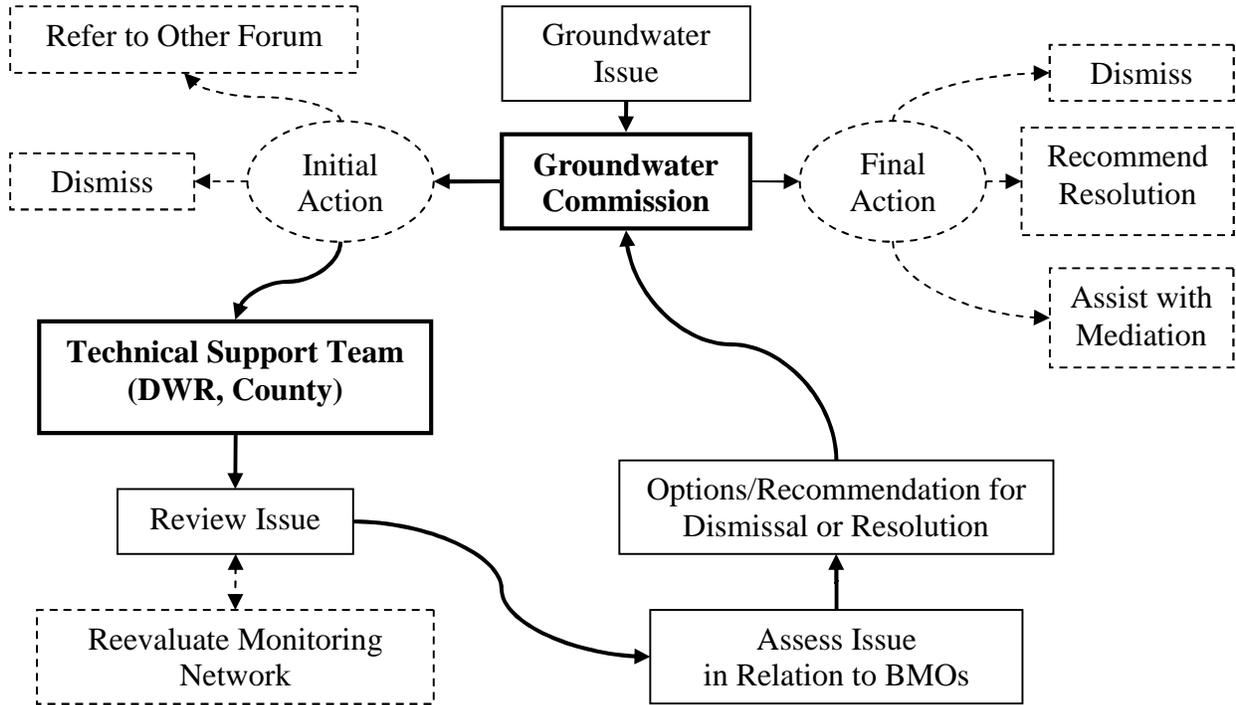


FIGURE IV.4

COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN

**EVALUATE WATER SUPPLY ASSESSMENTS
AND DEVELOPMENT PROPOSALS**

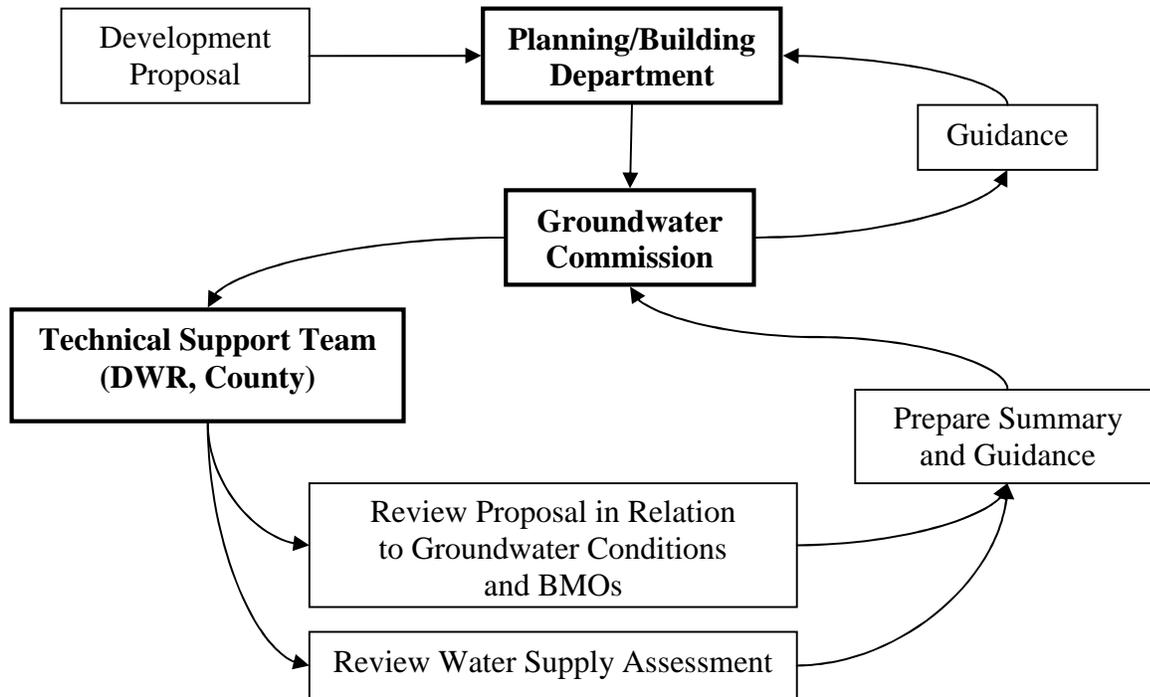


FIGURE IV.5

COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN

PREPARATION OF GROUNDWATER SUBSTITUTION
WATER TRANSFER PROPOSAL

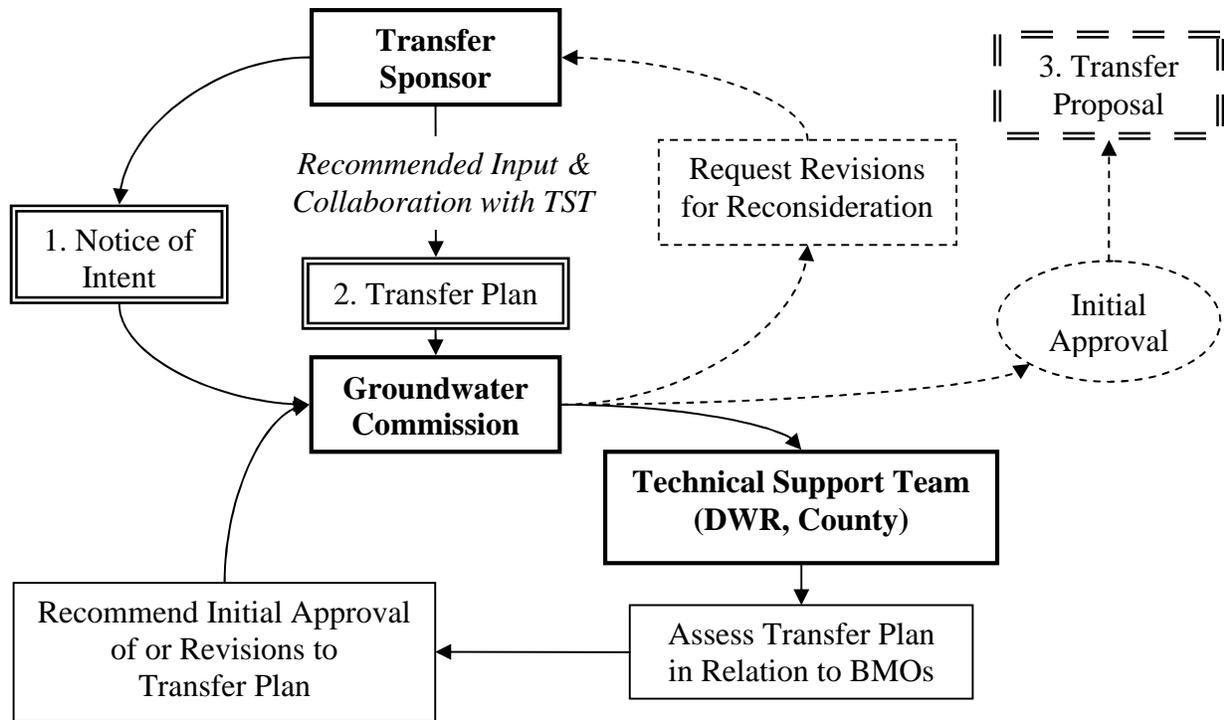


FIGURE IV.6

COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN

ACCEPTANCE OF WATER TRANSFER PROPOSAL

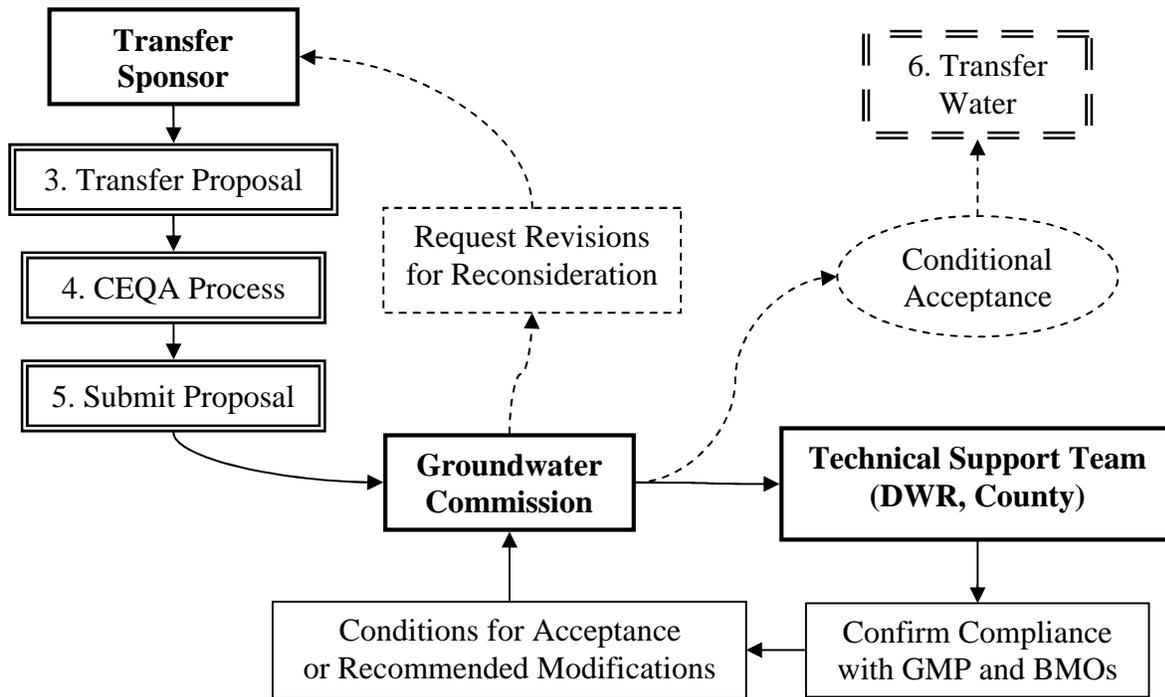
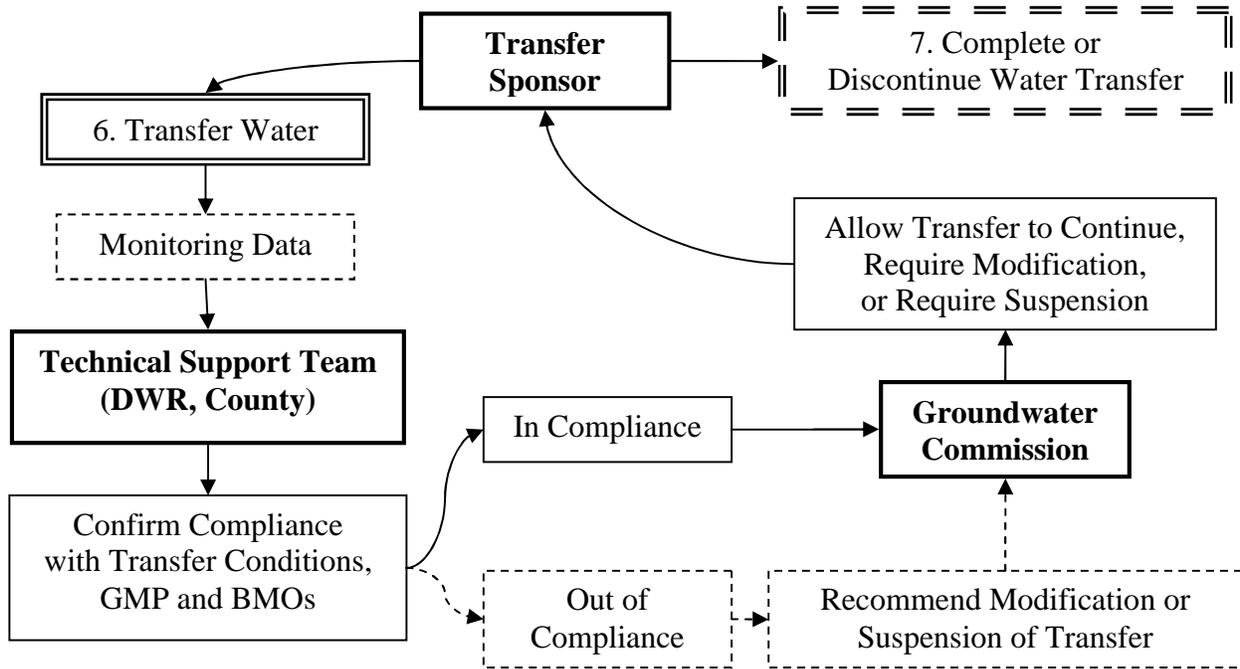


FIGURE IV.7

COLUSA COUNTY GROUNDWATER MANAGEMENT PLAN

ENFORCEMENT OF CONDITIONS DURING WATER TRANSFER





Exhibit

Exhibit



**COLUSA COUNTY
GROUNDWATER MANAGEMENT PLAN
RESPONSE TO COMMENTS RECEIVED
FROM AGENCIES ON DRAFT GMP**

Presented below are the comments that were received from various agencies/entities on the draft Groundwater Management Plan for Colusa County. Please note that each comment has been extracted from miscellaneous forms of correspondence (e.g., emails, letters, notes, memos). For easy reference, each comment is quoted in italic print noting the person who sent it, the type of correspondence, and the date it was received. Wood Rodgers' responses to the comments are presented in bold print.

Chuck Owens, California Department of Water Resources, Email, April 14, 2008

“The first attachment is an example of GW level, GE quality, and subsidence BMOs with clearly stated procedures and actions – it addresses Dan’s, Bill’s, and my comments given on April 10, and my and Eric’s comments to Kim following our March 4 meeting with Sutter County.”

The BMOs have been revised following the example provided, and includes clearly stated procedures and actions.

“The second attachment addresses my comment on Subsection 6.2.4 GW Levels – hydrographs are used to display GW levels in basins/sub-basins countywide.”

Groundwater level hydrographs for monitoring wells throughout the County are included in Figure II.5.

“The third attachment is a GMP implementation progress table with actions and schedules – it addresses my comment on Subsection 8.3, Subsection 8.5 GMP Implementation, and Subsection 9.0 Action Program.”

A table with actions and timing has been developed and is included as Table IV.1.

Lester Messina, Glenn County Water Advisory Committee, Email, June 10 2008

“On page 16, the last comment under 2a Settlement Contracts discusses reductions of 25%, but under what /when circumstances...”

The USBR Sacramento River Settlement Contracts state that, “In a Critical Year, the Contractor’s Base Supply and Project Water agreed to be diverted during the period April through October of the Year in which the principal portion of the Critical Year occurs, and each monthly quantity of said period shall be reduced by 25 percent.”

“On page 18, the continuation of the geology discussion, the first paragraph may be somewhat confusing. Maybe the whole geology overview needs to be reformatted??”

The paragraph was edited to eliminate confusion.

“On page 25, the last section of Groundwater levels needs a little more discussion on what the value of the information of those nested wells brings to the area.”

Section III.C.2.a.1 discusses the importance of nested monitoring wells. A reference to this section has been added.

“Page 28, mid page there should be an “of.”” “Developing a better understanding of...”

This correction has been made.

“On page 30, item 6, there is some discussion of limited bureaucracy but it is going to have to happen somehow.”

It is recognized that some bureaucracy will be needed to implement the GMP. Section IV.A.2 and Section IV.A.3 discuss the institutional structure that has been identified as necessary to implement the GMP. However, recognizing that some bureaucracy will be needed, the intent is to limit it to what is needed and not go beyond.

“In the discussion of the BMO’s the words “mitigate against” appear in all of them, is there a description within the document on how to “mitigate against” and what is required to accomplish this?????”

The language has been modified.

“On page 34 WDL is discussed with a web address, you should also discuss the Butte County BMOIC and the regional efforts behind that data base”.

A discussion of regional monitoring efforts and the BMOIC has been added.

“On page 34 on the last statement about subsidence monitoring you could say “The survey established baseline elevations in April 2008 and will be available to the public later this year as reference points for future monitoring” (or something like that).”

This section has been updated to include a more detailed discussion of the Sacramento Valley GPS Height Modernization Project.

“On page 51, third paragraph uses the word “granted” maybe too harsh. If you made that change would it change any of the flow figures in the back of the document?”

The language has been modified.

Chuck Owens, California Department of Water Resources, Email, June 12, 2008

“...BMOs need standards or performance objectives with actions or procedures.”

The BMOs have been revised to include a more detailed description of the standards/objectives for each BMO, including a listing of specific adverse impacts that shall be protected against or mitigated under each BMO. The BMOs have been revised to include the actions that will be taken with respect to each BMO.

“BMOs in the Public Draft are neither qualitative or quantitative.”

The BMOs have been revised to include a more detailed description of the standards/objectives for each BMO, including a listing of the specific adverse impacts that shall be protected against or mitigated under each BMO. The description of the standards/objectives for each BMO is sufficiently specific to allow the BMOs to be interpreted and applied to various scenarios; consequently, the revised BMOs are qualitative.

Robert Hickey, City of Colusa, Letter, June 17, 2008

“Section III, C.3: This section states that “the County intends to prepare a formal Groundwater Monitoring Program” as funding becomes available. The City of Colusa can work with the Technical Support Team to determine ideal sites within city limits for groundwater and land subsidence monitoring.

Figure III. 3: This figure shows eight nested monitoring wells currently operating within the County, none of which are in the vicinity of the City of Colusa. A nested monitoring well located in the City of Colusa will provide valuable information and be of great benefit for groundwater levels and quality within the various aquifers.

“Section III. E. 2: This section discusses formalizing a groundwater monitoring program and the need for monitoring groundwater levels, groundwater quality, inelastic surface subsidence, and flow and surface water that directly affect groundwater levels/quality of are caused by groundwater pumping. Based on previous mentioned information and references, the City of Colusa is well situated for a monitoring well that benefits the GWMP and the City.”

The comments noted above reflect the City’s support of the GMP and do not require responses.

Dan McManus, California Department of Water Resources, July 6 2008

“Although the GWMP lists qualitative BMOs and proposes a structure for implementation, there isn’t a concrete schedule or management process to facilitate development of quantifiable or narrative BMOs that will “protect against and mitigate adverse impacts” related to each of the individual BMOs. Throughout the Action Plan, the BMOs are identified as components that need to be formalized or should be developed. I think it would be hard for a public representative or water purveyor to fully understand the ramification of adopting a GWMP that leaves these items

to be defined in the future...especially if the plan is to eliminate the ordinance prior to defining the BMOs.”

The BMOs in the GMP (Section III.B) have been developed and formalized. The BMOs have been revised to include a more detailed description of the standards/objectives for each BMO, including a listing of specific adverse impacts that shall be protected against or mitigated under each BMO. The BMOs have also been revised to include the actions that will be taken with respect to each BMO. Together, these revisions make the BMOs specific with regard to how to avoid or mitigate adverse impacts, and also make clear the ramifications of adopting the GMP. The Action Program of the GMP includes periodically revising and updating the GMP (Section III.E.1.d) so that as more data becomes available the BMOs can be revised as appropriate, but until such revision takes place, the BMOs in Section III.B are in effect.

“Because the BMOs consist of only an outline of what should be considered, it is very likely that an application under the AB303 Local Groundwater Assistance Grant Program will not score well under the existing AB303 scoring criteria.”

The BMOs have been revised to include a more detailed description of the standards/objectives for each BMO, including a listing of specific adverse impacts that shall be protected against or mitigated under each BMO. The BMOs have also been revised to include the actions that will be taken with respect to each BMO. The revised BMOs and GMP comply with the voluntary, required, and recommended components of a GMP (as shown in Table 1.1) and as such should be scored favorably under the AB 303 Local Groundwater Assistance Grant Program.

“The “Plan Implementation” should include a schedule, whereby if the proposed GWMP is adopted, that would be followed to further define and finalize the BMOs, the Monitoring Program, the Local and Regional Groundwater Management Coordination, and the Action Plan.”

A table showing activities to be implemented and the general time frame is included as Table IV.1.

“It should be explained up-front that this GWMP will replace the existing county ordinance. This is not mentioned until page 38, and then, there is no explanation of when or how this will happen, i.e., will the county ordinance stay in effect until the BMO are quantified and the structure and funding for the GWMP is fully defined?”

The purpose of the GMP has been expanded to address this item.

“All public agencies with GWMPs should be identified in a table. Of these agencies, there should be some attempt to identify which ones have expressed an interest in adopting the new GWMP and working to develop quantifiable BMOs. Without an ordinance, and without any idea which of the public agencies (potential water transfer entities) are agreeable to the conditions of

the new GWMP, there is no way for the average person or public representative to know if adopting the proposed GWMP will result in improved sustainability or just facilitate more water transfers.”

The water purveyors with groundwater management plans are identified in Section II.B.1 and Section IV.E.

“In the “Issues of Concern” section (p4-7), there is a big difference in evaluating the survey and providing opinions as to what was or wasn’t understood, and what will or won’t constitute successful local management. The ladder should be avoided.”

The discussion has been revised to eliminate conjecture as to what was understood in the survey.

“Page v, first two sentences: These sentences seem to imply that 96% of the Sacramento Valley portion of Colusa County is under either surface water or groundwater application...is that true? That doesn’t leave much area for native veg or none irrigated acreage.”

The percentages relate to the irrigated or developed area of the Sacramento Valley part of the County, which represents approximately 40 percent of the County’s area.

“Page vi, first paragraph, last sentence: I suggest starting the sentence with...These challenges amplify..., rather than “This amplifies...”

The language has been modified.

“Page vi, second paragraph, first sentence: If the GWMP is not implemented, it does not legally qualify as a GWMP; thus, it would just be an advisory document.”

In order to legally qualify as a GMP, the GMP must be “adopted.” The language in this section is intended to emphasize that the GMP must not only be adopted, but the actions outlined must be undertaken for it to be effective.

“Page vi, second paragraph, second sentence: Sentence seem redundant...isn’t this document called Colusa County Groundwater Management Plan, do we have to say that it is tailored to the community of Colusa County.”

This language is intended to emphasize that this GMP is specific to Colusa County and does not reflect a “boilerplate” GMP that would be appropriate for all counties.

“Page vi, second paragraph, fourth & fifth sentence: It is one thing to acknowledge that the implementation of a GWMP will require some additional bureaucracy, and follow the statement up with a justification....it is another to make the statement that...“It may be true”...that it is merely an investment in more bureaucracy. I think that these sentences should be reworded.”

The sentences were reviewed with minor edits made.

“Page vi, third paragraph, last sentence: seems like we should pull the “constraints and opportunities” statement and just say something like...”as more efficient and effective management alternatives are defined.””

Good suggestion; changes were made.

“Page vi, last paragraph: The wording in the first part of the paragraph goes too far down the ...this GWMP doesn’t apply to 96% of the county...prior to recovery of the last sentence. A better approach might be to just reference the appropriate section of the CA Water Code and follow with a statement of the need to execute participation agreements with other agencies, i.e., California Water Code 10750.8. (a) states that...” a local agency may not manage groundwater pursuant to this part within the service area of another local agency without the agreement of that other entity.”, thus, it is important that local agencies come together to develop one groundwater management plan that will have participation by, and serve the needs of, all public and private water users within the county.”

Good comments; the section has been edited.

“Page vii, first full paragraph, second sentence: This sentence seems to be difficult to read...suggestion...insert “of water-related matters” after “collaboration” and delete everything after “boundaries.””

The language has been modified.

“Page vii, first full paragraph, third sentence: Need to indicate the nature of the Four County Group and the Multi-Party Water Resource Group...what is the form of the group, what is the purpose...most folks don’t have a clue.”

A sentence on the purpose was added.

“Page vii, paragraph following the bullets: “Action Program” is cap/small case, but “groundwater management process” is not...should be consistent.”

The capitalization has been modified.

“Page vii, last sentence of the paragraph following the bullets: Although true, I don’t think the last sentence is needed and it really seems to only set-up the debate you are trying to avoid. It might be better to mention the opportunities for funding through grant programs or other measures.”

The sentence was deleted.

“Page I, bullet list: It seems like this bullet list should jibe with the statements of intent that were made on page vi in paragraph three and four. Also, it seems like some of the bullets should match the page vii bullets identifying ‘key elements’ of a GWMP. Otherwise, there seems to be a disconnect between the intent of the Colusa GWMP and what has already been identified as a successful GWMP elements.”

The reasons/purpose for preparing the GMP are different than what is essential to implement one. No changes were made.

“Figure I.1: Legend color for ‘other’ basins, doesn’t match the color in the map.”

The colors have been modified.

“Page 4, first and second full paragraphs, last sentences: You shouldn’t really try to interpret why there was a lower response. There is an equal possibility that they had a clear understanding of the objectives.”

See response to Comment No. 6.

“Page 9, under Water Purveyors: Should list how many have GWMPs. Also should identify the existing Colusa County Ordinance and summarize its content.”

The section has been revised to include a discussion of water purveyors with GMPs. A summary of the existing Colusa County groundwater ordinance has been included in the Introduction.

“Page 9 & 10: It is mentioned on page 9 that managed wetlands represent 54% of the 740,000 acres in the county, but on page 10 it is mentioned that wildlife refuges represent only 3% of the irrigated land and 2% of the county at large...these statements don’t seem to jibe...maybe more explanation is needed.”

The 400,000 acres represents irrigated land as well.

“Page 24, Groundwater Levels; It might be nice to mention that groundwater level data can be accessed on-line at Water Data Library, and give the url...same goes with subsidence and water quality data.”

The Water Data Library is referenced in the Monitoring Program (Section III.C.2). This section has been revised to include more discussion of the data available on WDL.

“Page 32, Groundwater Quality; It seems that a statement should be made regarding the need to coordinate land use planning and resource management with respect to areas of existing poor groundwater quality.”

Further discussion has been added to address the need for coordination. The revised BMO also describes actions that will be taken under the BMO, including referring guidance to other county departments such as Planning/Building or Environmental Health.

“Page 36, third full paragraph: Update to describe the spring 2008 GPS subsidence grid that was established.”

This section has been updated to include a more detailed discussion of the Sacramento Valley GPS Height Modernization Project.

“Page 36, last sentence; should define “effective player” and “effective groundwater management.”

Language was added to accomplish this.

“Page 38, (b): Typically, updating something doesn’t mean replacing it. Need to further identify the process and schedule for replacing the ordinance...will this happen before the BMOs are quantified?”

Language was changed to “replace” the existing ordinance. This should be done as soon as possible.

“Page 39, c: The GWMP should identify the Public Outreach Program, not just identify that one should be developed.”

Specific public outreach activities are described as part of the actions under each revised BMO. The Action Program includes formalizing the public outreach program. The formal public outreach program will provide specifics on the methods that will be used to conduct public outreach, the groups that will be contacted, etc. However, the schedule for making information available to the public and the description of what will be provided are included in the GMP under each BMO and in Table IV.1.

Charles R. Owens, P.G., California Department of Water Resources, Memo, July 7, 2008

“The May 2008 version of the GMP is a substantial improvement over the initial Administrative Draft. However, the Basin Management Objectives (BMOs) in the May 2008 draft do not identify any specific quantitative or qualitative objectives for basins underlying Colusa County. No actions or procedures or monitoring protocols are identified to manage the basin, and no implementation schedule is provided. Given this, the second paragraph of Task 3.4 in the subcontract Scope of Work was not really fulfilled, and it is anticipated the GMP would not score high in DWR’s competitive AB 303 grant program.”

The BMOs have been revised to include a more detailed description of the standards/objectives for each BMO, including a listing of specific adverse impacts that shall be protected against or mitigated under each BMO. The BMOs have also been revised to include the monitoring, actions, and procedures that will be taken with respect to each BMO. A table with specific actions and a general timeline for the County is now included as Table IV.1 The description of the standards/objectives for each BMO is sufficiently specific to allow for the BMOs to be interpreted and applied to various scenarios; consequently, the revised BMOs are qualitative.

“DWR comments on the Administrative Draft to divide the document into two parts was partly addressed. However, both parts should be in one document separated by a divider rather than in two volumes so that readers have the supporting information at hand, if needed. DWR did not receive Volume 2.”

It is deemed to not be practical or convenient for the public’s use to have all the materials compiled into a single document. Copies of Volume 2 were delivered to Colusa County.

“The following sentence at the top of p. vi has five inaccuracies: “As part of the Bay-Delta Water Rights Hearings, several water purveyors in the Sacramento Valley, including Colusa County, signed on to an agreement that provides for implementing projects to produce 185,000 acre-feet of water that would not otherwise be available to the Sacramento River”.”

(1) The Short-Term Settlement Agreement was not part of the SWRCB hearings; rather, it was to avert the Phase 8 hearings the parties believed would have triggered litigation. (2) Colusa County is not a water purveyor. (3) Colusa County is not a signatory to the agreement, but I think it adopted a resolution in support. (4) Under the agreement, river diverters in the Sacramento Valley are to provide at least 92,500 AF and up to 185,000 AF to the SWP and CVP in dry years. This water is part of the diverters’ reservoir allocations they would not divert, and instead, substitute groundwater to irrigate crops. (5) The goal is for more water to reach the Delta to meet water quality objectives, so saying the water “would not otherwise be available to the Sacramento River” misses the point of the hearings and the agreement.”

The clarifying language is appreciated.

“This section should describe “Groundwater (GW)-Surface Water (SW) Interaction” in the county. At least, state if the reach of the Sacramento River in the county is a losing stream that recharges GW or a gaining stream with a baseflow component from GW, and if there are seasonal reversals. This may also reveal if the creeks are hydraulically connected to shallow GW. If the creeks are hydraulically connected to GW, then pumping nearby wells could deplete stream flow, which is important to down-gradient riparian water right holders, USBR, and DWR. DWR-ND may have data to make these evaluations.”

To determine groundwater-surface water interaction, it is necessary to have nested monitoring wells located in close proximity to stream gage and monitoring stations. The nested monitoring wells must be completed in the very shallow

groundwater zone that is directly connected to surface water, as well as in the zones below. The existing nested monitoring wells in Colusa County are shown in Figure III.3; the locations are not suitable for evaluating stream/aquifer interactions. Further, the stream/aquifer interaction along the Sacramento River (including where it is a gaining or losing reach) has not been well-characterized in Colusa County. The Department of Water Resources Northern District has stated that existing data is inadequate to characterize the system. Language has been added to address this lack of understanding.

“The long, general discussion of “Groundwater” on pages 17-24 would be more useful if it conformed to subcontract Scope of Work Task 2.2, as follows. Each of the three basins (Sacramento Valley/Colusa, Sacramento Valley/West Butte, and small Coast Range basins) should have a summary of aquifer characteristics including “aquifer types (confined, semi-confined, unconfined), the lateral and vertical extent of aquifers based on electric logs, vertical hydraulic relationships between aquifers”, and if available, “information on specific capacity, well yield, storage capacity, and identify recharge areas.””

The discussion of groundwater in the GMP was organized to make the best use of available data to describe the aquifer system underlying Colusa County. It is important to recognize that this system is not fully characterized, and the discussion in the GMP was limited by information available in published studies and maps. The discussion of groundwater is subdivided into seven sections: groundwater basins and subbasins, geology, groundwater levels, groundwater quality, land subsidence, surface water flow and quality, and groundwater infrastructure. The Colusa and West Butte subbasins of the Sacramento Valley Groundwater Basin are separated by the Sacramento River. Available data indicate that the Sacramento River does not represent a hydrogeologic boundary to any but the shallowest aquifers and does not divide geologic formations or aquifers; as such, it makes more sense to discuss the portion of the Sacramento Valley Groundwater Basin underlying Colusa County as a whole (rather than by subbasin). As discussed in the GMP, the small Coast Range basins have very limited (if any) available data and cannot be characterized in any detail. The groundwater discussion is consequently focused on the Sacramento Valley Groundwater Basin. Each of the geologic formations containing fresh water is discussed in detail, including the age, depth, materials, and ability to yield water to wells. The lateral extent of the aquifers is discussed but cannot be presented in detail because of lack of published data. The surface geology of the county is shown in Figure II.2 and a simplified geologic cross-section is shown in Figure II.3. Confinement of each of the aquifers is not fully characterized and in general varies by area within the aquifer, so a meaningful discussion could not be included. The vertical hydraulic relationship between aquifers is not well-understood and data is lacking to make the characterization; however, water level data from two nested monitoring wells is presented in Figure II.6 and is inconclusive with regard to hydraulic relationships between aquifers. Further, meaningful published information on specific capacity, well yield, storage capacity, and recharge areas for most of the aquifers underlying the County is lacking, and these characteristics often vary by area. Ongoing monitoring and studies are suggested in the Action

Program to help further understand the aquifer system underlying Colusa County.

“Note: Two colors on Figure 1.2 do not match the map colors.”

The colors have been modified.

“Goal #1, to “Ensure a Reliable Water Supply”. The GMP does not identify any specific objectives or parameters to measure or processes that will ensure GW or SW supplies. If Goal #1 only applied to GW, then there would be little difference between it and Goal #2, to “Ensure Long-Term GW Sustainability.”

Neither Goal #1 or Goal #2, or any of the others, consider potential impacts from GW pumping on neighbors or the environment. Consider replacing the first two goals with the following goals:

“To sustain GW resources to meet present and future demands in Colusa County”.

“To minimize third party and environmental impacts due to GW pumping.””

The GMP goals were formulated and reviewed several times with the PAC. As stated in the GMP (Section III.A), the Groundwater Management Goals “represent the overarching intents of the County with regard to groundwater management.” They are not BMOs, are not intended to serve the purpose of BMOs, and lack the specificity of BMOs. The BMOs presented in the GMP include detailed standards/objectives, including a listing of specific adverse impacts that shall be protected against/avoided or mitigated under each BMO, as well as specific actions that will be taken in this regard for each BMO.

“Regarding Goal #3, Optimize Conjunctive Use, p. 29 states that it “generally means that, whenever possible, SW is used to the fullest extent with GW serving as a back-up supply.” This describes how much of the San Joaquin Valley operates because its SW supplies are insufficient, but not the Sacramento Valley, which provides SW to much of the State via the SWP and CVP. At DWR, conjunctive use is generally understood to mean relying more on GW in dry years when less SW is available, and relying more on SW in wet years when supplies are abundant while aquifers recharge. Consider deleting Goal #3 because it fails to grasp the concepts of basin management and conjunctive use in the Sacramento Valley, like the “related goal” in the second paragraph: “... to “even out” water availability in the county.””

The full description of conjunctive use in Section III.A.3 states that:

“The term ‘conjunctive use’ basically means using surface water and groundwater together to meet water demands, using different proportions of each depending on availability. For example, in years of reduced surface water availability, more groundwater would be used and groundwater levels might decline; conversely, in years of full surface water availability, less groundwater would be used and groundwater levels would recover. Optimizing conjunctive use generally means

that, whenever possible, surface water is used to the fullest extent with groundwater serving as a ‘back-up’ supply.’”

This description, although not identical, is fully consistent with the comment that, “At DWR, conjunctive use is generally understood to mean relying more on GW in dry years when less SW is available, and relying more on SW in wet years when supplies are abundant while aquifers recharge.”

A special consideration in some areas of Colusa County, where the groundwater basin historically has not been “exercised,” is to expand the use of groundwater, thereby inducing more recharge and increasing the overall water supply available to the County. More technical data on the aquifer is needed to begin to understand the real opportunity.

“Goal #4, to “Protect Water Rights”, like Goal #1, applies to both SW and GW, and the former does not belong in a GMP. What SW rights in state law does the county want to protect? The GMP does not identify any threats to SW rights or any actions the county will take to protect them. Whereas, adopting a GMP proclaims the County’s desire to protect overlying landowners’ rights to drill wells and extract GW for beneficial use on their property, and to some extent, accomplishes Goal #5 to Maintain Local Control.”

The reason for including a goal of protecting surface water and groundwater rights in the GMP is described in Section III.A.4, which states that the “county’s overall water supply is primarily surface water, and changes in surface water rights and reductions to the amount of available surface water will result in an increased demand for groundwater.” It is consequently an important goal for the County to protect surface water rights to avoid increased demands for groundwater that would be unsustainable.

Surface water supplies and rights will continue to be challenged. To the extent the County, through its GMP, can demonstrate/document management of surface water and groundwater resources, its chances of averting litigation (of Phase 8) can be enhanced. In reality, you cannot manage groundwater without surface water.

“Regarding Goal #6, to Prevent Unnecessary Restrictions on GW Use, no unnecessary restrictions on GW use are identified in the GMP. Specific examples should be provided to make this goal meaningful.”

Concern has been expressed by county residents in PAC meetings and informal conversations that this GMP is intended to regulate groundwater use. This goal is intended to directly address this general concern. This is a goal of the County’s groundwater management efforts, not a BMO, and as such does not include specific actions. To the extent the BMOs are met, the need for restructure is minimized. However, the intent is that the County’s groundwater management actions be consistent with this goal.

“The BMOs on pages 31-33 do not identify any specific objectives, parameters, methods, or procedures for managing a basin. The Action Program does not identify any specific actions to monitor or manage basin conditions. None of the actions on pages 37-44 propose monitoring aquifer parameters such as storage.

An effective GMP identifies BMOs that can accomplish the two recommended goals in the preceding comments on GW Management Goals, and has monitoring protocols with an implementation schedule for specific actions to be taken.”

The BMOs have been revised to include a more detailed description of the specific standards and objectives for each BMO, including a listing of specific adverse impacts that shall be protected against or mitigated under each BMO. Each BMO now includes specific monitoring related to the BMO as well as actions that will be taken for each BMO. A table with activities and timing is included as Table IV.1. For the purposes of the BMOs, water levels, water quality, and inelastic land subsidence will be monitored and evaluated at a minimum of semiannually. The existing groundwater monitoring network is fully described in Section III.C.2, and future groundwater monitoring is described in Section III.C.3.

“This GMP’s BMOs would require the county to mitigate adverse impacts due to pumping, but that cost should be borne by the responsible parties.”

“The BMO section of the GMP (Section III.B) specifically states that:

“The County’s role with regard to mitigation will not be to actively undertake mitigation to offset the actions of others. The groundwater management processes allow the County to assist in providing a forum for discussing groundwater issues and providing technical review and recommendations to help resolve these issues and disputes. These recommendations may include mitigation to be undertaken by some or all of the involved parties.”

“On p. 38, it is proposed that the GMP replace the existing county GW ordinance. Because the GMP does not have substantive BMOs or actions, replacing the ordinance with the GMP would leave the county with the appearance of managing GW without doing so.”

The revised BMOs are substantive and include specific actions. The GMP, including the revised BMOs, would manage groundwater in a meaningful way. The process outlined for handling data and information related to the BMOs will facilitate management of the groundwater resources.

“Monitoring Protocols” is another AB 303 grant application scoring criterion. To satisfy this criterion, the GMP must identify specific GW monitoring protocols and discuss them with respect to GW management. GW monitoring protocols include established procedures, methods, locations, measurement frequencies, and sampling that promote collection of consistent, reproducible, standardized data and efficient, effective GW management addressing: a) GW quality degradation, b) inelastic land subsidence, c) changes in SW flow and quality, and d) GW levels, availability, storage, and beneficial uses.”

The revised BMOs each include a description of monitoring related to that BMO, including locations. The existing groundwater monitoring network in the county is fully described in Section III.C.2, including parameters, locations, frequencies, and who conducts the monitoring. Groundwater monitoring within the County is currently conducted almost entirely by DWR. Until funding becomes available for the County to conduct its own monitoring or formalize a monitoring program, it will have to rely on the continuation of monitoring by DWR. As the lead monitoring agency, DWR establishes procedures, methods, locations, measurement frequencies, and sampling that promote the collection of consistent reproducible, standardized data. The County simply does not have the capability to do this with its current resources, but the GMP includes a plan to take on this role as funding becomes available. The BMOs describe how monitoring data will be used to manage groundwater with respect to the BMOs for groundwater levels, groundwater quality, inelastic land subsidence, and surface water flow and quality.

“The County’s consultant, Wood Rodgers (WR), put its name and/or logo on the cover and every page of the GMP. The County may want to reconsider the inclusion of these references to WR, and the last paragraph of the Preface. Also, consider replacing WR’s now irrelevant May 19, 2008 letter with a title page that states: WR prepared the GMP under County direction with financial and technical assistance from DWR.”

Wood Rodgers’ logo has been removed from the cover of the GMP. It is consistent with industry standards for the consultant’s name and/or logo to be included in the title block of figures and on the cover of reports. This is even true for the good examples you provided for reference.

Chuck. Owens, P.G., California Department of Water Resources, Email, July 14, 2008

This response addresses the comments to draft Basin Management Objectives in the email from Mr. Owens.

Many of the comments are vague and unprofessional. They reflect a narrow view of water management and we do not necessarily agree with them. Where possible, every attempt was made to glean useful information from the comments and edits.

Please note the email from Mr. Owens follows in its entirety at the end of this Exhibit.

Dan McManus, California Department of Water Resources, July 15, 2008

This response addresses the comments to draft Basin Management Objectives in the email from Mr. McManus.

The comments and edits are good and have been incorporated into the GMP.

Please note the email from Mr. McManus follows in its entirety at the end of this Exhibit.

Lewis Bair, Reclamation District 108 and Thaddeus Bettner, Glenn-Colusa Irrigation District Letter, July 28, 2008

“Both RD108 and GCID have exercised their authority under California Water Code § 10750 et seq. to adopt and implement a Groundwater Management Plan for their respective service areas and wish to continue to exercise this authority. The GMP should state clearly that the County’s implementation of the GMP will not affect either district’s authority to continue to implement their already-existing Groundwater Management Plan. It is both RD108’s and GCID’s intent that its Groundwater Management Plan be consistent with and implemented in coordination with the County’s GMP.”

Language has been included in Section I.B., to further clarify this item.

“Both RD108 and GCID anticipate that the nature of how the plans will coordinate, will be addressed in a separate memorandum of understanding between each district and the County. RD108 and GCID look forward to the opportunity to work with the County on a memorandum of understanding that will both provide for cooperation and joint implementation of the GMP and protect the districts’ ability to implement their own plan.”

The expressed interest to work with the County to develop a Memorandum of Understanding for cooperation and joint implementation is appreciated. This activity has been discussed generally in Section I.B., and for RD 108 and GCID specifically in Section IV.E.1.

“The May 2008 draft GMP describes the County’s proposed institutional framework as it applies to proposals for groundwater substitution water transfers. For a transferor, the process involves filing a series of documents with the Groundwater Commission for review and approval and subsequent enforcement of conditions by the Groundwater Commission. Because the GMP does not distinguish between short-term (less than one year) and long-term transfers, short term transfers would be subject to this potentially lengthy process. Both districts are concerned that short-term transfers, which can be an important State-wide water supply management tool, may be hindered by this process. RD108 and GCID would like to work with the County to develop a more abbreviated process, perhaps through a simple checklist, for review of short-term transfers by the Groundwater Commission. Both districts support a joint effort by the transferor and the County to ensure that both short-term and long-term transfers are consistent with a Basin Management Objectives identified in the GMP.”

The point is well taken. The text on water transfers has been modified to account for short-term transfers. Also, the draft guidelines recently distributed by DWR and the U.S. Bureau of Reclamation for 2009 (short term) water transfers are referenced and included as Appendix L.

“RD108 and GCID both feel that the role of Water Users Group should be clarified and further developed in the GMP. For example, the GMP states at p.47 that the Water Users Group “would receive information about the activities of the Groundwater Commission and the Technical Support Team and provide input and feedback to these bodies.” However, it is not clear what role, if any, the Water Users Group will play in advising the Groundwater Commission (e.g., on the development of quantitative Basin Management Objectives). It is recommended by both RD108 and GCID that further development and clarification of the Water Users Group and its role in implementing the GMP be made.”

An attempt was made to expand the discussion on the role of the Water Users Group.

“In order to ensure successful coordination of the districts’ existing Groundwater Management Plans with the GMP, the districts anticipate a joint effort to develop qualitative Basin Management Objectives. Participation solely in the Water Users Group does not appear to afford either district this opportunity. Again, the districts anticipate that the memorandum of understanding between each district and the County will address the districts’ role with respect to implementation of specific elements of the GMP and how the plans will coordinate to address local as well as regional groundwater management issues.”

The Water Users Group, as proposed, is to review material prepared by the TST and assist the TST in addressing groundwater issues as they arise. These activities are viewed as a regular part of their “business.” From time to time topics or issues will arise similar to what is noted in the paragraph. It is anticipated that items or topics requiring broader stakeholder participation or other expertise would be brought to the Commission with a specific proposal by the TST. Ideally, the need for specific task-oriented attention would emerge through regular meetings of the TST and Water Users Group. The text has been modified to address this.

“The GMP should provide some insight and guidance as to how the County’s GMP will coordinate with other Counties. For example, if County GMP’s have differing approval requirements on water transfers, how will the GMP be applied to multi-county agencies like RD108 and GCID?”

The applicable requirements will, at least in the early years, be those within the County where the “groundwater” substitution is proposed. Ideally, over time a more regional process could be worked out in order that the districts are subject to a single process only. Language has been included in the GMP, Section IV.A.3.d, and Section IV.C.

“On pages 54-57, the Draft GMP identifies approaches that could be used to fund the activities identified within the GMP. While the intent of the approaches is helpful, the proposed funding alternatives are too speculative and could lead the reader to oppose the plan based on financial concerns. It would be more appropriate to identify within the GMP that funding is needed and one of the tasks of the Colusa County Board of Supervisors would be to develop a strategy to secure funding to implement objectives of the GMP.”

A new Plan Implementation Schedule, Table IV.1, has been added to the GMP that shows the need for the Board of Supervisors to develop a strategy for funding the implementation of the GMP.

Fran Borcalli

From: Owens, Chuck [owens@water.ca.gov]
Sent: Monday, July 14, 2008 3:23 PM
To: Kim Venton; shackney@countyofcolusa.org
Cc: Fran Borcalli; Hong, Eric; McManus, Dan; Ehorn, Bill
Subject: RE: Revised Example BMO for Colusa County GMP (W/ ATTACHMENT)
Attachments: Revised-BMO-Draft_8-10-08.doc; RE: Revised Example BMO for Colusa County GMP (W/ ATTACHMENT)

Kim, my comments are attached. Eric Hong's comments below concisely state the big problem.

Chuck,

Doing a quick read on this, the objective itself is unclear. Narrative describes what can happen with high/low groundwater levels and some causes, but not a description on what's to be achieved. The monitoring and actions identified look OK, but what are they to be evaluated against?

Not sure if any of these revisions are new or just reformatting of previous information.

Eric

Chuck Owens, P.G.

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From: Kim Venton [mailto:kventon@woodrogers.com]
Sent: Friday, July 11, 2008 11:08 AM
To: shackney@countyofcolusa.org; McManus, Dan; Owens, Chuck
Cc: Fran Borcalli
Subject: Revised Example BMO for Colusa County GMP (W/ ATTACHMENT)

All,

I am sorry, I didn't attach the file in my original email. Here it is!

--Kim

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Cc: Fran Borcalli
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Hi All,

As a follow-up to our meeting yesterday, please find attached a revised BMO for the Colusa County GMP. I have incorporated the activities from the "Institutional Processes" section of the GMP direction into the BMO, and also expanded the discussion of

9/9/2008

monitoring as it relates directly to the BMO. Please take a look at this and see if it addresses the concerns that we discussed yesterday. Let me know if you have any comments or suggested revisions, and once we come to consensus on the format of the BMO, I will revise the whole set to reflect these changes.

Thanks!

--Kim

Kimberly Venton
Associate - Hydrogeologist

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A. BASIN MANAGEMENT OBJECTIVES

A BMO relates to a physical condition that is affected by the use or management of groundwater. An effective BMO is comprised of the following:

- A specific parameter that can be scientifically measured.
- A clearly defined monitoring program through which data is obtained to assess performance.
- A process with methods for evaluating and reporting the data such that emerging problems can be detected before they become significant or irreversible.
- A process through which emerging problems can be dealt with in advance of significant or irreversible adverse impacts occurring.

The BMOs adopted by Colusa County address the following factors:

"factors"? – they are subjects, not factors. "Objectives" for managing the basin are not identified herein. Webster's defines "objective" as "something toward which effort is directed: an aim, goal, or end of action." WR must identify objectives!

- Groundwater Levels
- Groundwater Quality
- Inelastic Land Subsidence
- Surface Water and Wetlands

A fundamental basis for groundwater management is for groundwater users to acknowledge that they have the capability to adversely impact one another. Protecting against adverse impacts from groundwater pumping is important to meeting the Groundwater Management Goals. [this is good, but needs to be built into BMO parameters, actions, and procedures]

* [name the "many factors" under the relevant BMO or delete this paragraph] Some of these conditions may occur as a result of factors other than groundwater pumping. Nevertheless, the conditions and factors [name them] that may contribute to adverse impacts must be monitored and evaluated on a regular schedule. The BMOs presented herein are qualitative [What are the qualities of each BMO? – none are identified!] at this time and are intended to provide a basis for the Colusa County Groundwater Commission to determine, based on appropriate hydrogeologic principles and other relevant information [what info?], whether adverse impacts from groundwater pumping exist in specific cases. [It is WR's contract task to develop BMOs and monitoring protocols here, now].

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Deleted: It is recognized that the specific conditions that may constitute an "adverse impact" from groundwater pumping depend on *many factors*, and may change over time

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Deleted: The County's groundwater management processes are a critical component of implementing the BMOs. After data have been gathered, compiled and evaluated over a 3 to 4 year period and the groundwater basins underlying the county are better-understood, it may be appropriate to formulate quantitative BMOs.



~~[delete this paragraph]~~ Several of the BMOs include “protecting against and mitigating” certain adverse impacts. Protecting against adverse impacts helps prevent them from occurring in the first place. ~~[What protections? – none are identified. How does merely stating the words “protecting against impacts” prevent them?]~~ However, the concept of mitigation is also important because it recognizes that certain adverse impacts may occur and from a resource management standpoint may be appropriate. Nevertheless, these adverse impacts need to be documented and mitigated. The County’s role with regard to mitigation will not be to actively undertake mitigation to offset the actions of others. The groundwater management processes allow the County to assist in providing a forum for discussing groundwater issues and providing technical review and recommendations to help resolve these issues and disputes. These recommendations may include mitigation to be undertaken by some or all of the involved parties. ~~[Mitigation should not be part of any BMO. Mitigation should be a conclusion the Commission reaches on a case-by-case basis after assigning responsibility for an impact caused by pumping if available data is sufficient to do so.]~~

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1. Groundwater Levels

The BMO for groundwater levels is to **protect against adverse impacts related to groundwater levels**. ~~[must identify protections and impacts to be meaningful]~~ Adverse impacts related to groundwater levels can occur from ~~groundwater levels lowered by pumping~~. What constitutes an excessively high or low groundwater level may change over time, and will also vary by land use and hydrologic and climatic conditions. ~~[baloney ...]~~

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~~[Why should the county care about naturally high GW levels? What GW Management Goal does it accomplish?]~~

Excessively high groundwater levels are problematic in some areas of the county. ~~[what areas – where in the county are high GW levels a problem?]~~ High groundwater levels in Colusa County are often naturally occurring; however, groundwater levels can be raised by application of water to the ground surface through irrigation, surface storage, or recharge projects ~~[has this occurred in Colusa County?]~~. When groundwater levels are near the surface, there is no storage capacity available for recharge, precipitation does not replenish groundwater, and instead is rejected and runs off the land. ~~[This represents a lost opportunity to capture recharge and increase the overall water supply for the county. [not true]~~ Adverse impacts related to high groundwater levels include:

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- Damage to foundations, roads and other infrastructure. ~~[building owner chose the land and what to build – its their problem]~~
- Water-logging the root zone of certain crops. ~~[farmers can grow rice or change land use, in any case, it’s a landowner problem]~~

Groundwater levels decline when pumping exceeds recharge, and rise when recharge exceeds pumping. It is important to note that periodic short-term declines in groundwater levels (during drought periods and/or increased pumping), which are then followed by recovery to at or near historic highs (during wet periods and/or



decreased pumping), are normal and do not necessarily represent overdraft. [Will the county dictate conjunctive use operations to RD108 and GCID?] Adverse impacts related to low groundwater levels due to pumping include:

- Neighbor can't draw from well because GW lowered below his well screen
- Exceeding annual safe yield by excessive pumping that results in overdraft
- Riparian and/or native vegetation habitat destroyed, and loss of aesthetic value, because GW lowered below root zones
- Gaining stream becomes a losing stream because excessive pumping lowers GW level below streambed thereby depriving aquatic life of the baseflow component of streamflow and down-stream water right holders of supplies
- Stream depletion due to pumping nearby hydraulically connected well that takes stream water belonging to riparian water right holders and/or takes water released from a reservoir allocated to down-stream contractors
- Depleted available groundwater supply.
- Inelastic land subsidence.

- a. Monitoring [To be meaningful, must name specific monitoring parameters relative to specific impact criteria (e.g. well screen elevations for first bullet above) to know if the objective is being met and if the BMO is meeting a basin management goal.]

The existing groundwater level monitoring network is described in Section III.C.2.a. Monitoring data will be obtained from the Department of Water Resources Water Data Library to support the BMO actions. [WR must propose monitoring protocols now], to evaluate overall compliance with BMOs. [Comply with what? No objectives or parameters or action triggers are identified in the GMP ...]

Separate, more specific, monitoring plans will be prepared by transfer sponsors for water transfers. [No, sponsors need to provide data for the county to perform evaluations after it hires a water administrator]

- b. BMO Actions

The County's processes with regard to the BMOs are fully described in Section IV.A.3. In summary, the County will take the following actions related to the groundwater level BMO:

- (1) Gather [gather what?? Name the data to be measured and describe analyses required to test if an objective is exceeded or not], Compile, Evaluate and Disseminate Groundwater Information (Public Outreach)

Deleted: By protecting against and mitigating excessively low groundwater levels that are caused by long-term declines without recovery, overdraft can be avoided by reducing pumpage or expanding the conjunctive use with surface water

Deleted: <#>Infrastructure problems when lowered groundwater levels dewater pumps or wells, so groundwater cannot be extracted using existing infrastructure even though it is available at greater depths.¶

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Deleted: When the County is able to develop a formal Groundwater Monitoring Program, as described in Section III.E, specific wells within the existing monitoring network can be identified as "preferred" monitoring locations.

Deleted: Until that time, the Technical Support Team (TST, described in Section IV.A.2) will use water level data from the wells shown in Figure H.5, or alternate nearby wells if appropriate.

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Deleted: These monitoring plans will be reviewed by the TST on a case-by-case basis to ensure that the monitoring locations and frequency are adequate to determine compliance with BMOs and transfer conditions.



[this is too generic/non-specific – each BMO has its own data needs by which to decide if there's an impact or not]

Does all of the following relate to the GW level BMO? Move it to "Proposed Commission Activities" or delete. If the county opts to hire a water administrator, it will be their job to collect and analyze data, and refer issues to the Commission. WR should not try to commit DWR to do work DWR does not budget for – our local assistance is voluntary.

The following activities will be conducted on a semiannual basis at a minimum.

- a. The TST will compile and analyze water level monitoring data, using hydrographs, groundwater elevation contours, and/or other appropriate methods.
- b. The TST will summarize groundwater conditions as they relate to the BMO.
- c. The TST will report its findings to the Groundwater Commission.
- d. The TST will reevaluate the adequacy of the monitoring network and monitoring data. If warranted, the TST will make modifications to the monitoring network.
- e. The Groundwater Commission will disseminate information to the public through newsletters, media coverage, the website, or a noticed public meeting.
- f. Based on the findings of the TST, the Groundwater Commission may refer guidance for consideration by the Planning and Building and/or Environmental Health Departments.

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(2) Receive and Address Groundwater Concerns/Issues

The following activities will be conducted when the TST determines that an issue exists or when a member of the public brings a concern, issue, or dispute directly to the Groundwater Commission.

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- The Groundwater Commission will determine whether to dismiss the issue, refer the issue to another forum, or forward the issue to the TST for further evaluation. The following actions assume the issue is forwarded to the TST.
- The TST will review the issue (including review of relevant monitoring data), assess the issue in relation to the BMOs, and report back to the Groundwater Commission with options and recommendations for dismissal or resolution of the issue.
- The TST will reevaluate the monitoring network in light of the issue, and make modifications as warranted.



- Based on the report of the TST, the Groundwater Commission will determine whether to dismiss the issue, recommend a resolution, and/or assist with mediation among the parties.
- If a conflict exists among parties, the Groundwater Commission will facilitate the evaluation of the issue on a technical basis, recommend or suggest potential solutions, and help the parties come to a resolution. The intent of this process is to work to resolve issues without legal action.

(3) Evaluate Water Supply Assessment and Development Proposals

The following activities will be conducted when the Planning and Building Department forwards development proposals and Water Supply Assessments to the Groundwater Commission.

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- The TST will review the proposals/assessments in relation to groundwater conditions and for consistency with BMOs.
- The TST will review Water Supply Assessments for technical accuracy, completeness, and consistency with BMOs.
- The TST will prepare summaries and guidance and will report back to the Groundwater Commission.
- The Groundwater Commission will issue guidance to the Planning and Building Department.

(4) Process Proposals for Water Transfers

The following activities will be conducted for all proposed water transfers within or outside the county

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- The transfer sponsor will file a Notice of Intent (NOI) with the Groundwater Commission. If the NOI does not appear to have any "fatal flaws", the Groundwater Commission will request that the transfer sponsor submit a Transfer Plan that includes general information about the proposed monitoring and mitigation program.
- The TST will evaluate the Transfer Plan in relation to BMOs and will recommend initial approval of or revisions to the Transfer Plan. The Groundwater Commission will take the input of the TST into consideration and will request revisions to the Transfer Plan or grant initial approval of the plan and request that the transfer sponsor submit a detailed Transfer Proposal and any required CEQA documentation.
- The TST will confirm compliance of the Transfer Proposal with the GMO and BMOs. The TST will provide the Groundwater Commission with recommendations for conditional acceptance or revision of the Transfer Proposal. The Groundwater Commission will conditionally accept the Transfer Proposal or request that the transfer sponsor make modifications.



- Once the Transfer Proposal is conditionally accepted, the water transfer may proceed.
- During the water transfer, the Groundwater Commission will enforce the conditions of the transfer, and will have the authority to modify or suspend the transfer at any time to comply with BMOs.
- The transfer sponsor will conduct monitoring as specified in the Transfer Proposal and will be required to submit monitoring data to the TST in a timely manner. The TST will determine if the transfer is proceeding in compliance with the transfer conditions and the BMOs. The TST will report these findings to the Groundwater Commission. If the transfer is out of compliance with the transfer conditions or BMOs, the TST will make recommendations to the Groundwater Commission for modification or suspension of the water transfer. The monitoring, submittal, and evaluation of monitoring data will be frequent enough to allow the Groundwater Commission to promptly address non-compliance.
- Taking into consideration the findings and recommendations of the TST, the Groundwater Commission will allow the transfer to continue, require modification to the transfer, or require suspension of the transfer.



Fran Borcalli

From: McManus, Dan [mcmanus@water.ca.gov]
Sent: Tuesday, July 15, 2008 7:51 AM
To: Owens, Chuck; Kim Venton; shackney@countyofcolusa.org
Cc: Fran Borcalli; Hong, Eric; Ehorn, Bill
Subject: RE: Revised Example BMO for Colusa County GMP (W/ ATTACHMENT)

Attachments: Revised-BMO-Draft_8-10-08_dan edits_2.doc



Revised-BMO-Draft
_8-10-08_dan ...

After the last meeting, we agreed that WR would take one of the BMOs and reformat the GMP text so that the BMO description, actions and process for implementation would be brought together for the reader, rather having to step through them separately. I'm assuming that the objectives and goals would still be listed at the beginning of the plan as in the May draft. I'm also assuming that, following the Groundwater Level BMO section, there would be additional sections explaining each of the remaining BMO's. However, in order to avoid redundancy in the action/implantation portion, it may be necessary to just highlight the differences for the subsequent BMOs.

I haven't had a chance to read Chuck's comments, but overall, I like the new format and I think, with an implementation schedule and clear description of the relationship between the new GMP and the existing ordinance, it is a workable plan. I have made some suggested edits that I think could help clarify some points...use as you see fit.

I will likely be away from my email for the next several days but I'm open to discuss things further via a conference call or meeting when I get back.

Dan

-----Original Message-----

From: Owens, Chuck
Sent: Mon 7/14/2008 3:22 PM
To: 'Kim Venton'; shackney@countyofcolusa.org
Cc: Fran Borcalli; Hong, Eric; McManus, Dan; Ehorn, Bill
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Doing a quick read on this, the objective itself is unclear. Narrative describes what can happen with high/low groundwater levels and some causes, but not a description on what's to be achieved. The monitoring and actions identified look OK, but what are they to be evaluated against?

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Thanks!

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Associate - Hydrogeologist

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A. BASIN MANAGEMENT OBJECTIVES

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- A specific parameter that can be scientifically measured.
- A clearly defined monitoring program through which data is obtained to assess performance.
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- A process through which emerging problems can be dealt with in advance of significant or irreversible adverse impacts occurring.

The BMOs adopted by Colusa County address the following parameters:

- Groundwater Levels
- Groundwater Quality
- Inelastic Land Subsidence
- Surface Water and Wetlands

Comment [Dan1]: Above we refer to BMO parameters... it would be good to keep the consistency

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A fundamental basis for groundwater management is for groundwater users to acknowledge that, working together to identify and implement a clear set of management goals and objectives, they have a greater capacity to sustain the resource and limit impacts to one another. Protecting against and mitigating adverse impacts from groundwater pumping is important to meeting the Groundwater Management Goals.

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It is recognized that the specific conditions that may constitute an “adverse impact” from groundwater pumping depend on many factors, and may change over time. Some of these conditions may occur as a result of factors other than groundwater pumping. Nevertheless, the conditions and factors that may contribute to adverse impacts must be monitored and evaluated on a regular schedule. The BMOs presented herein are qualitative at this time and are intended to provide a basis for the Colusa County Groundwater Commission to determine, based on appropriate hydrogeologic principles and other relevant information, whether adverse impacts from groundwater pumping exist in specific cases. The County’s groundwater management processes are a critical component of implementing the BMOs. After data have been gathered, compiled and evaluated over a 3 to 4 year period, and the groundwater basins underlying the county are better-understood, it may be appropriate to formulate quantitative BMOs.

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Comment [Dan2]: I think this sentence brings up a good point, but I think the short-term vs long-term aspect needs to be presented so that people don't get the wrong idea that somehow long-term impacts could be appropriate.

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Comment [Dan3]: It is a little unclear to me what “actively undertake” means. Are you trying to say that the County will not...actively establish and administer the mitigation process? If so, it seems like this is an important aspect and it needs to be more clearly worded.

1. Groundwater Levels

The BMO for groundwater levels is to **protect against and mitigate adverse impacts related to groundwater levels**. Adverse impacts related to groundwater levels can occur from excessively high or low groundwater levels. What constitutes an excessively high or low groundwater level may change over time, and will also vary by land use and hydrologic and climatic conditions.

Excessively high groundwater levels are problematic in some areas of the county. High groundwater levels in Colusa County are often naturally occurring; however, groundwater levels can also be raised by application of water to the ground surface through irrigation, surface storage, or recharge projects. When groundwater levels are so high that there is no storage capacity available for recharge, precipitation does not replenish groundwater, rather it runs off the land and into surface water systems as rejected source of groundwater recharge. This represents a lost opportunity to capture recharge and increase the overall water supply for the county. Adverse impacts related to high groundwater levels include:

Comment [Dan4]: Just a suggestion for rewording...I'm not sure it is any better.

Deleted: and instead is rejected and runs off the land.

- Damage to foundations, roads and other infrastructure.
- Water-logging the root zone of certain crops.

Groundwater levels decline when pumping exceeds recharge, and rise when recharge exceeds pumping. It is important to note that periodic short-term declines in groundwater levels (during drought periods and/or increased pumping), which are then followed by recovery to at or near historic highs (during wet periods and/or decreased pumping), are normal and do not necessarily represent overdraft. By protecting against and mitigating excessively low groundwater levels that are caused by long-term declines without recovery, overdraft can be avoided by reducing pumpage or expanding the conjunctive use with surface water. Adverse impacts related to low groundwater levels include:

- Infrastructure problems when lowered groundwater levels dewater pumps or wells, so groundwater cannot be extracted using existing infrastructure even though it is available at greater depths.
- Depleted available groundwater supply.



- Inelastic land subsidence.
- Reduced surface water flows due to increases in streambed infiltration, or increases in the capture of groundwater that otherwise would have contributed to increasing the base flow of a surface water system.

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a. Monitoring

The existing groundwater level monitoring network is described in Section III.C.2.a. Monitoring data will be obtained from the Department of Water Resources Water Data Library to support the BMO actions. When the County is able to develop a formal Groundwater Monitoring Program, as described in Section III.E, specific wells within the existing monitoring network can be identified as “preferred” monitoring locations. Until that time, the Technical Support Team (TST, described in Section IV.A.2) will use water level data from the wells shown in Figure II.5, or alternate nearby wells if appropriate, to evaluate overall compliance with BMOs.

Separate, more specific, monitoring plans will be prepared by transfer sponsors for water transfers. These monitoring plans will be reviewed by the TST on a case-by-case basis to ensure that the monitoring locations and frequency are adequate to determine compliance with BMOs and transfer conditions.

b. BMO Actions

The County’s processes with regard to the BMOs are fully described in Section IV.A.3. In summary, the County will take the following actions related to the groundwater level BMO:

(1) Gather, Compile, Evaluate and Disseminate Groundwater Information (Public Outreach)

The following activities will be conducted on a semiannual basis at a minimum.

- a. The TST will compile and analyze water level monitoring data, using hydrographs, groundwater elevation contours, and other appropriate methods as needed.
- b. The TST will summarize groundwater conditions as they relate to the BMO.
- c. The TST will report its findings to the Groundwater Commission.
- d. The TST will reevaluate the adequacy of the monitoring network and monitoring data. If warranted, the TST will make modifications to the monitoring network.
- e. The Groundwater Commission will disseminate information to the public through newsletters, media coverage, the website, or public meeting.

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f. Based on the findings of the TST, the Groundwater Commission may recommend actions for consideration by the Planning and Building, and/or Environmental Health Departments.

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(2) Receive and Address Groundwater Concerns/Issues

The following actions will be conducted when the TST determines that an issue exists or when a member of the public brings a concern, issue, or dispute directly to the Groundwater Commission.

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- The Groundwater Commission will determine whether to dismiss the issue, refer the issue to another forum, or forward the issue to the TST for further evaluation. The following actions assume the issue is forwarded to the TST.
- The TST will review the issue (including review of relevant monitoring data), assess the issue in relation to the BMOs, and report back to the Groundwater Commission with options and recommendations for dismissal or resolution of the issue.
- The TST will reevaluate the monitoring network in light of the issue, and make modifications as warranted.
- Based on the report of the TST, the Groundwater Commission will determine whether to dismiss the issue, recommend a resolution, and/or assist with mediation among the parties.
- If a conflict exists among parties, the Groundwater Commission will facilitate the evaluation of the issue on a technical basis, recommend or suggest potential solutions, and help the parties come to a resolution. The intent of this process is to work to resolve issues without legal action.

(3) Evaluate Water Supply Assessment and Development Proposals

The following activities will be conducted when the Planning and Building Department forwards development proposals and Water Supply Assessments to the Groundwater Commission.

- The TST will review the proposals/assessments in relation to groundwater conditions and for consistency with BMOs.
- The TST will review Water Supply Assessments for technical accuracy, completeness, and consistency with BMOs.
- The TST will prepare summaries and guidance and will report back to the Groundwater Commission.
- The Groundwater Commission will issue guidance to the Planning and Building Department.

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(4) Process Proposals for Water Transfers



The following activities will be conducted for all proposed water transfers within or outside the county

- The transfer sponsor will file a Notice of Intent (NOI) with the Groundwater Commission. If the NOI does not appear to have any “fatal flaws”, the Groundwater Commission will request that the transfer sponsor submit a Water Transfer Plan that includes general information about the proposed monitoring and mitigation program.
- The TST will evaluate the Water Transfer Plan in relation to BMOs and will recommend initial approval of or revisions to the Water Transfer Plan. The Groundwater Commission will take the input of the TST into consideration and will request revisions to the Water Transfer Plan, or grant initial approval of the plan and request that the transfer sponsor submit a detailed Water Transfer Proposal and any required CEQA documentation.
- The TST will confirm compliance of the Water Transfer Proposal with the GMO and BMOs. The TST will provide the Groundwater Commission with recommendations for conditional acceptance or revision of the Transfer Proposal. The Groundwater Commission will conditionally accept the Water Transfer Proposal or request that the transfer sponsor make modifications.
- Once the Water Transfer Proposal is conditionally accepted, the water transfer may proceed.
- During the water transfer, the Groundwater Commission will enforce the conditions of the transfer, and will have the authority to modify or suspend the transfer at any time to comply with BMOs.
- The transfer sponsor will conduct monitoring as specified in the Water Transfer Proposal and will be required to submit monitoring data to the TST according to a schedule that allows for adequate review and response in a timely manner. The TST will determine if the transfer is proceeding in compliance with the transfer conditions and the BMOs. The TST will report these findings to the Groundwater Commission. If the transfer is out of compliance with the transfer conditions or BMOs, the TST will make recommendations to the Groundwater Commission for modification or suspension of the water transfer. The monitoring, submittal, and evaluation of monitoring data will be frequent enough to allow the Groundwater Commission to promptly address non-compliance.
- Taking into consideration the findings and recommendations of the TST, the Groundwater Commission will allow the transfer to continue, require modification to the transfer, or require suspension of the transfer.

Comment [Dan5]: It may seem obvious, but I think it would be good to be specific and refer to it as a Water Transfer Plan.

Comment [Dan6]: I'm not sure where this abbreviation has been spelled out in the document, but it may be appropriate to spell it out again in this section to avoid any confusion.

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Comment [Dan7]: I'm assuming that this next section would be a continuation of the other BMO's (monitoring, actions, ect.) but with a more abbreviated action section, or reference to the process used for the above GW Level BMO action process.

