# Agricultural Water Management Plan

Prepared Pursuant to Water Code Section 10826

**Corcoran Irrigation District**
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Adopted on August 11, 2015

Prepared by:
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Consulting Engineers
Hanford California

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# Section I: Introduction

## A. Description of Previous Water Management Activities

Corcoran Irrigation District (CID or District) is located within a closed hydrologic basin, which by its nature, requires precise control of water applications. Previous water management activities include metered water deliveries, tailwater recirculation, and conjunctive groundwater use. These activities are continued in this Agriculture Water Management Plan (AWMP).

## B. Coordination Activities

1. Notification of AWMP Preparation
   A Notice of Preparation of this AWMP was sent on June 9, 2015 to the City of Corcoran, Kings County, Tulare Lake Drainage District, and Tulare Lake Water Storage District, Tulare Irrigation District, and Kaweah Delta Water Conservation District. A copy of the Notice of Preparation is included in Appendix A.

2. Public Participation
   Notice of a public hearing about the proposed adoption of this AWMP was published in the Hanford Senitnel on July 25, 2015 and August 1, 2015. No written comments were received from the public about this AWMP. A public hearing to receive comments on the AWMP was held on August 11, 2015. No member of the public attended the meeting and no public comments were received.

## C. AWMP Adoption and Submittal

1. AWMP Adoption
   A copy of the signed resolution adopting this AWMP is included in Appendix A.

2. AWMP Submittal
   On August 18, 2015, copies of the Adopted AWMP were mailed to:
   The Kings County Library
   The California State Library
   Department of Water Resources
   The Kings County Local Agency Formation Commission

3. AWMP Availability
   Copies of this AWMP are available from the District upon request.

## D. AWMP Implementation Schedule

See Section VII for the Implementation Schedule.

# Section II: Description of the Agricultural Water Supplier and Service Area

## A. Physical Characteristics

1. Size of the service area.

The District was created in July of 1919 to provide irrigation water to agricultural lands within its boundaries. CID has a gross acreage of approximately 48,500 acres, which includes active agriculture, rural residences, and reservoirs. The District's assessed acreage is approximately 43,900 acres, of which approximately 38,000 acres is irrigable agriculture.

2. Location of the service area and water management facilities.

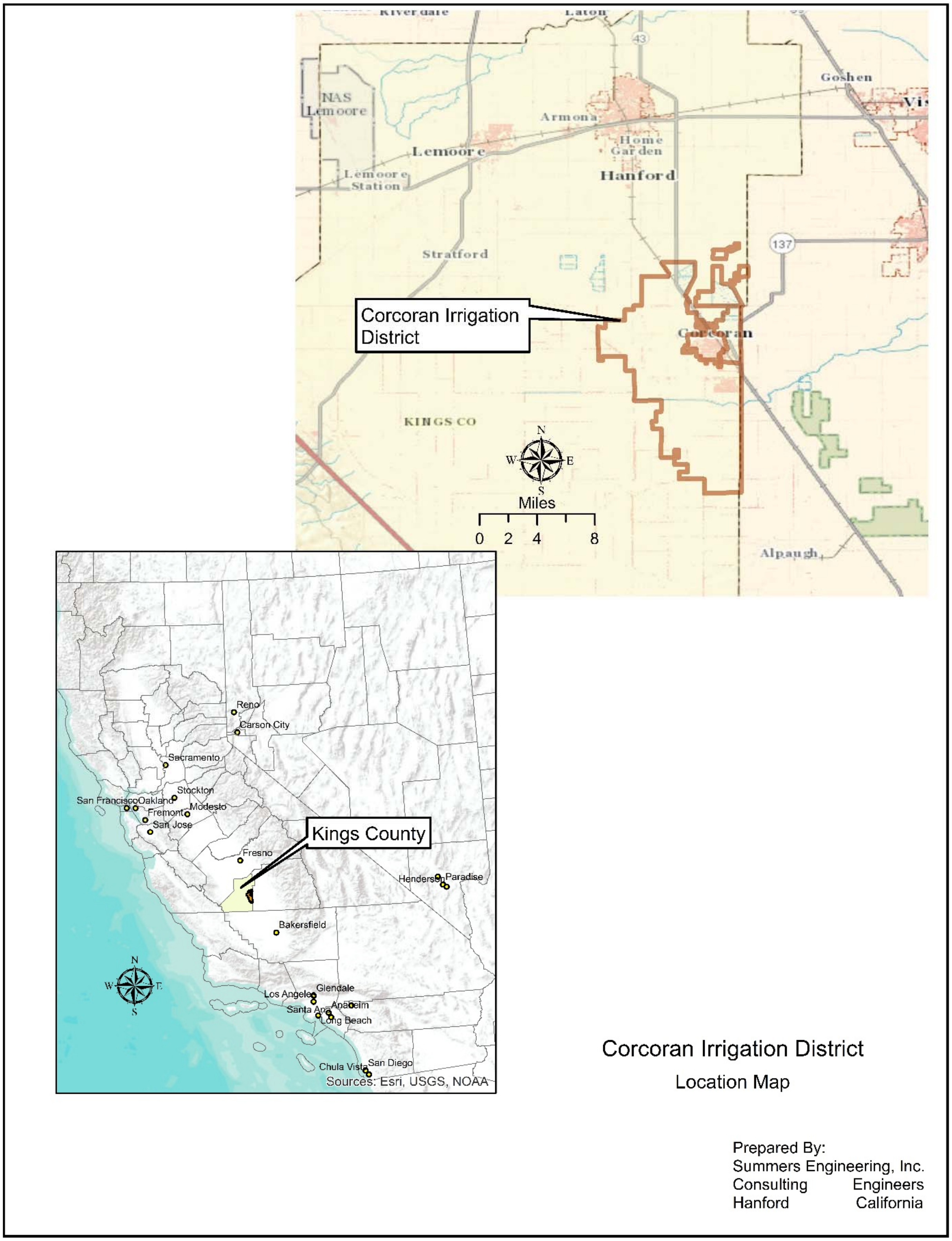
CID is located in the Central San Joaquin Valley of California (see Figure 1). It surrounds the City of Corcoran in south eastern Kings County. Figure 2 shows the District service area and principal irrigation facilities.

Irrigation facilities within the District include approximately 118 miles of canals and 2 miles of pipeline. The District operates three reservoirs with a total capacity of 8,000 acre feet. These reservoirs are located at the northerly end of the district and are used to provide operational storage and delivery flexibility. CID owns and operates 76 wells, which pump into the reservoirs to contribute to the District's water supply. The volume of groundwater pumped varies from year to year depending on the availability of surface water supplies. This is discussed in more detail in Section III.

3. Terrain and soils

The District is located within the Northeast portion of the historic Tulare Lake Bed region. The topography of the District slopes gradually in a southwesterly direction from the District's outer northeasterly boundary towards the lowest region in the Tulare Lake Bed which is just to west of the District westerly boundaries. The lowest region within the Tulare Lake Bed is approximately 173 feet above mean sea level (MSL) and the elevation in the most north easterly portion of the District is approximately 227 feet above MSL. The City of Corcoran is at an approximate elevation of 205 MSL. The generally flat terrain has an average north-south slope of about 1.8 feet per mile and an east-west average slope of approximately 2.8 feet per mile. The District abuts the "closed" Tulare Lake Bed which has no natural outlet. It is important to note that no natural outflow from the historic Tulare Lake has occurred since the late 1870's. This is a result of the upstream diversions on the eastside of

**Figure 1.**


Riverdale
Laton
Goshen
NAS
Lemoore
Armona
Lemoore
Home
Garden
Lemoore
Station
Hanford
Stratford
Corcoran Irrigation District
Corcoran
KINGS CO
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0 2 4 8
Alpaugh
Reno
Carson City
Sacramento
Stockton
San Francisco
Oakland
Modesto
Fremont
San Jose
Kings County
Fresno
Henderson
Paradise
Bakersfield
Glendale
Los Angeles
Santa Ana
Anaheim
Long Beach
Chula Vista
San Diego
Sources: Esri, USGS, NOAA
Corcoran Irrigation District
Location Map
Prepared By:
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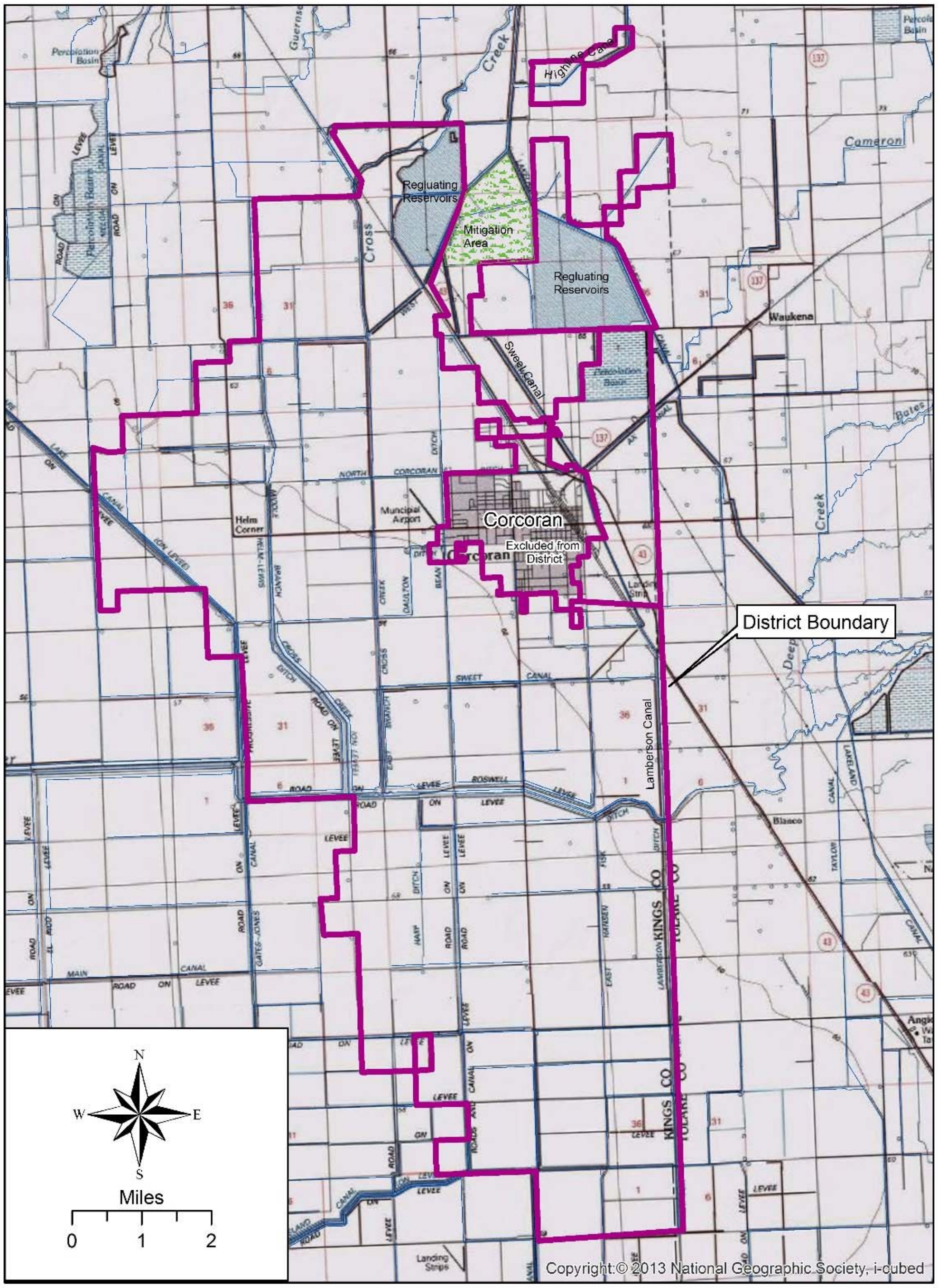
**Figure 2.**




Corcoran Irrigation District

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the San Joaquin Valley from the Kings, Kaweah, Tule Rivers and the Kern River to the south. It is also a result of the U.S. Army Corps of Engineers flood control projects on the tributaries. However, periodic flood waters still flow in roughly 1 out of every 7 years into the Tulare Lake Bed west of the District boundary.

The District encompasses soils that are primarily poorly drain clays and clay/loam type soils. The Corcoran Clay is an impermeable hydrologic barrier that ranges from 400 to 600 feet below the surface. The clay layer ranges in thickness from 50 to 200 feet. Recharge above the Corcoran Clay is possible, but the Corcoran Clay, prevents any economically feasible attempt to directly recharge the aquifer below the Corcoran Clay within the District boundary. Groundwater found in the southwesterly portion of the District is typically unusable due to the high concentrations of salts and heavy impermeable soils.

4. Climate

The climate in the region is typical of the southern San Joaquin Valley. The Tulare Lake Bed region is semi-arid. Average annual rainfall is 7.1 inches. Spring seasons are usually mild with some wind, summers hot and dry, autumns cool and brisk, and winter seasons are typically characterized by fog and rain with temperatures seldom reaching the freezing point. Average precipitation and maximum and minimum temperatures were measured at the District office.

Table 1 indicates average monthly precipitation from 1940 to 2014. Monthly rainfall ranges from 0.0 to about 1.15 inches. About 70% of the rainfall typically occurs between the months of December to March. Maximum and minimum average monthly temperatures are listed in Table 2.

**Table 1: Average Monthly Precipitation – 1940 to 2014**

| Month | Average Monthly Precipitation |
|---|---|
| January | 1.39 |
| February | 1.32 |
| March | 1.15 |
| April | 0.70 |
| May | 0.23 |
| June | 0.06 |
| July | 0.01 |
| August | 0.01 |
| September | 0.14 |
| October | 0.31 |
| November | 0.70 |
| December | 1.06 |
| Total: | 7.07 |

Source: NOAA National Climate Data

**Table 2: Average Temperatures.**

| Month | Average High | Average Low | Monthly Average |
|---|---|---|---|
| | (ºF) | (ºF) | (ºF) |
| January | 54.9 | 36.1 | 45.5 |
| February | 61.8 | 39.3 | 50.5 |
| March | 68.2 | 42.4 | 55.3 |
| April | 75.9 | 46.3 | 61.1 |
| May | 85.4 | 52.5 | 69.0 |
| June | 93.0 | 58.4 | 75.7 |
| July | 99.1 | 63.3 | 81.2 |
| August | 97.2 | 61.7 | 79.4 |
| September | 91.5 | 57.2 | 74.3 |
| October | 80.9 | 49.1 | 65.0 |
| November | 66.2 | 40.3 | 53.3 |
| December | 55.5 | 35.9 | 45.7 |

Source: NOAA National Climate Data Center

As reflected in Table 2, the 74-year average maximum and minimum temperatures occur respectively during July and December

## B. Operational Characteristics

1. Operating rules and regulations

A copy of the District's Rules and Regulations are included in Appendix B. The purpose of these rules is to provide guidance to the District Manager and staff for the economic and equitable service of water to all of the water users within CID. They outline the whole process for ordering, delivering, measuring, and billing for water. Some key points of the regulations are listed below:

- Water deliveries must be requested by the water user 48 hours in advance of delivery need.
- Water allocation is based on the water user's irrigated acreage as a percentage of the total District acreage. This provides an equitable allocation of water (on a per-acre basis) to all water users.
- Flow meters are required at all pumps and gravity turnouts.
- The District reserves the right to refuse water delivery to water users wasting or improperly using water.

2. Water delivery measurements or calculations

All water delivery points within CID are meter with propeller type flow meters. The majority of water deliveries (>90%) within CID are made through mobile pump units. These pump turnouts are mobile, high-flow pump units with propeller meters incorporated into the discharge manifold to totalize delivered water. The pump units are owned, operated and maintained by the respective water user, however their operation is contingent on a correctly installed and operating flow meter, which CID staff check daily during operation.

The remaining gravity turnouts discharge water deliveries through a pipe section with an open flow meter to measure delivered water. All flow meters are factory certified to be within 5% accuracy. All meter installations are inspected by District Staff on a rotating basis. In the case where meters are broken or installed incorrectly, the District will withhold water deliveries until the meter is fixed or installation is corrected. It is the obligation of the water user to maintain and replace the flow meter as necessary.

3. Water rate schedules and billing

District Staff reads each turnout meter daily and uses the readings to calculate delivered water and the associated water bill. District billing is on a per Acre-foot basis with the water fee, comprising of the cost of water, conveyance, and other operations and maintenance costs. The water rate changes on an annual basis according to available surface water supplies. Water users are billed monthly for the delivered water.

4. Water shortage allocation policies – Drought Management Plan.

The Water shortage allocation policy is incorporated into the District's Rules and Regulations for the Rotation and Delivery of water (see Appendix B). The water volume delivered to each water user is based on both the percentage of that water user's land compared to the whole of CID as well as the total available water. The District has developed a Drought Management Plan Process which is applied in all years but becomes a crucial part of water supply planning during drought conditions.

**Drought Management Plan Process:**

- <u>Early Planning:</u> Early forecasts of likely surface water supplies are reviewed by the District Water Conservation Coordinator in late December and early January. The Water Conservation Coordinator uses this information along with known groundwater supplies to predict the total water available. The District then shares that information with water users so that they may begin planning for the year.
- <u>Supply Update:</u> A new surface water supply forecast is typically available in March, with allows the Water Conservation Coordinator to revise the water supply estimate and update water users. In extremely dry years, water users will modify their planting decisions to account for the reduced water supply. These modifications can include field fallowing or changes in crop selection to crops that require less water.
- <u>Growing Season Operations:</u> During the growing season, District Staff carefully account for all water delivered and scrutinize District water delivery operations and grower water use. Any operations that result in water waste are quickly corrected.

# Section III:  Description of Quantity of Water Uses

## A.  Agriculture Water Use

All water use within CID is for agricultural purposes.  The District water supplies come from the Kings and Kaweah Rivers and groundwater.  The current water allocation from the Kings River is based upon Kings River Water Association Administrative Agreements and allocation from the Kaweah River is based on Kaweah & St. Johns River Association Agreements.  The Kings River water allocations for CID are reliable and provide a water supply in most years.  The Kaweah River water allocations are typically only available during high-flow periods. The District's allocation is, in turn, allocated among its water Users based upon each of their respective owned/operated lands as a percent of the District's total acreage. Water users are required to make delivery requests 48 hours in advance due to the time it takes for water to flow from Pine Flat Dam to the District.  When water demand exceeds supply, water may be allocated based on a percentage of the supply and the water user District acreage farmed.  Table 3 shows the monthly deliveries by CID along with total annual surface and groundwater deliveries in terms of the 2006 to 2014 average, a wet year example (2011), a dry year example (2013), and a critically dry year example (2014).

**Table 3: Irrigation Deliveries**

| | 2006-2014 Average Total Deliveries (acre feet) | Wet Year (2011) Total Deliveries (acre feet) | Dry Year (2013) Total Deliveries (acre feet) | Critical Year (2014) Total Deliveries (acre feet) |
|---|---|---|---|---|
| January | 5,231 | 2,737 | 6,494 | 8,406 |
| February | 3,646 | 1,581 | 6,719 | 2,518 |
| March | 5,549 | 4,382 | 7,128 | 4,050 |
| April | 6,123 | 6,216 | 8,084 | 5,784 |
| May | 7,008 | 5,905 | 6,398 | 5,257 |
| June | 12,548 | 10,340 | 14,598 | 12,676 |
| July | 14,018 | 14,511 | 15,234 | 14,188 |
| August | 13,624 | 14,402 | 13,388 | 12,221 |
| September | 5,084 | 4,654 | 4,134 | 2,943 |
| October | 2,382 | 1,193 | 3,469 | 2,780 |
| November | 1,790 | 631 | 3,423 | 1,975 |
| December | 4,616 | 6,259 | 6,628 | 3,573 |
| Total | 81,619 | 72,811 | 95,695 | 76,371 |
| Groundwater | 50,819 | 6,595 | 69,181 | 62,892 |
| Surface Water* | 30,801 | 66,216 | 26,513 | 13,479 |

* Includes recirculated tailwater.

During wet periods, there is typically a large amount of surface water from the Kings and Kaweah rivers available to CID, and little groundwater is required to meet irrigation demands. This is demonstrated by the Wet Year example, where groundwater made up only 5% of the total deliveries. During these wet periods, excess surface water is impounded in the District reservoirs and used to recharge their groundwater supplies for future use.

During dry periods, a much smaller volume of surface water is available, so CID relies on groundwater to meet irrigation demands. As is demonstrated by the Critically Dry year example, groundwater can make up more than 50% of the supplied irrigation water during these dry periods.

**Irrigation Methods and Cropping.**

More than 90% of the crops grown within CID are field or truck crops, most notably cotton and alfalfa, which made up 36% and 16% (respectively) of the 2013 water year. About 6% of the District is planted to permanent crops, including pistachios, olives, and grapes. Table 4 shows the 2013 crops.

**Table 4: 2013 Cropping Pattern**

| Crop | 2013 Planted Acres | % of Acres Planted |
|---|---|---|
| Alfalfa | 6,108 | 16% |
| Corn | 2,463 | 7% |
| Cotton | 13,595 | 36% |
| Grapes | 152 | 0% |
| Lettuce seed | 100 | 0% |
| Olives | 70 | 0% |
| Pistachios | 2,214 | 6% |
| Safflower | 210 | 1% |
| Tomatoes | 1,167 | 3% |
| Wheat | 11,797 | 31% |
| Fallow | 0 | 0% |
| Total: | 37,876 | |

Approximately 90% of the cropped acreage within CID is irrigated with conventional irrigation methods such as furrow or flood. The notable exceptions to this are the trees, which are irrigated with micro-sprinklers or surface drip, and the tomatoes which are irrigated with buried drip systems. CID expects to see a growth in the use of high-efficiency irrigation systems (such as drip) in the future.

It should be noted that CID does not control what crops are planted or how they are irrigated.  Those decisions are made by the growers based on a variety of factors, including international market demand, water supply, and crop rotation schedules.

### B.  Environmental Water Use

Through an agreement with Kaweah Delta Water Conservation District and the U.S. Army Corps of Engineers, CID maintains approximately 1,064 acres of shore bird habitat near the northerly end of the District between the East and West branches of the Lakeland Canal (see Figure 2).  This area only receives excess flood waters and is therefore only irrigated during wet years.  When the water is available, up to 2,150 acre feet can be delivered and that water is retained to support the habitat for a minimum of 30 days.

### C.  Recreational Water Use

None of the District's water supply is dedicated to recreational water use.

### D.  Municipal and Industrial Use

None of the District's water supply is dedicated to municipal or industrial water use.

### E.  Groundwater Recharge Use

Although groundwater supplies are an important component of the District's overall water allocation, there is no set volume or percentage of the surface supplies dedicated to groundwater recharge.  During periods of above normal runoff, surface supplies from the Kings and/or the Kaweah Rivers can be diverted to the District's reservoirs to recharge the upper groundwater aquifer (above the Corcoran Clay).  Additional recharge occurs incidentally from the unlined canals operated by the District. Additionally during wet periods, CID water users will avoid using groundwater, allowing the aquifers to recharge naturally.

### F.  Transfer and Exchange Use

While water transfers are not a typical part of CID operations, the District will occasionally enter into water transfer agreements with nearby water agencies.  These transfers are usually initiated to take advantage of delivery timing, to minimize system losses and to optimize water use.  Growers may also transfer water into or out of the District.  These types of transfers typically move water from a grower's land within CID to that same grower's land outside of the District.  Out of basin transfers are not authorized by the District.

### G.  Other Water Use

There are no other water uses within CID.

# Section IV: Description of Quantity and Quality of the Water Resources of the Agricultural Water Supplier

## A. Water Supply Quantity

The District's water supply consists of surface water supplied through the Kings and Kaweah rivers and local groundwater pumped into the District's irrigation system. Table 5 shows the 2006 to 2014 water deliveries from CID including the groundwater and surface water components.

**Table 5: Water Deliveries**

| Year | Surface Supplies | Groundwater Supplies | Est. Recirculated Tailwater* | Total Deliveries |
|---|---|---|---|---|
| 2006 | 58,060 | 12,697 | 1,411 | 72,168 |
| 2007 | 1,213 | 77,287 | 8,587 | 87,088 |
| 2008 | 0 | 71,425 | 7,695 | 79,120 |
| 2009 | 10,538 | 73,344 | 8,149 | 92,031 |
| 2010 | 37,462 | 26,702 | 2,967 | 67,132 |
| 2011 | 65,483 | 6,595 | 733 | 72,811 |
| 2012 | 28,556 | 57,244 | 6,360 | 92,160 |
| 2013 | 18,826 | 69,181 | 7,687 | 95,695 |
| 2014 | 6,491 | 62,892 | 6,988 | 76,371 |

* Estimated recirculated tailwater is calculated from groundwater adjusted for reservoir losses and total delivered volume.

1. Surface Water Supply

The District's surface water supplies consist of water rights on the Kings and Kaweah Rivers. The Kings and Kaweah Rivers originate in the southern Sierras east of the District. These two rivers are regulated by dams constructed by the US Army Corps of Engineers in the 1950's and 1960's. The Kings River is the primary local river water supply for the District. The District's Kaweah River water rights are primarily high-flow water rights and deliveries from that system tend to have excessive channel losses to the District. During extremely wet years, floodwaters from these two rivers along with the Tule and Kern Rivers will inundate lands within the Tulare Lake Bed. Flooding of cropland occurs on the average of one out of every seven years. During extreme flooding periods, flood flows will enter the Tulare Lake Bed, not only from the principal rivers mentioned, but also from uncontrolled streams such as Deer Creek, Poso Creek, White River, and runoff from the west side of the San Joaquin Valley. The District is able to use some of the residual floodwaters in Tulare Lake Bed for irrigation. The balance of these waters is lost to evaporation and aquifer recharge.

The Kings River water supplies are a reliable source of surface water to the District, and even in critically dry year types, some water from this system is available to CID.

The Kaweah River water supplies available under the District's water rights are more erratic in nature and the volume available to CID changes from year to year. In dry years, little to no water from the Kaweah system is available to CID. During above-normal or wet years, the lack of reservoir capacity on the four major rivers on the east side of the Tulare Lake Bed results in flood releases from each of the respective reservoirs. Since the Tulare Lake Bed is a closed basin, inundation of cropland leads to decreased demand for surface waters. More surface reservoir capacity would provide greater storage for irrigation deliveries in subsequent years. It would also result in less groundwater pumping in a below-normal year by having more stored water for delivery.

The District has three existing surface storage reservoirs.At this time it is preparing a Reservoir Master Plan to further improve and optimize its ability to store, recharge the aquifer above the Corcoran Clay, and improve its ability to efficiently deliver the additional water available during years of above normal water supply runoff.

2. Groundwater Supply

The District is located within the southern portion of the Tulare Lake Subbasin (TLS) in Subbasin number 5-22-12 of the San Joaquin Valley Groundwater Basin, as detailed in the Department of Water Resources Bulletin 118, January 2006 Update. The TLS consists essentially of a shallow aquifer and a deep aquifer separated by the Corcoran Clay hydrogeologic barrier. The Corcoran Clay is located about 500 to 600 feet below the ground surface and ranges in thickness from about 75 to 150 feet within the central portion of the District. Flood basin deposits within the western portion of the District are relatively impermeable silt and clay with some interspersed silty sand lenses. Extending to the east the shallow surface soils include an increased percentage of silty sand layers with increasing permeability. The deeper, relatively impermeable Corcoran Clay prevents any opportunity to directly recharge the lower aquifer below the Corcoran Clay, and the shallow flood basin deposits of impermeable silts and clays prevent any feasible attempt to directly recharge the shallow aquifers above the Corcoran Clay west of Highway 43.

Due to the saline soils located on the periphery of the historic Tulare Lake, shallow groundwater lying beneath the vast majority of District lands southwest of Highway 43 is not usable. The District owns and operates 76 groundwater wells. District wells are located northeast of Highway 43 in the northeastern portion of the District. Groundwater pumped from the District well field is discharged into District canals and then into operational reservoirs for storage and then conveyed through the District canal systems to its water users.

In 1995, the District and several other public entities and private landowners located within and around the Tulare Lake Bed area joined together to establish the Tulare Lake Bed Coordinated Groundwater Management Plan under the provisions of AB 3030 chaptered in 1992. In July 2012 under the provisions of SB 1938, a Compliant Groundwater Management Plan ("Plan") was adopted. A copy of the current Plan is included in Appendix C. The principle purposes of the Plan are to coordinate and preserve local management of the groundwater resources and document the long-standing groundwater management practices and programs of the local landowners. Many of the entities do not have groundwater wells but many do. The Plan focuses on conjunctive management of area surface water supplies and groundwater by the different water users to enhance the groundwater resources. There is an emphasis on on-farm management and the desire to effectively manage and improve water delivery efficiency and reduce the need for groundwater pumping when surface supplies are limited in dry years. The Plan participants publish an annual report. The Plan describes ongoing efforts supporting the groundwater resources which in some years have included purchasing surface water and recharging areas on the east side of the District

3. Other Water Supplies

The District is also active in water exchange programs to more efficiently manage its Kings and Kaweah River water supplies. The District has surface storage reservoirs with a combined maximum capacity of 8,000 acre feet. A Reservoir Master Plan report is in preparation which will review and recommend modifications to the reservoirs to improve flood storage operations and recharge opportunities so the District can more efficiently capture and utilize flood releases from both the Kings and Kaweah Rivers. In wet years the District undertakes water exchanges with other agricultural entities which have a demand for water. In exchange, the District receives water from these entities at a later date or payment to purchase water during dry years. Prime examples of a beneficial water purchase are ones entered into with Kings River Water Association member units who may purchase water in wet years from the District but in dry years may not have enough stored water available for a water run. When the entities are willing, the District has purchased water supplies available during dry years to supplement their own supply and reduce the need for groundwater pumping. Kings River water transfers occur on a regular basis to better utilize the river supply. The District manages, reviews and balances its water supplies through water purchases and transfers to best serve its water users.

4. Drainage From the Water Supplier's Service Area

Because CID lies in a closed basin, there is no natural outlet for any excess surface flows. All surface runoff (tailwater) is either recirculated by the water users or is discharged back into the District's irrigation system to be reused as part of the irrigation supply.

Some areas of the District suffer from a shallow or perched water table that is managed with subsurface drainage systems (tiles). These systems are owned and operated by the individual landowners but discharge into a drainage collection system owned and operated by Tulare Lake Drainage District. CID does not own or operate any drains nor manage any subsurface drain water.

## B. Water Supply Quality and Water Quality Monitoring Practices

CID periodically collects water samples at key surface and groundwater supply points and has them analyzed for electrical conductivity, pH, TDS, total nitrogen, and boron. The purpose of this monitoring is to provide water users with a general idea of the irrigation water quality they will receive and to monitor for long term trends. Both the surface and groundwater quality supplying the District are very good and growers are not concerned with water quality impacts to their crops.

1. Surface Water Supply

Surface water samples are collected from the District's Highline Canal, representing the water quality of only the incoming surface water, and at the Sweet and Lamberson Canals, representing surface water blended with groundwater pumped from wells and recirculated tailwater. Table 6 shows the water quality results for these sources from 2013.

**Table 6: Surface Water Quality**

| Irrigation Year: 2013<br>Location | E.C.e<br>ds/m | pH | TDS<br>ppm | Total N<br>ppm | Boron<br>ppm |
|---|---|---|---|---|---|
| Highline @ Kansas Ave | 0.05 | 7.6 | 32 | <0.5 | 0.01 |
| Sweet Canal @ Nevada Ave | 0.17 | 9.2 | 109 | <0.5 | 0.12 |
| Lamberson Canal @ Plymouth Ave | 0.29 | 8.8 | 186 | <0.5 | 0.17 |

2. Groundwater Supply

The District's groundwater supply comes from 76 District-owned wells. Table 7 shows the groundwater quality for wells at key locations within the District.

**Table 7: Groundwater Quality**

| Irrigation Year: 2013<br>Location | Aquifer Penetration* | E.C. ds/m | pH | TDS ppm | Total N ppm | Boron ppm |
|---|---|---|---|---|---|---|
| Well -- A | Shallow | 0.268 | 8.6 | 201 | | < 0.1 |
| Well -- B | Shallow | 0.179 | 9.0 | 136 | | < 0.1 |
| Well -- C | Shallow | 0.294 | 8.7 | 213 | | < 0.1 |
| Well -- D | Shallow | 0.239 | 8.5 | 187 | | < 0.1 |
| Well -- E | Deep | 0.34 | 9.5 | 226 | | 0.60 |
| Well -- F | Deep | 0.41 | 9.3 | 262 | <0.5 | 0.31 |
| Well -- G | Deep | 0.30 | 9.3 | 192 | <0.5 | 0.28 |
| Well -- H | Deep | 0.34 | 9.4 | 218 | <0.5 | 0.33 |
| Well -- I | Deep | 0.39 | 8.4 | 250 | <0.5 | 0.26 |
| Well -- J | Deep | 0.38 | 8.7 | 243 | <0.5 | 0.34 |

* Shallow indicates well perforations above the Corcoran Clay. Deep indicates well perforations below the Corcoran Clay.

3. Other Water Supplies

There are no other water supplies distinctly monitored by CID. As noted earlier, tailwater discharges not recirculated by individual water users are assimilated into the District's water supply, however these water sources are not independently monitored. The blended water quality (aggregate of surface supplies, groundwater supplies, and recirculated tailwater) is measured by the Sweet and Lamberson Canal samples.

4. Drainage From the Water Supplier's Service Area

Tailwater generated by irrigation operations is either recirculated by the landowner or discharged back into the District's water distribution system. CID does not separately monitor tailwater discharges from water users into its conveyance system (although they can be estimated). Some regions within CID have perched water table conditions that are managed by subsurface drainage systems (tile systems). Water produced by the tile systems (tile water) is highly mineralized and is generally not fit for recirculation. Instead, this tile water is discharged into drains owned and operated by Tulare Lake Drainage District and is not monitored or managed by CID.

# Section V:  Water Accounting and Water Supply Reliability

## A.  Quantifying the Water Supplier's Water Supplies

1.  Agricultural Water Supplier Water Quantities:  Agricultural water supplies (by source) are tabulated in Section III A (Tables 3 and 5).  This summarizes all of the water supplied by the District to growers for irrigation.  All of the water delivered by CID is used for agricultural purposes.

2.  Other Water Sources Quantities:  Aside from the water supplies previously mentioned, other water sources include rainfall and flood waters.  Table 8 tabulates the average rainfall and base evapotranspiration for CID.

**Table 8: Average Monthly Precipitation and Evapotranspiration.**

| Month | Average Monthly Precipitation (inches) | Average Monthly ETo (inches) |
|---|---|---|
| January | 1.39 | 1.23 |
| February | 1.32 | 2.17 |
| March | 1.15 | 4.14 |
| April | 0.70 | 6.07 |
| May | 0.23 | 8.15 |
| June | 0.06 | 8.90 |
| July | 0.01 | 8.97 |
| August | 0.01 | 8.07 |
| September | 0.14 | 6.08 |
| October | 0.31 | 4.11 |
| November | 0.70 | 2.09 |
| December | 1.06 | 1.17 |
| Total: | 7.07 | 61.15 |

Precipitation: NOAA National Climate Data Center

ETo: CIMIS - Tulare Station

As evident in Table 8, virtually all precipitation occurs outside of the typical growing season (April to September) resulting in virtually no usable effective precipitation[1]

Excessive rainfall, however, can result in flood releases from Pine Flat Reservoir and Lake Kaweah.  During flood release events, CID coordinates

[1] The exception to this would be for winter crops such as wheat, which would be partially irrigated through natural precipitation.

with other Tulare Lake Basin water agencies to utilize their canals and reservoir systems to minimize inundation of farmland.

Flooding of cropland occurs on the average of one out of every seven years. During extreme flooding periods, flood flows will enter the Tulare Lake Bed, not only from the principal rivers mentioned, but also from the Tule and Kern rivers and uncontrolled streams such as Deer Creek, Poso Creek, White River, and runoff from the west side of the San Joaquin Valley. Since the Tulare Lake Bed is a closed basin, inundation of cropland leads to decreased demand for surface waters.

## B. Quantification of Water Uses

All water used in CID is for agricultural purposes. CID growers apply water before the growing season for pre-irrigation for certain crops. This practice provides some leaching and sufficient soil moisture for the germination of seeds. The remainder of water use goes to meet the crop consumptive use (ETc). Because of the heavy soil conditions and the closed-basin topography, widespread leaching is avoided as it creates a perched water table that inhibits healthy plant growth. These same conditions render canal seepage and operational spills to insignificant levels. Table 9 shows the typical breakdown between water uses.

**Table 9: Water Use**

| Practice | 2006-14 Average | Wet Year (2011) | Critical Dry Year (2014) |
|---|---|---|---|
| | (acre feet) | (acre feet) | (acre feet) |
| Pre-irrigation | 12,471 | 10,352 | 13,895 |
| Consumptive Use | 68,814 | 62,459 | 59,475 |
| Total | 81,286 | 72,811 | 73,370 |

Because CID sits within the Tulare Lake Basin, there is no natural outlet for tailwater or operational spills. Irrigation runoff (tailwater) is completely recaptured, either by the grower or by the District's irrigation system. In both cases, tailwater is recirculated as part of the irrigation supply, however it is not separately measured.

## C. Overall Water Budget

Table 10 shows the water budget for the average (2006 to 2014) demand and supply. Note that flood water is not included in this budget.

**Table 10: Water Budget**

| Supply | Average Year Amount (Acre Feet) |
|---|---|
| Surface Water | 30,801 |
| Ground Water | 50,819 |
| Total Supplies: | 81,619 |
| | |
| **Demand** | **Amount (Acre Feet)** |
| Pre-Irrigation | 12,471 |
| Crop Consumptive Use | 68,814 |
| Total Demand: | 81,286 |

## D. Water Supply Reliability

The District's water supply is highly dependent on annual precipitation and runoff into Pine Flat and Kaweah reservoirs. Because of this dependence, the amount of surface water supplies available to District water users can vary significantly from year to year. In most years, the discrepancy between crop water demand and surface water supply is made up through groundwater pumping. In periods of severe drought, water users will fallow ground that would be planted in other years to reduce overall water demand.

# Section VI: Climate Change

The long-term impacts of climate change on the District are not known. It is anticipated that climate change will result in wide variations in precipitation, contributing further to the poor reliability of the District's surface water supply. CID expects to rely on its groundwater supplies to help make up for surface water shortfalls. In addition, improvements to existing reservoirs and the planned construction of new reservoirs will allow the District to capture flood water and either use it directly as a supply or to recharge groundwater. District growers also have the ability to fallow ground to reduce water demand in periods of severe drought.

# Section VII: Water Use Efficiency Information

## A. Efficient Water Management Practice (EWMP) Implementation and Reporting

Table 11 provides a brief summary of the EWMPs that CID has planned to implement. Details of each EWMP are provided after the table.

**Table 11: Report of EWMPs Implemented/Planned**
(Water Code §10608.48(d), §10608.48 (e), and §10826 (e))

| EWMP No.* | Description of EWMP | Status of EWMPs |
|---|---|---|
| **Critical EWMPs** | | |
| 1 | Water Measurement | Currently Implemented |
| 2 | Volume-Based Pricing | Currently Implemented |
| **Conditionally Required EWMPs (locally cost-effective and technically feasible EWMPs)** | | |
| 1 | Alternate Land Use | Not Implemented – Infeasible. |
| 2 | Recycled Water Use | Not Implemented – Infeasible. |
| 3 | On-Farm Irrigation Capital Improvements | In Progress – Grower initiated. |
| 4 | Incentive Pricing Structure | Not Implemented – Not Planned. |
| 5 | Infrastructure Improvements | Planned. |
| 6 | Order/Delivery Flexibility | Not Implemented – Infeasible. |
| 7 | Supplier Spill and Tailwater Systems | Implemented. |
| 8 | Conjunctive Use | Implemented. |
| 9 | Automated Canal Controls | Improvements Planned. |
| 10 | Customer Pump Test/Eval. | Implemented – Grower initiated. |
| 11 | Water Conservation Coordinator | Implemented. |
| 12 | Water Management Services to Customers | Implemented – Grower initiated. |
| 13 | Identify Institutional Changes | Implemented |
| 14 | Supplier Pump Improved Efficiency | Implemented |

Notes:
*EWMP numbers correspond to (Water Code §10608.48(c)

**Critical Efficient Water Management Practices:**
Critical EWMP 1 - Water Measurement: CID measures 100% of it deliveries. Approximately 90% of the measurement points are propeller meters on pump discharge manifolds. The remaining 10% of the measurement points are open flow propeller meters installed at the ends of gravity pipelines. Propeller meters are certified by the manufacturer to be accurate within 5%. Meters are repaired or replaced as needed and CID will refuse to deliver water to any grower with a broken or improperly installed meter.

Critical EWMP 2 – Volume-based Pricing: CID utilizes volume-based pricing. District water users are billed according to the volume of water delivered. The volume of delivered water is measured by factory-certified, totalizing meters which are read monthly by District staff.

**Conditional Efficient Water Management Practices:**
EWMP 1 – Alternate Land Use: This EWMP is not applicable. There are no lands in the District where irrigation and farming activities contribute to significant drainage problems.

EWMP 2 – Recycled Water Use: This EWMP is not applicable. There is no waste water in the area available to the District. CID does not currently have an opportunity to assimilate recycled water into its irrigation supply.

EWMP 3 – On-Farm Irrigation Capital Improvements: This EWMP is implemented by CID growers. Approximately 10% of the District is irrigated using high efficiency irrigation systems such as buried drip or micro-sprinklers. Growers are aware of the benefits of pressurized irrigation systems and are converting from conventional surface methods as the crop rotation and budget allow. CID does not have a financial incentive program to assist growers with irrigation system improvements and all irrigation improvements are funded and implemented by the growers. However recent conversion trends indicate a steady increase in the acreage irrigated with high efficiency irrigation system and CID expects to see 50% of the District acreage irrigated with such systems by 2020.

EWMP 4 – Incentive Pricing Structure: Legal counsel for CID has advised that incentive pricing systems, such as tiered water pricing, may be subject to Proposition 218 elections and need to be set according to actual service costs (see Capistrano Taxpayers Association, Inc. v. City of San Juan Capistrano, April 2015). Until this legal issue is clarified, CID does not plan to implement a specific incentive pricing structure. CID does set the price of water based on actual costs (including operations, maintenance, administration, and purchased water), some of which are fixed regardless of the available water supply. To that end, the price of water becomes proportional to the available volume of water. In drought years, a lower (or absent) surface water supply will result in a significantly higher unit price of water, which does create an incentive to adjust cropping patterns and reduce water demand.

EWMP 5 – Infrastructure Improvements: This EWMP is planned. CID is in the process of developing a five-year plan to construct improvements to key pump stations. These improvements will include the installation of variable frequency drives and SCADA automation on three pump stations that are critical to District water deliveries. These improvements will allow CID to exactly match water deliveries with demand and to monitor and control the pump stations remotely from the office. Details of this plan are still in progress and the costs and benefits have not yet been fully developed.

EWMP 6 – Order/Delivery Flexibility: This EWMP is not technically or financially feasible. The nature of the District's delivery system as well as the general topography of the area dictates the operation and order of delivery system. Surface water deliveries from the Kings and Kaweah rivers are managed by upstream water agencies and outside of CID control. Conversion to an "on-demand" system would require the entire system to be replaced with a pressurized delivery system at a cost well beyond the District's resources.

EWMP 7 – Supplier Spill and Tailwater Systems: This EWMP has been implemented. CID does not generate any operation spills. All tailwater generated within the District is either recirculated by the individual water user or discharged back into the CID irrigation system for reuse as irrigation water. The volume of recirculated tailwater is not separately measured.

EWMP 8 – Conjunctive Use: This EWMP has been implemented. CID operates as a conjunctive use district by using groundwater as a supplemental water supply when surface supplies are insufficient to meet demand and relying on surface supplies in lieu of groundwater when possible. The District is in the process of developing a new Reservoir Master Plan, which will include activities and improvements specific to conjunctive use and groundwater management. This plan is expected to be completed within 12 months.

EWMP 9 – Automated Canal Controls: This EWMP is being implemented as part of EWMP 5, infrastructure improvements.

EWMP 10 – Customer Pump Evaluations: This EWMP has been implemented by the growers. Growers within CID understand the need to maintain efficient pumps and will schedule pump tests on an as needed basis to evaluate efficiency and make repairs. CID water users have not asked the District to participate in this process.

EWMP 11 – Water Conservation Coordinator: This EWMP has been implemented. The District Board of Directors has appointed Gene Kilgore, the District's manager, as the Water Conservation Coordinator.

EWMP 12 – Water Management Services to Customers: This EWMP is not implemented by CID. The majority of water users within the District employ agronomists and other water management professionals directly. There is no demand for the District to provide this service.

EWMP 13 – Identify Institutional Changes: This EWMP has been implemented. CID holds monthly board meetings where water users can present concerns regarding District policies. At this time CID has not received any complaints or concerns from water users regarding its policies.

EWMP 14 – Supplier Pump Improved Efficiency: This EWMP has been implemented. CID participates in PG&E's Advanced Pumping Efficiency Program (APEP) and regularly evaluates all of its pumps.

**Schedule and Budget to Implement EWMPs.**
CID or its water users have already implemented many of the listed EWMPs. Other EWMPs, particularly those related to infrastructure improvements and canal automation, are currently in the process of being planned and a detailed schedule or budget has not yet been developed.

**Table 12: Schedule to Implement EWMPs**
(Water Code §10608.56 (d))

| EWMP | Implementation Schedule | Finance Plan | Budget Allotment |
|---|---|---|---|
| **Critical** | | | |
| 1 – Water Measurement | Complete | Grower Financed | $0 |
| 2 - Volume-Based Pricing | Complete | | $0 |
| **Conditional** | | | |
| 1 – Alternate Land Use | Not Applicable | | |
| 2 – Recycled Water Use | Not Applicable | | |
| 3 – On-Farm Irrigation Capital Improvements | In-progress: Grower Driven | Grower Financed | $0 |
| 4 – Incentive Pricing Structure | Not Planned | | |
| 5 – Infrastructure Improvements | Planning in Progress | Not yet determined | Not yet determined |
| 6 – Order/Delivery Flexibility | Not Planned | | |
| 7 – Supplier Spill and Tailwater Systems | Implemented | Grower Financed | $0 |
| 8 – Conjunctive Use | Implemented | | $0 |
| 9 – Automated Canal Controls | Planned: see #5 | Not yet determined | Not yet determined |
| 10 – Customer Pump Test/Eval. | Grower Implemented | Grower Financed | $0 |
| 11 – Water Conservation Coordinator | Implemented | $0 | $0 |
| 12 – Water Management Services to Customers | Grower Implemented | Grower Financed | |
| 13 – Identify Institutional Changes | Implemented | $0 | $0 |
| 14 – Supplier Pump Improved Efficiency | Implemented | Included in Annual Maintenance Budget | |
| **Total all EWMPs** | | | |

# Section VIII: Supporting Documentation

### Agricultural Water Measurement Regulation Documentation (as applicable)

**A. Legal Certification and Apportionment Required for Water Measurement**

CID has access to all measuring points. No Legal Certification is required.

**B. Engineer Certification and Apportionment Required for Water Measurement**

CID measures all deliveries volumetrically. No Engineer Certification is required.

**C. Description of Water Measurement Best Professional Practices**

Included in Appendix D.

**D. Documentation of Water Measurement Conversion to Volume**

Not applicable – all deliveries are metered volumetrically.

**E. Device Corrective Action Plan Required for Water Measurement**

See Appendix D.

**Other Documents (as applicable)**

No other documents are required.

# Appendix A: Preparation and Adoption Documents

## Notice of Preparation

## Resolution of Adoption

The following notice of preparation was mailed to:
The City of Corcoran
Tulare Lake Drainage District
Tulare Lake Basin Water Storage District
The Kings County Department of Planning

GENE KILGORE
MANAGER-TREASURER

SHIRLEY PADDOCK
SECRETARY - ASSESSOR
AND TAX COLLECTOR

# Corcoran Irrigation District

P.O. BOX 566 - CORCORAN, CALIFORNIA 93212
TELEPHONE (559) 992-5165 - FAX (559) 762-7227

June 8, 2015

City of Corcoran
1033 Chittenden Avenue
Corcoran, CA 93212
ATTN: Kindon Meik

**SUBJECT: Notice of Preparation of an Agricultural Water Management Plan by Corcoran Irrigation District.**

Dear Mr. Meik,

This letter is being sent to inform you that Corcoran Irrigation District is preparing an Agricultural Water Management Plan (AWMP) in accordance with California Water Code. Should you have any concerns or wish to provide input, please submit those in writing to the District by July 14, 2015. A public hearing for comments on the AWMP will be held during the July Board of Directors Meeting on July 14, 2015.

Sincerely,

Gene Kilgore
General Manager

**RESOLUTION NO. 2015- 1**

**RESOLUTION OF THE BOARD OF DIRECTORS OF THE CORCORAN IRRIGATION DISTRICT**

WHEREAS, the Corcoran Irrigation District ("District") is a California irrigation district and is the type of entity required under California law to adopt and implement an agricultural water management plan;

WHEREAS, in an attempt to comply with California Water Code Section 10826 and related statutes, the District had a draft agricultural water management plan (the "Agricultural Water Management Plan") prepared by its consulting engineers;

WHEREAS, on July 25, 2015 and August 1, 2015, notice of a public hearing to consider adoption of the Agricultural Water Management Plan was duly published in the *Hanford Sentinel*, a newspaper of general circulation within the boundaries of the District;

WHEREAS, on August 11, 2015, the Board of Directors of the District held a public hearing for the purposes as described in the aforementioned published notice; and

WHEREAS, after hearing the staff report on the Agricultural Water Management Plan and holding the public hearing regarding the same, the Board of Directors of the District found it to be in the best interest of the District to have the Agricultural Water Management Plan to comply with the statutory requirements and to guide and direct its activities,

NOW, THEREFORE, on a motion made by Director DeVaney, seconded by Director Hansen, and unanimously carried, the Board of Directors of the District unanimously resolved to adopt the Agricultural Water Management Plan, a copy of which is attached hereto and marked “Exhibit A,” as its agricultural water management plan and to authorize all further steps required by law to finalize it.

Ayes: Rietkerk, DeVaney, Gilkey, Hansen, Boyett,

Noes: none

**CERTIFICATE AUTHORIZING RESOLUTION**

I, Shirley Paddock, hereby certify as follows:

1. That I am the Secretary of the Corcoran Irrigation District; and

2. That the foregoing resolution, consisting of three pages, including this page, is a true and correct copy of a resolution of the Board of Directors of the Corcoran Irrigation District passed at the meeting of the Board of Directors regularly held on August 11, 2015, at the District's principal executive office, located in Corcoran, California.

IN WITNESS WHEREOF, I have signed this certificate this 11th day of August, 2015, at the District's principal executive office.

Shirley Paddock

Shirley Paddock, Secretary

# Appendix B: Second Amended Rules and Regulations of the Corcoran Irrigation District

# SECOND AMENDED RULES AND REGULATIONS

# OF THE CORCORAN IRRIGATION DISTRICT

These Second Amended Rules and Regulations were adopted by the Board of Directors (Directors) of the Corcoran Irrigation District on March 11, 2014 under authority provided pursuant to California Water Code Sections 22225 and 22257

These rules and regulations are intended to assist the Directors and District employees in giving economic management and equitable service of water to all water users in the District.  It is the hope of the Directors that all water users will familiarize themselves with these rules and regulations and assist in the business of the District—that of conveyance and supply of water for irrigation.

These rules and regulations are sufficiently elastic to permit the District Manager to vary the method of water distribution to suit local soil and crop conditions.  As new conditions arise, it may be necessary to change or amend these rules and regulations. The Directors invite all water users to provide suggestions to better improve the District's purpose.

Employees of the District are expected to be courteous and considerate in all their interactions with the public and all water users must exercise the same consideration in their interactions with District employees.

All taxpayers and water users should feel a personal interest in helping to keep down expenses. This can be accomplished if water users will stop small leaks in their systems, report problems with the District's conveyance system or facilities, and minimize backing water up in District canals.

## RULES AND REGULATIONS

1. **Management of System** - The operation and maintenance of the conveyance systems and facilities of the District shall be under the exclusive management of the District Manager, appointed by the Directors. No person not authorized by the District Manager shall interfere with the operation of any part of the conveyance system.

2. **District Manager and Assistants** - The District Manager shall employ such canal operators and other assistants required for the operation and maintenance of the system.

3. **Application for Water** - On or before March 1st of each year, each water user shall file with the District Manager a written application on forms supplied by the District, specifying the number of acres to be irrigated, the kind of crop and the acreage of each, the location of the land to be irrigated, and the area served by each distribution lateral. No water will be delivered until the completed application form is delivered to the District.

4. **Rotation and Delivery of Water** - At the Directors discretion, water may be delivered by a prorated allocation to water users. The quantity of water delivered to each water user will be based on the water user's irrigated acreage percentage of the total District acreage and the water available. Thus, the prorated allocation of water available to a water user is determined by dividing the water user's irrigated acreage, located within the District, by the total District acreage, and multiplying the quotient by the total amount of acre feet of the expected daily available water supply.

5. **Quality of Water** - Water supplied by the District is provided for agricultural water only. Water provided by the District is in a raw, untreated condition and is not fit for human consumption or any other domestic use.

6. **Disclaimer for Failure of District to Deliver Water** - Delivery of water will be on an interruptible and non-dependable basis. Water will only be provided to water users as such times and in such a manner as the District, at its sole discretion, may decide. The District shall not be responsible or liable for its failure to deliver water to any water user or for any damages, consequential or otherwise, resulting from such failure.

7. **Charges for Water** - The District's charges for conveyance, use and sale of water, together with other related charges. The Directors annually review and

determine charges for water, including the fee rate for water and conveyance use per acre. The District reserves the right to increase the fee rates without prior notice to water users. A minimum charge of 10 acre feet per irrigation will be charged if the District has to fill the canal system in non-use system. However, if an operable flow meter is installed, the charge will be based on the measured flow.

8. **Quantity of Water to be Supplied** - The head of water requested by and delivered to a water user may vary, so long as the variation does not adversely affect another water user. The water user who is first in time has priority unless water demand exceeds supply or capacity, thereby requiring the District Manager to begin allocating water supply or channel capacity. In no case, will a head of water less than two (2) cubic feet per second be delivered to a water user.

9. **Condition of Water Users Land and Ditches** - Water users will be required at all times to keep their ditches and facilities for conveying and distributing water in good condition and free from weeds, so that water can be conveyed without undue loss either of water or human resources. The District Manager shall have the right to refuse to deliver water to a water user whose ditches, structures / or land is so impaired that water cannot be distributed economically.

10. **Use and Care of Water** - Water must be used continuously by the water user throughout the period of the run, both day and night. If water is wasted or improperly used, the District Manager may refuse further delivery of water until the cause of waste is removed or repaired.

11. **Liability of District** - The District shall not be liable for damage resulting directly or indirectly from any water user’s failure to divert water as requested, either in a private ditch or in a District conveyance facility.

12. **Access to Water User’s Ditches and Land** - The District Manager, authorized canal operators and assistants shall at all times have access to the ditches of water users or the lands irrigated with District’s water.

13. **Complaints of Service** - Complaints of service or of the action of District canal operators or other employees of the District, shall be made in writing and filed with the District Manager. Complaints of service or actions of the District Manager shall be made in writing and filed with the District President.

14. **Use of Right-of-Way by Water User** - The rights of way occupied by District conveyance systems and structures shall not be used by water users for growing of crops or any other purpose except by written permission of the Directors. Canal banks shall not be disturbed; fences, gates, bridges or any other structure shall not

be built on or across District rights-of-way, conveyance systems or property without such written permission.

15. **Additional Diversion Outlets** - Additional diversion outlets or other structures may be constructed or placed in District conveyance systems only when written authority from the Directors is first granted. Construction or placement of an additional diversion outlet or other structure is to be performed by the District staff or under their direction and at the sole expense of the water user

16. **Length of Irrigation System -** Water will be provided in the conveyance systems of the District when it is available for distribution and required by water users, except for such times that are necessary for cleaning or repairing of systems or structures. Maintenance and system improvements may be scheduled when demand is the lowest, if possible, and water users will be given 30 days written notice of such activities.

17. **Abatement of Nuisance** - No yard waste, tree or bush pruning, garbage, refuse, dead animal, sewage or animal excrement from any source, including any livestock containment area, shall be placed in or be allowed to be spilled or drained into any water conveyance system of the District. Any person found violating the above rule will be prosecuted to the full extent of the law.

18. **Request for Water Used** - All water users requesting water must sign and deliver to the District a water ticket 48 hours before a water delivery is made by the District, specifying the head of water requested, times of delivery, crop and acres covered.

19. **Prepayment of Water Charges by Delinquent Users** - A water user who has an outstanding water charge that is more than 60 days overdue will be required to pay the charge in full, including all late fees, before such user is provided additional water.

20. **Total Water Available –** When demand exceeds the available water supply, water supply may be allocated, based on water users percentage of District acres farmed. (Refer to Regulation #4 to determine percentage)

21. **In Period of Extreme Drought** – During a drought period, it may be necessary to allocate water supply or conveyance system capacity. Allocations will be percentage based. (Refer to Regulation #4 to determine percentage)

22. **Canal or Storage Use -** Subject to available capacity and District operations, the District's conveyance systems may be used to convey or store private water. A wheeling charge, set by the Directors may be assessed per acre-foot of private

water conveyed or stored. Under no circumstance shall the conveyance or storage of private water permitted if, in any way, it adversely affects the conveyance or storage of District water or District operations.

23. **<u>Water Measurements</u> -** Operable flow meters or other means to accurately record and measure water shall be installed on all pumps or other devices that extract water from District facilities and conveyance systems. Pumps or other extraction devices that do not have an operable flow meter may be charged at the pump's or device's manufactured maximum pumping design capacity. District employees shall, at all times, have access to water measurements and water measurement devices that measure flow of District water.

24. **<u>Modification</u>** - The Directors may modify these rules and regulations temporarily to meet special conditions or permanently as they deem it in the best interest of the District.

# Appendix C: Groundwater Management Plan

# TULARE LAKE BED
# COORDINATED
# GROUNDWATER MANAGEMENT PLAN
# (SB 1938 COMPLIANT)

**Adopted**
**7/27/12**

July 27, 2012

# TULARE LAKE BED
# COORDINATED
# GROUNDWATER MANAGEMENT PLAN
# (SB 1938 COMPLIANT)

**Adopted**
**7/27/12**

July 27, 2012

Prepared by:

SUMMERS ENGINEERING, INC.
CONSULTING ENGINEERS
HANFORD, CALIFORNIA

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# I. INTRODUCTION

Participants in this Coordinated Groundwater Management Plan (the Plan) consist of water agencies and private landowners located within the Tulare Lake area. Due to the unique geology, topography, and water resources in the Tulare Lake area, the participants have elected to manage their groundwater resources under a single coordinated plan. Figure 1 is a location map of the Tulare Lake sub-basin and the Plan boundary. Plan participants are listed as follows and a brief summary about each participant is provided at the end of this chapter.

- Alpaugh Irrigation District
- Angiola Water District
- Atwell Island Water District
- City of Corcoran
- Corcoran Irrigation District
- Lovelace Reclamation District #739
- Melga Water District
- MOU Private Lands
- Salyer Water District
- Tulare Lake Basin Water Storage District
- Tulare Lake Reclamation District #761

<u>Plan Authority</u>

Agencies participate in the Plan in accordance with the terms of a Joint Powers Agreement (JPA) entered into pursuant to California Water Code Section 10755.2 which provides for adoption and implementation of coordinated groundwater management plans. The JPA allows for amendments to include additional local agencies, public and private entities, and private parties as participants in the Plan. Private landowners participate in accordance with the JPA and a Memorandum of Understanding (MOU). Tulare Lake Basin Water Storage District is the administrator of the Plan.

The Plan was first adopted and implemented in 1997 under California Water Code Sections 10750 et. seq., which includes codification of California Assembly Bill 3030. This document updates the original Plan to comply with requirements of California Senate Bill 1938, which amended the Water Code in 2002.

Purpose

The coordinated approach provides a framework for the local management of groundwater resources, allowing participants to collectively pursue Plan objectives versus each agency implementing its own groundwater management activities. A key element of the Plan is monitoring of groundwater levels. Plan participants conduct quarterly meetings and monitoring data is disseminated annually to neighboring groundwater management agencies and the State. The Plan also includes preparation of an annual report describing water supplies and groundwater levels. By coordinating monitoring and reporting activities, plan participants are kept apprised of groundwater conditions and are able to optimize their management of available water supplies. The regular dissemination of data also serves to establish and maintain a line of communication between the Plan participants and other local or State agencies.

Historically the Tulare Lake Bed area has conjunctively managed its water supplies to maximize the importation of surface water for irrigation so groundwater usage can be minimized. These activities are documented in the annual report as Plan participants continue to use conjunctive water management in the area.

Another goal of the Plan is to preserve local management of groundwater resources in the Tulare Lake Bed area. The JPA, which allows other public and private entities to join the Plan, encourages local stakeholder involvement in managing groundwater.

Plan Participants

**Alpaugh Irrigation District**

Alpaugh Irrigation District (AID) was formed in March of 1915 and is located in the southeastern portion of the Plan area. Figure 2 is a location map of AID's boundary. AID obtains water from the Friant-Kern Canal as a US Bureau of Reclamation (USBR) Class II Contractor, as well as periodic flood release water known as the USBR's Section 215 water. This water can be delivered to the entire District. Deer Creek occasionally provides some unregulated waters during periods of heavy precipitation and high runoff. Deer Creek is also used as AID's conveyance facility for delivery of USBR Water. AID owns and operates eighteen wells which provide the major portion of its water supplies. The wells extend below the Corcoran clay to an average depth of 1,500 feet. AID has ponds that capture and recover local surface water supplies and provide incidental groundwater recharge.

**Angiola Water District**

Angiola Water District (AWD), formed in November of 1957, owns and operates all the irrigation wells within its boundaries. Figure 3 is a location map of AWD's boundaries. The wells are located in well fields owned by AWD on both the east and west sides of Highway 43. The wells east of Highway 43 are generally considered to provide better quality water. Currently, the wells have a combined pumping capacity of approximately 100 cubic feet per second (cfs). All but seven of the wells draw water from the confined aquifer below the Corcoran Clay and range in depth from 850 to 1,850 feet.

Groundwater is used to supplement AWD's surface water supplies from the State Water Project (SWP), Central Valley Project (CVP), Kings River, Tule River, Deer Creek, and residual floodwaters from Tulare Lake. As the representative of lands within its boundaries, AWD receives a percentage of Kings River Water and SWP Water from the Tulare Lake Basin Water Storage District. AWD holds a permit for diversions from Deer Creek and is one of only two permitted appropriators thereof. Deer Creek, Tule River, and Kings River water is available to AWD dependent on the local hydrologic conditions.

**Atwell Island Water District**

The Atwell Island Water District (AIWD) was established in 1977. Figure 4 is a location map of AIWD's boundary. All wells within AIWD are owned and operated by the landowners or their farmer tenants. These are deep wells which are perforated below the Corcoran Clay. AIWD started receiving Federal water in June of 1978 after entering into a water service contract with the USBR, through the County of Tulare. The USBR contract provides for a maximum of 1,055 acre-feet of water to be transported annually through the San Luis Canal and California Aqueduct to the Cross Valley Canal. Rather than taking delivery from the Cross Valley Canal, AIWD exchanges its USBR water with Arvin-Edison Water Storage District and receives deliveries from the Friant-Kern Canal.

In June of 1993 AIWD, together with Hills Valley Irrigation District, entered into a contract with Tulare County for additional USBR water available for delivery within Cross Valley Canal. Through this agreement, both districts contracted for an additional 954 acre-feet of surface water annually.

AIWD has also periodically contracted for surplus USBR water through temporary water service contracts.

**City of Corcoran**

The City of Corcoran was incorporated in 1914. The City is approximately 7.5 square miles (4,800 acres). Figure 5 is a location map of the City limits. The California State Prison Corcoran, with approximately 5,000 inmates, and the California Substance Abuse Treatment Facility and State Prison Corcoran, with an inmate population of approximately 7,000, are included in the City limits.

The sole source of water for the City of Corcoran's municipal water service is two well fields located northeast of the City. The City currently utilizes five wells. Two other existing wells are being rehabilitated or replaced. Annual pumping from the City's wells is approximately 6,427 acre-feet. The City's service population is approximately 25,900 people, including the two Department of Corrections units and some residents located outside the City limits.

The City has voluntarily implemented a water conservation policy that includes among other provisions, prohibitions against water waste, domestic irrigation restrictions and City Manager authority to require property owners and/or water users to utilize certain restrictions on their water use.

The City provides for groundwater recharge through the operation of a storm water drainage basin and wastewater basins. The City has also required the use of treated wastewater by the California State Prison Corcoran for irrigation of alfalfa fields in-lieu of groundwater pumping.

**Corcoran Irrigation District**

Corcoran Irrigation District (CID) was formed in July of 1919. Figure 6 shows the location of CID. CID owns and operates storage and percolation reservoirs totaling 3,000 acres, with a surface storage capacity of approximately 10,000 acre-feet. The reservoirs can recharge up to 200 acre-feet daily and are a key part of CID's conjunctive water management program.

CID's available surface water supplies include Kings River water, Kaweah River water, and supplemental water available from the Kaweah Delta Water Conservation District and others as well. CID has a contract with the USBR to access USBR Section 215 water when available. In most years the principal source of water to CID is Kings River water derived from stock held in the Corcoran Irrigation Company, Peoples Ditch Company, and other mutual water companies on the Kings River.

CID maintains a well field of both shallow and deep wells located northeasterly of the City of Corcoran. The Corcoran Clay is approximately 50 feet thick and at a depth of 500 feet below the well field. The shallow wells tap the unconfined aquifer located above the Corcoran Clay while the deeper wells penetrate the confined aquifer below the clay and produce the majority of CID's groundwater supplies.

**Lovelace Reclamation District #739**

Lovelace Reclamation District #739 (LRD) encompasses approximately 5,900 acres located immediately north of Tulare Lake Basin Water Storage District. The location of the LRD's boundary is shown on Figure 7. The primary purpose of LRD is flood control. However, lands within LRD receive local surface water and State Water Project water. There are privately owned groundwater wells within the LRD boundary.

**Melga Water District**

Melga Water District (MWD) encompasses approximately 75,000 acres, most of which lie within the boundaries of the Tulare Lake Basin Water Storage District. MWD's boundaries are indicated on Figure 8. MWD was formed in January of 1953. Approximately 7,200 acres of MWD is outside of the Tulare Lake Basin Water Storage District's boundary in the northeastern part of the Plan area.

The surface water supplies available to lands within MWD include State Water Project water and Kings River water. Lands in MWD also periodically receive water from the Kaweah and Tule Rivers.

Privately owned and operated groundwater wells are located within MWD and provide supplemental irrigation water during water-deficient periods.

**MOU Private Lands**

There are approximately 10,300 acres of MOU lands within the Plan boundary as shown on Figure 9. These landowners requested that their lands be brought into the Plan because a part of their land was not included or they preferred to have all of their lands included under a single plan. Available water sources for MOU lands include local surface water, State Water Project water, and groundwater.

**Salyer Water District**

Salyer Water District (SWD) encompasses approximately 10,400 acres. Its boundaries are indicated on Figure 10. A portion of the acreage lies inside the boundary of Tulare Lake Basin Water Storage District with the remaining acreage located in the northeastern portion of the Plan area. Lands within SWD can receive local surface water and State Water Project water. Some privately owned groundwater wells are located within SWD.

**Tulare Lake Basin Water Storage District**

The Tulare Lake Basin Water Storage District (TLB) was formed in September of 1926, at which time nearly all the lands within its boundaries were in agricultural production. TLB has water and storage rights on the Kings and Tule Rivers. TLB's primary source of local surface water is considered to be the Kings River. Figure 11 is a location map of the TLB boundary.

TLB's Kings River water right is held under the Empire Weir No. 2 account and TLB is one of the twenty-eight member units of the Kings River Water Association (KRWA). This water right is erratic in nature, providing substantial water in years of moderate to heavy precipitation, while providing little or no water in years of below average precipitation. TLB's average Kings River entitlement totals approximately 58,500 acre-feet per year. Some lands within TLB also receive deliveries of Kings River water from other KRWA units (water rights).

TLB contracted with the California Department of Water Resources in 1963 to provide a more dependable surface supply for its landowners and to reduce reliance on groundwater. TLB's annual State Water Table A 2012 entitlement totals 88,922 acre-feet. Deliveries of State Water Project (SWP) water began in 1968. TLB delivers substantial quantities of surplus State Water Project water when available. TLB neither owns nor operates any wells. When sufficient surface water supplies are available almost no groundwater is pumped by TLB's water users. It should be noted that this is true for most of the Plan participants.

**Tulare Lake Reclamation District #761**

Tulare Lake Reclamation District #761 (TLRD) encompasses approximately 35,000 acres, nearly all of which lie within the boundary of Tulare Lake Basin Water Storage District. Figure 12 is a location map of the TLRD boundary. Lands within TLRD can receive local surface water and State Water Project water. TLRD 's average Kings River entitlement is approximately 24,500 acre-feet per year. There are some privately owned groundwater wells within TLRD's boundary.

# II. MANAGEMENT AREA

Location

Figure 1 is a location map of the Coordinated Groundwater Management Plan (Plan) area boundary. The Plan area is roughly bounded by the Kings County line on the east, Interstate 5 and Highway 41 on the west, Lansing Avenue on the north, and Wichita Avenue on the south (also Tulare Lake Basin Water Storage District's Lateral B Canal). Some participants' boundaries extend beyond this rough perimeter.

Climate and Hydrology

The climate in the region is typical of the southern San Joaquin Valley. The Tulare Lake Bed region is semi-arid. Average annual rainfall is 7.4 inches. Spring seasons are usually mild with some wind, summers are hot and dry, autumns are cool, and winter seasons are typically characterized by fog and rain with temperatures seldom dropping below the freezing point.

Corcoran Irrigation District measures and records precipitation and maximum and minimum temperatures at a station near the eastern boundary of the Plan area. Historic data from this site is presented as follows in Tables 1 and 2. Average monthly rainfall varied from 0 to 1.47 inches. Approximately 70% of the rainfall typically occurs during the months of December through March. Average maximum and minimum temperatures occur respectively during July and December.

**Table 1**
Average Precipitation from 1931 to 2011

| Month | Average Precipitation (inches) |
|---|---|
| January | 1.47 |
| February | 1.44 |
| March | 1.18 |
| April | 0.68 |
| May | 0.22 |
| June | 0.04 |
| July | 0.01 |
| August | 0.03 |
| September | 0.14 |
| October | 0.37 |
| November | 0.69 |
| December | 1.16 |
| **Average Annual Precipitation** | **7.42** |

Source: Corcoran Irrigation District records

**Table 2**
Average Maximum and Minimum
Monthly Temperatures from 1948 to 2010

| Month | Average Maximum Temperature (°F) | Average Minimum Temperature (°F) |
|---|---|---|
| January | 55 | 37 |
| February | 62 | 40 |
| March | 68 | 43 |
| April | 76 | 47 |
| May | 85 | 53 |
| June | 93 | 59 |
| July | 99 | 63 |
| August | 97 | 62 |
| September | 91 | 57 |
| October | 81 | 49 |
| November | 66 | 41 |
| December | 55 | 36 |

Source: Corcoran Irrigation District records

The Plan area is a “closed” basin with no natural outlet. No natural outflow from the historic Tulare Lake has occurred since the late 1870’s. This is a result of upstream diversions of the four major river tributaries on the east side of the San Joaquin Valley and the U.S Army Corps of Engineers flood control projects on these tributaries. However, during years of above normal runoff, floodwaters can inundate highly productive farmland within the Plan area. On average, some flooding occurs during one of every four to five years.

Land Use

The majority of land in the Plan area is used for irrigated agriculture. Typical crops grown in the area include tomatoes, wheat, barley, safflower, alfalfa, and cotton. There are some nut orchards, but these are much less prevalent than row crops. There are a number of dairies in the northerly and easterly regions of the Plan area. Urban land use is minor in comparison to the overall Plan area. The largest urban area is the City of Corcoran and the nearby California State Prison Corcoran. Alpaugh is a small community located near the southeast corner of the Plan area.

Water Resources and Supplies

Water resources and supplies for the Plan area include various surface water sources and groundwater. The descriptions of individual Plan participants found in Chapter 1 indicate specific supplies that are available to participants.

**Surface Water**

Surface water supplies are generally derived from participant and landowner water rights on the Kings, Kaweah, and Tule Rivers, State Water Project (SWP) contracts, and US Bureau of Reclamation (USBR) contracts. Water is occasionally available from Deer Creek. Water users in the Plan area also acquire additional local surface water supplies when available. Floodwater, which occurs infrequently, is impounded by the landowners in the southern and northeastern parts of the Plan area.

The Kings, Kaweah, Tule, and Kern Rivers originate in the southern Sierras east of the Plan area. These four major rivers are regulated by dams and reservoirs constructed by the US Army Corps of Engineers in the 1950’s and 1960’s. Smaller uncontrolled streams, including Deer Creek, Poso Creek, and the White River, provide erratic flows during flood periods. The Kings River is the primary source of surface water into the Plan area. Kings River water is delivered to the Plan area from the northeast through the Lakeland Canal, from the northwest through the South Fork of the Kings River, and through other privately owned canals. Tule River water is delivered to the Plan area from the east. The Kern River enters the Plan area from the south and the Kaweah River enters from the northeast.

In very wet years floodwater entering the Plan area can inundate Tulare Lake Bed lands. Flooding of cropland occurs an average of one in four to five years. During extreme flooding periods the four principal rivers, smaller uncontrolled streams, and arroyos on the west side of the San Joaquin Valley can all flow into the Plan area. Residual floodwaters in Tulare Lake Bed are used to the maximum extent possible for irrigation. Floodwater not used for irrigation is lost primarily to evaporation.

Local river water supplies vary greatly from year to year depending on hydrologic conditions. Flood releases can occur on the four major rivers at times of above average runoff. Since the Tulare Lake Bed is a closed basin, inundation of cropland leads to decreased demand for surface water supplies. The inundation and decreased demand typically occur at the same time there are flood releases from east side reservoirs. Subsequently an even greater proportion of the total reservoir releases is lost through flood releases. More reservoir capacity would permit the flood water to be stored and conserved providing increased surface water deliveries in subsequent years, thereby resulting in less groundwater pumping. Plan participants actively pursue projects that will increase local surface water storage.

**Groundwater**

The Plan area overlies the southern portion of the Tulare Lake Groundwater Basin (TLGB). The TLGB has been described in studies conducted by the Department of Water Resources and the United States Geological Survey. Generally, the TLGB consists of a shallow aquifer and a deep aquifer on the fringe of the foot print of the historic lakebed. The shallow and deep aquifers are separated by a hydrogeologic formation known as the Corcoran Clay. The Corcoran Clay layer varies from approximately 50 to 200 feet in thickness, and occurs at depths of 400 to 600 feet. The soil profile above and below the Corcoran Clay layer consists of very dense clay as well. The soils that underlie the Plan area are primarily low water bearing, fine textured clay materials with interspersed lenses of silty sand. These relatively impermeable soils limit direct recharge of the shallow aquifer.

In the Tulare Lake Bed, the first waters encountered have high concentrations of salts; therefore, the shallow wells are located on the fringe of the historical lake bed as there is no shallow water that is suitable for agricultural purposes in the interior portion of the Plan area.

Geology

Figure 13 is a location map of the Tulare Lake Bed and a corresponding geologic cross section through the Plan area. The cross section indicates the elevation and thickness of major geologic formations along the cross section line. This information was sourced from the U.S. Geologic Survey Water Supply Paper (WSP) 1999-H, which includes detailed technical descriptions of the southern San Joaquin Valley's subsurface geology. A general description of the Plan area topography and geology is provided as follows.

The topography is a gradually sloping trough from the area's outer boundary toward the lowest region in the Tulare Lake Bed, which lies at approximately 175 feet above mean sea level (MSL). The generally flat terrain has an average slope of about one-foot per mile.

The soils in the historic lake bed are primarily impermeable clays. Soils along the rim of the historic lake bed are primarily fine grained, silty alluvium which were deposited along the shoreline. Older Continental alluvium deposits have noticeably finer texture than the younger Sierra Nevada deposits, which are highly permeable and consist of gravel, fine to very coarse sand, and silt. The alluvium deposits interfinger with clay layers near the Plan area boundary, and diminish approaching the interior of the lake bed. Areas near the center of the lake bed are almost entirely clay strata.

Groundwater Levels

The numeric depth to groundwater data presented herein dates to 1994. From 1994 to 2010, depth to water measurements were collected from a group of 28 wells within the Plan area. In 2011 the monitoring program was reorganized to conform with the California Statewide Groundwater Elevation Monitoring (CASGEM) program. A group of 16 wells was selected as being representative of conditions in the Plan area. Ground and well head elevations were surveyed and tied-in to a statewide elevation datum so groundwater elevations can be determined from the depth to water readings of the wells. Approximately 10 of the 16 CASGEM wells were in the original group of 28 wells. Table 3 indicates the average depth to water readings in the Plan area from 1994 to 2011. The data is separated into average readings for the shallow and deep wells that are monitored. Shallow wells are perforated above the Corcoran clay and deep wells are perforated below the Corcoran clay. Over the period of record, the average depth to water has ranged from about 70 to 175 feet for the upper aquifer and 110 to 310 feet for the lower aquifer.

**Table 3**
Depth to Static Water in Plan Area

| Year | Shallow Well Average in feet | | Deep Well Average in feet | |
|---|---|---|---|---|
| | Spring | Fall | Spring | Fall |
| 1994 | 130 | | 250 | |
| 1995 | 87 | | 145 | |
| 1996 | 85 | | 135 | |
| 1997 | 142 | 90 | 169 | 172 |
| 1998 | 82 | 65 | 120 | 116 |
| 1999 | 67 | 69 | 110 | 146 |
| 2000 | 75 | | 150 | |
| 2001 | 132 | 103 | 242 | 267 |
| 2002 | | 91 | 266 | 209 |
| 2003 | 121 | 118 | 256 | 260 |
| 2004 | 126 | | 254 | |
| 2005 | | | 257 | |
| 2006 | | | | |
| 2007 | 146 | 141 | 271 | 259 |
| 2008 | 156 | 175 | 274 | 289 |
| 2009 | 147 | 176 | 268 | 313 |
| 2010 | 150 | 147 | 285 | 269 |
| 2011 | 127 | 118 | 213 | 213 |

Depth to water readings in the Plan area fluctuate up and down in response to hydrologic conditions and the availability of imported surface supplies. Figure 14 is a chart that illustrates these trends from water years 1993-94 to 2010-11.

Table 4 is a listing of the CASGEM wells and elevation data for each well site, and Figure 15 is a location map of the CASGEM wells. Beginning in the fall of 2011 these wells will be measured two times per year and the groundwater elevation data will be reported to the designated regional monitoring entity, Kings River Conservation District, and ultimately to the State.

**Table 4**
CASGEM Well Information

| Well No. | Latitude | Longitude | Groundwater Subbasin | Reference Elevation | Ground Elevation |
|---|---|---|---|---|---|
| Shallow Wells | | | | | |
| 2 | 36.17 | -119.67 | Tulare Lake | 197.0 | 195.3 |
| 4 | 36.20 | -119.58 | Tulare Lake | 210.2 | 207.4 |
| 9 | 36.13 | -119.55 | Kaweah | 203.2 | 199.1 |
| 11 | 36.09 | -119.47 | Kaweah | 211.6 | 210.2 |
| 14 | 35.99 | -119.49 | Tule | 188.8 | 187.4 |
| Deep Wells | | | | | |
| 1 | 36.17 | -119.88 | Tulare Lake | 205.7 | 202.7 |
| 3 | 36.17 | -119.69 | Tulare Lake | 195.6 | 193.1 |
| 5 | 36.19 | -119.58 | Tulare Lake | 209.1 | 206.7 |
| 6 | 36.14 | -119.89 | Tulare Lake | 199.9 | 196.9 |
| 7 | 36.06 | -119.78 | Tulare Lake | 176.6 | 176.4 |
| 8 | 36.09 | -119.66 | Tulare Lake | 179.8 | 177.2 |
| 10 | 36.07 | -119.61 | Tulare Lake | 182.0 | 180.2 |
| 12 | 36.09 | -119.46 | Kaweah | 212.3 | 211.3 |
| 13 | 36.04 | -119.59 | Tulare Lake | 182.2 | 181.3 |
| 15 | 35.96 | -119.48 | Tule | 185.3 | 184.3 |
| 16 | 35.91 | -119.45 | Tule | 199.0 | 197.5 |

Water Quality

Surface water supplies to the Plan area are of excellent quality due to low total dissolved solids (TDS). Kings River supplies have TDS of approximately 100 parts per million (ppm) and State Project water TDS is about 250 ppm. Well water in the Plan area generally has higher TDS than Kings River surface water and is comparable to State Project water. Kings River and State Project water typically ranges from 100 to 300 ppm. Most of the groundwater wells range in TDS from 150 to 500 (ppm).

The City of Corcoran, which is the only Plan participant that relies exclusively on well water for its supplies, monitors and reports its source water quality in accordance with Title 22 requirements for potable water systems.

# III. GROUNDWATER MANAGEMENT PLAN COMPONENTS

This chapter summarizes the components of the Coordinated Groundwater Management Plan (Plan). Components that are recommended for SB1938 compliance but are not applicable to this Plan, are also identified.

Saline Intrusion

Saline intrusion of the groundwater aquifer is not a concern in the Plan area.

Management of Wellhead Protection Areas

Wellhead protection areas, if such areas exist, are managed in accordance with County requirements.

Regulation of Migration of Contaminated Groundwater

There are no known issues related to the migration of contaminated groundwater within the Plan area.

Well Abandonment and Destruction

Well abandonment and destruction within the Plan area are conducted in accordance with County requirements.

Existing Groundwater Management and Conjunctive Use Activities

As stated elsewhere in the Plan, direct recharge is limited due to the geologic conditions throughout most of the Plan area. However, most participants use surface water supplies whenever possible in-lieu of groundwater pumping. Conjunctive management of local water resources, including surface water through indirect or in-lieu recharge, has been practiced in the Plan area for nearly a century. Groundwater levels that have declined during dry periods typically recover when adequate surface water supplies are available to the Plan area.

### Direct Recharge

The confined and unconfined aquifers underlying the Plan area are primarily recharged from seepage from rivers and irrigation facilities on the east side of the San Joaquin Valley. Corcoran Irrigation District (CID) owns ponding basins in the northeastern corner of the Plan area which are used to provide direct recharge primarily to the unconfined aquifer above the Corcoran clay with limited benefit to the lower aquifer. CID uses the ponds for direct recharge when excess surface water is available, typically during years with above average runoff.

### Surface Storage

Landowners can store water in ponds at the south end of the Tulare Lake Bed. These ponds are located on land that is marginal for farming and not suitable for direct recharge. When floodwater enters the Lake Bed from the various tributary rivers and creeks, and it threatens to inundate prime farmland, the water is diverted into these storage ponds using a system of ditches and pumps. As irrigation demands increase, the water stored in the ponds is used for irrigation in-lieu of groundwater pumping.

### State Water Project

Irrigating with imported surface water supplies minimizes groundwater pumping and recharges the groundwater aquifers through indirect or in-lieu recharge. Erratic local river supplies and the desire to reduce groundwater pumping motivated Tulare Lake Basin Water Storage District (TLB) to enter a contract for State Water Project (SWP) water in the early 1960’s. Two diversion points and canals were constructed from the California Aqueduct to the west side of the Plan area. From 1968 through 2011, more than 4.5-million acre-feet of irrigation water was imported into the Plan area from the California Aqueduct. Although the cost of imported surface water is frequently higher than the cost of pumping groundwater, growers in the Plan area continue to purchase and deliver this water to reduce their reliance on groundwater.

### Empire Weir No. 2 Pool

TLB is also active in water exchange programs using its delivery facilities from the Kings River and California Aqueduct. The District does not have major surface storage or groundwater banking capabilities. However, Kings River water is received through the Empire Weir No. 2 pool, which has about 400 acre-feet of temporary storage capacity.

### Kings County Exchange

The County of Kings is a SWP Contractor but it has no direct connection from the California Aqueduct to deliver its SWP water. The TLB entered into an exchange agreement with the County of Kings in 1967. Through that agreement TLB accessed 4,000 acre-feet per year of the County's contract supply from the Aqueduct in exchange for an equivalent amount of Kings River water.

In 1979, the County determined it could no longer afford the cost of the SWP water and therefore entered into an agreement with various water agencies in the area to sell them the exchanged Kings River water for the cost of maintaining the County's SWP contract. The water agencies were willing to pay for this supply to offset groundwater pumping and not lose this imported water supply. The original agreement has since been amended several times and the current exchange amount is 3,100 acre-feet.

### Urban and Prison Water Use Mitigation Program

The City of Corcoran and the California State Prison Corcoran rely solely on groundwater for their water supplies. To offset impacts on groundwater, the City and prison contribute annually to a mitigation fund. Under the Plan the mitigation fund can be used to purchase and divert affordable surface water to CID's recharge ponds, which are located near the City's well field. Alternatively, growers in CID can receive surface water purchased through the mitigation fund in lieu of operating their irrigation wells. Approximately 12,250 acre-feet of surface water has been purchased under this program since it began.

**Drought Year Surface Water Purchases**

TLB also purchases surface water supplies for conjunctive use. During dry years, District water users purchased Yuba County Water Agency Water, California Drought Water Bank Water, and SWP Supplemental Short Term Water Purchase water for delivery from the California Aqueduct.

These programs demonstrate Plan participants' cooperation and coordination with each other to optimize and manage their groundwater supplies. In years when surface water from local rivers or other imported surface water is available, groundwater use is reduced and indirect recharge occurs. In dry years groundwater supplies are used. Figure 14 is a chart that graphically illustrates the effectiveness of these programs. The chart shows how the proportion of surface water and groundwater use varies depending on hydrologic conditions, and the responsiveness of groundwater levels when surface supplies are abundant and groundwater pumping is reduced.

Monitoring of Groundwater Levels and Storage

A key component to the Plan is monitoring of groundwater levels within the Plan area. Collection and dissemination of this data was recently reorganized to conform with the California Statewide Groundwater Elevation Monitoring (CASGEM) program. Under this program, a group of 16 representative wells was selected. Figure 15 is a location map of the wells. The well location symbols and map legend indicate if the wells are perforated above or below the Corcoran clay layer.

To conform with the CASGEM program, the selected well sites were surveyed and the elevations were tied-in to a statewide elevation datum. Included in the survey were the elevations of the natural ground adjacent to the wells, bench marks on the well head concrete pads, and measurement reference points on the sounding tubes.

The well owners are responsible for measuring their respective CASGEM wells during the spring and fall each year. Depth to water measurements are taken after the well pumps have been turned off for a period of time to allow the water level to stabilize. These readings are submitted to the Plan administrator, TLB, which processes all the CASGEM data and submits it in an electronic format to the designated reporting agency, Kings River Conservation District (KRCD).

Monitoring of Groundwater Quality

Owners of the CASGEM wells periodically test their well water for electrical conductivity (EC) which relates to the total dissolved solids in the water. EC measurements will be logged by TLB acting as Plan administrator.

Monitoring of Surface Flow and Surface Water Quality Relative to Groundwater and Groundwater Pumping

Surface soils in the Plan area are primarily semi-permeable to impermeable, and the depth to usable groundwater, if any, is far below the ground surface or any canals or stream beds within the Plan area. Surface flow does not comingle with the usable groundwater and therefore does not affect groundwater quality or quantity. The naturally high concentration of salts in the perched groundwater precludes its use for irrigation or municipal uses.

Monitoring and Management of Inelastic Land Surface Subsidence

Plan participants are currently reviewing options for monitoring land subsidence. One option would be to establish a set of reference points throughout the Plan area and perform periodic elevation surveys of the points. The reference points could be located on canal structures or other permanent concrete structures that are at least several years old and have undergone most of the settlement that is typical following construction. Since these types of structures are founded near the ground surface, changes to their elevation would be approximately the same as the surrounding ground. Monitoring of the reference points could also include an assessment of how changes in ground elevations might affect surface flows in the Plan area.

Well Construction Policies

Wells constructed within the Plan area are done in accordance with County and State Department of Water Resources requirements.

Construction and Operations of In-Lieu Recharge, Storage, Conservation, Water Recycling, and Extraction Projects

As previously discussed, many of the Plan participants have constructed and operated projects related to storage, conservation, water recycling and extraction.

**Angiola Water District Projects**

Angiola Water District (AWD) continues to research a number of projects involving their system which would benefit groundwater in the Plan area. These projects are presented conceptually as follows and will require additional investigations to determine their feasibility.

*Surface Storage Basins*

AWD has a system of production wells and ditches located just west of Highway 43. The land surrounding the wells is marginal ground that is not continuously farmed and it encompasses most of three sections (3 square miles). Two of the sections are partially owned by AWD and the third is held by a private owner. The well system ditches are generally located along the perimeter of the parcels. It is proposed that earthen levees be constructed on the land for storage basins. Floodwater from Deer Creek could be diverted into the proposed basins. Instead of pumping groundwater, water stored in the basins could later be released into the existing well system ditches for AWD's irrigation demands.

*Injection Wells*

There are a number of locations within the above described AWD well field where existing wells have been retired and new wells were constructed within a few hundred feet or less. The wells were retired because the casings deteriorated and were no longer suitable for pumping. These casings might still be utilized to inject surface water into the aquifer. This may be done by connecting the existing well system ditches to the injection wells and using water stored in the proposed basins for direct recharge. It might also be possible to divert surface water to the injection wells from other parts of the Plan area using AWD's main delivery ditch.

*Groundwater Conservation Easement*

Another concept or related concepts being considered by AWD is a groundwater conservation easement or land fallowing program which result in reducing groundwater pumping.

**Other Projects**

Another concept which has been discussed by the Plan participants would be a program to flood fallowed land for temporary storage. As with AWD's proposed storage basins, this program would require construction of earthen berms or levees to contain the floodwater, and coordination among the Plan participants to divert floodwater to the designated areas.

<u>Relations with Local, State, and Federal Regulatory Agencies</u>

Under the Plan, participants attend regular quarterly meetings. These meetings provide a forum for the Plan administrator, TLB, to report on groundwater and surface water conditions, review conjunctive management activities being implemented by other Plan participants, and review regulations that could affect groundwater use and management. The meetings also provide an opportunity for Plan participants to meet and coordinate with other local water management agencies such as Kaweah Delta Water Conservation District.

The participants submit groundwater elevation data to TLB and the District disseminates the data to Kings River Conservation District (KRCD) and the State Department of Water Resources. KRCD is the designated reporting agency for the Plan under the State's SBx7-6 California Statewide Groundwater Elevation Monitoring (CASGEM) program. Data for this program is submitted semi-annually.

The formation of the Plan participants under the Joint Powers Agreement and their ongoing participation in monitoring groundwater and attending the quarterly meetings demonstrates the effectiveness of the coordinated plan approach being used for groundwater management in the Tulare Lake Bed.

Land Use Planning

Land use planning in the Plan area is done in accordance with County and City General Plans and zoning ordinances.

# IV. MANAGEMENT OBJECTIVES

The primary objectives of the Coordinated Groundwater Management Plan are listed as follows.

- Monitor groundwater levels and disseminate data to plan participants.
- Maintain relationships with local and State agencies.
- Define opportunities for sustaining local groundwater supplies, including enhancing conjunctive use.
- Enhance existing conjunctive use through operational programs to import additional surface water and capital projects to increase surface water use and groundwater storage.

# V. MONITORING

Following are the monitoring protocols for the Coordinated Groundwater Management Plan:

Groundwater Levels

- California Statewide Groundwater Elevation Monitoring (CASGEM) program.
- CASGEM Well locations indicated on Figure 15.
- Designated well owners measure depth to groundwater in spring and fall.
- Measurements taken when well is not being pumped and level has stabilized.
- Measurements are transmitted to Tulare Lake Basin Water Storage District (TLB).
- TLB processes data and transmits summary of depth to water and water elevations to Kings River Conservation District (KRCD).
- KRCD forwards groundwater level data to California Department of Water Resources.

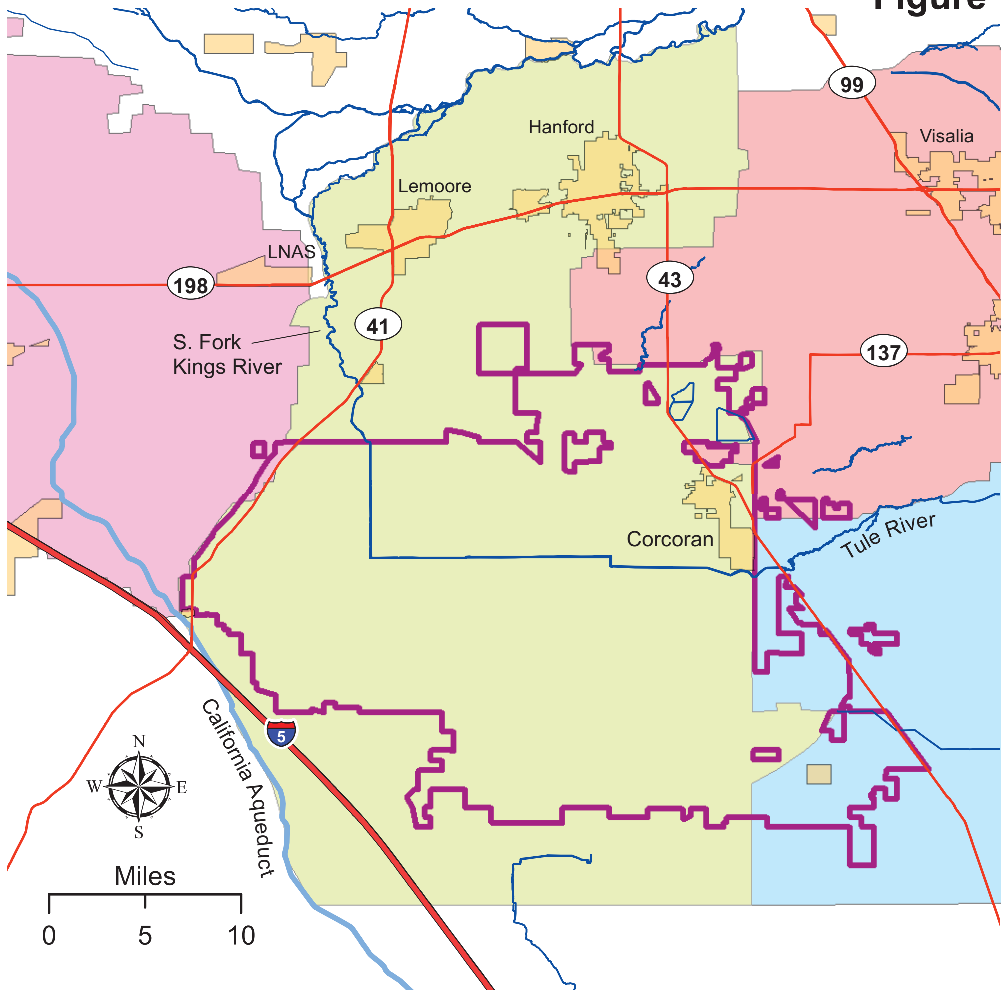
Groundwater Quality

- CASGEM well owners periodically test well water for electrical conductivity (EC).
- Samples taken after well has been pumped for a short time.

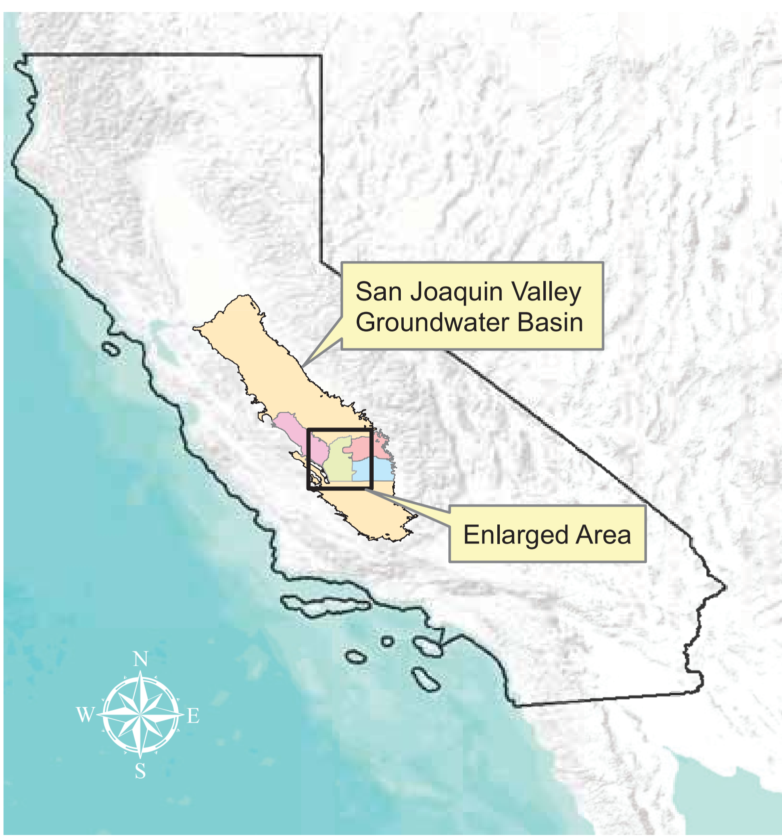
Inelastic Land Subsidence

- Monitoring program currently under review by Plan participants.

**Figure 1**




**ENLARGED AREA**




**STATE OF CALIFORNIA**

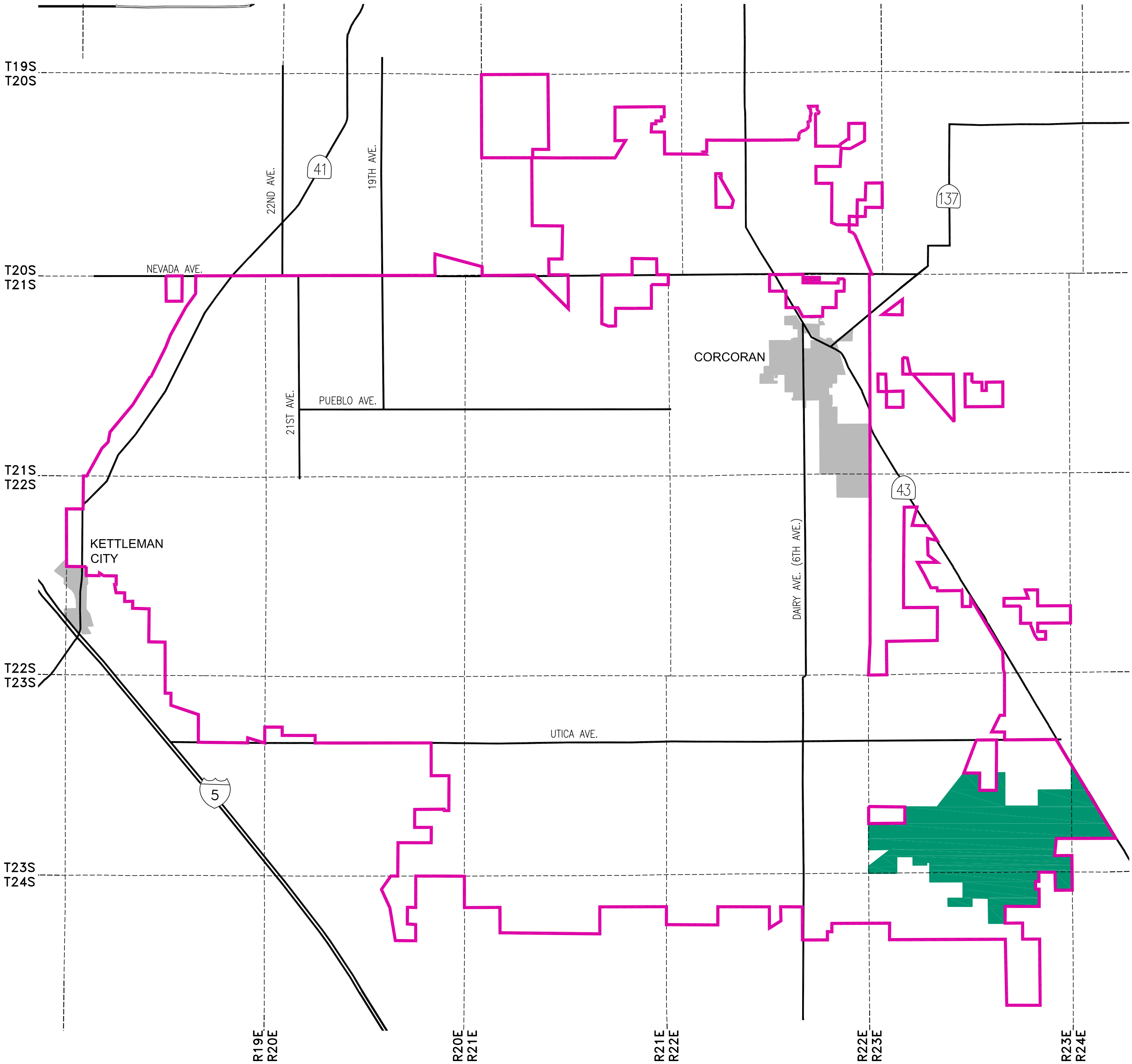
## Legend

- Interstate Highway
- State Highway
- Rivers
- **Canals**
- **Plan Area Boundary**
- Westside Groundwater Sub-basin
- Tule Groundwater Sub-basin
- Tulare Lake Groundwater Sub-basin
- Kaweah Groundwater Sub-basin

# Tulare Lake Bed Coordinated Groundwater Management Plan Plan Area Location Map

Summers Engineering, Inc.
Consulting Engineers
Hanford California

FIGURE 2




**LEGEND**

GROUNDWATER MANAGEMENT PLAN BOUNDARY

ALPAUGH IRRIGATION DISTRICT

SCALE IN MILES

0 1 2 3 4

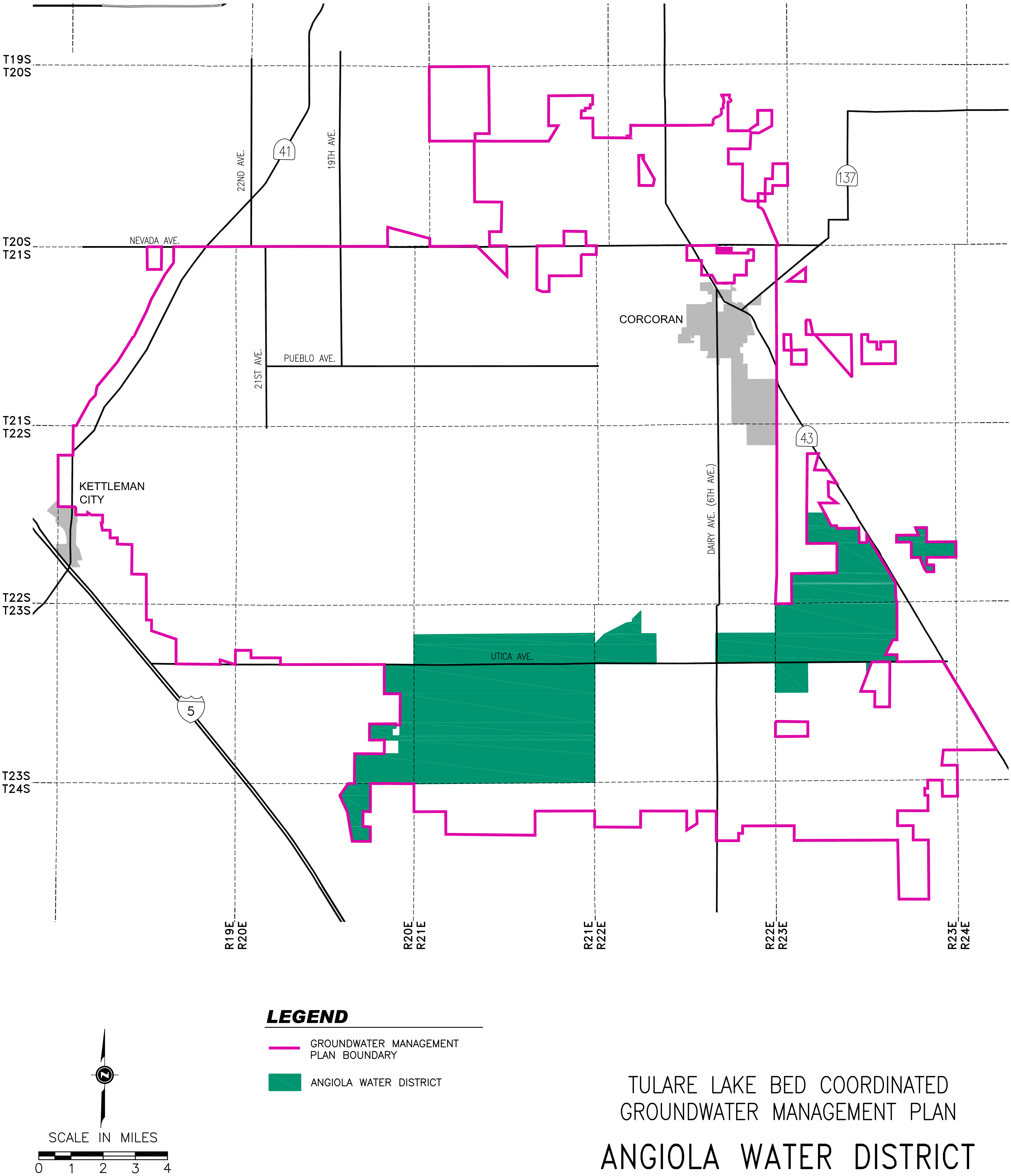
TULARE LAKE BED COORDINATED
GROUNDWATER MANAGEMENT PLAN

# ALPAUGH IRRIGATION DISTRICT LOCATION MAP

SUMMERS ENGINEERING, INC.
Consulting Engineers
HANFORD CALIFORNIA

October 2011

FIGURE 3




TULARE LAKE BED COORDINATED
GROUNDWATER MANAGEMENT PLAN

# ANGIOLA WATER DISTRICT LOCATION MAP

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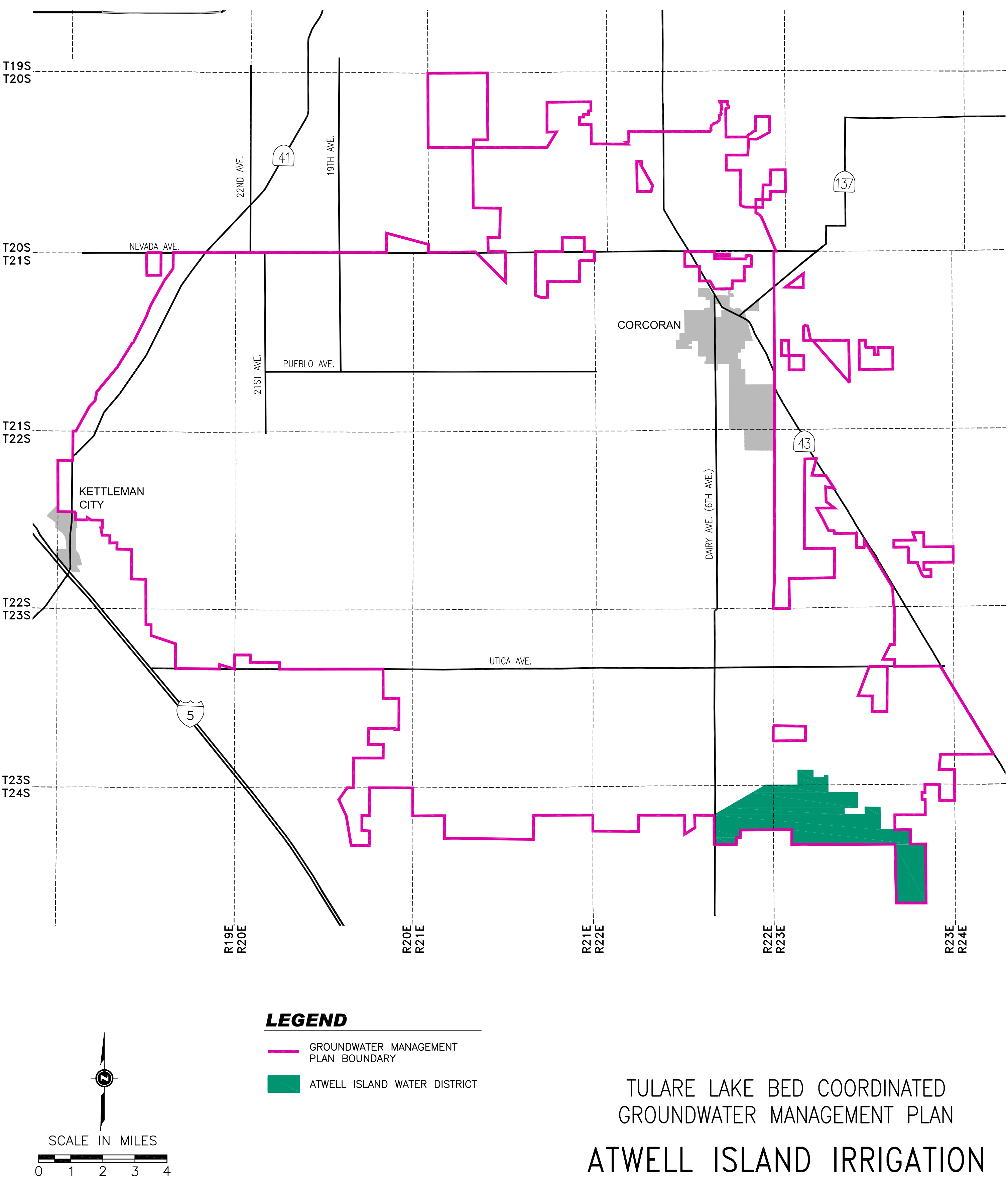
Consulting Engineers
HANFORD CALIFORNIA

October 2011

FIGURE 4




TULARE LAKE BED COORDINATED
GROUNDWATER MANAGEMENT PLAN

# ATWELL ISLAND IRRIGATION DISTRICT LOCATION MAP

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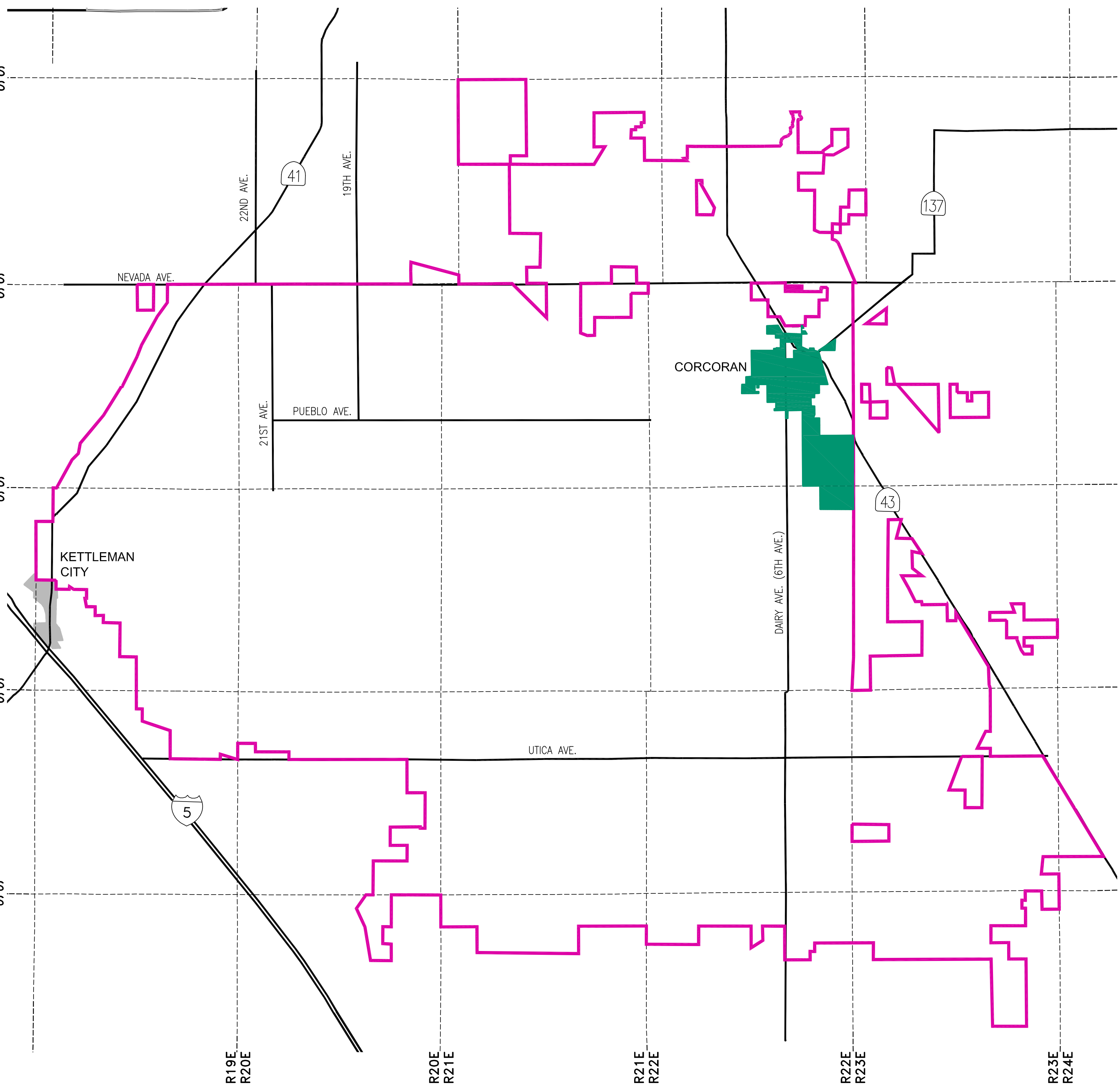
FIGURE 5




## LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- CITY OF CORCORAN

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

# CITY OF CORCORAN LOCATION MAP

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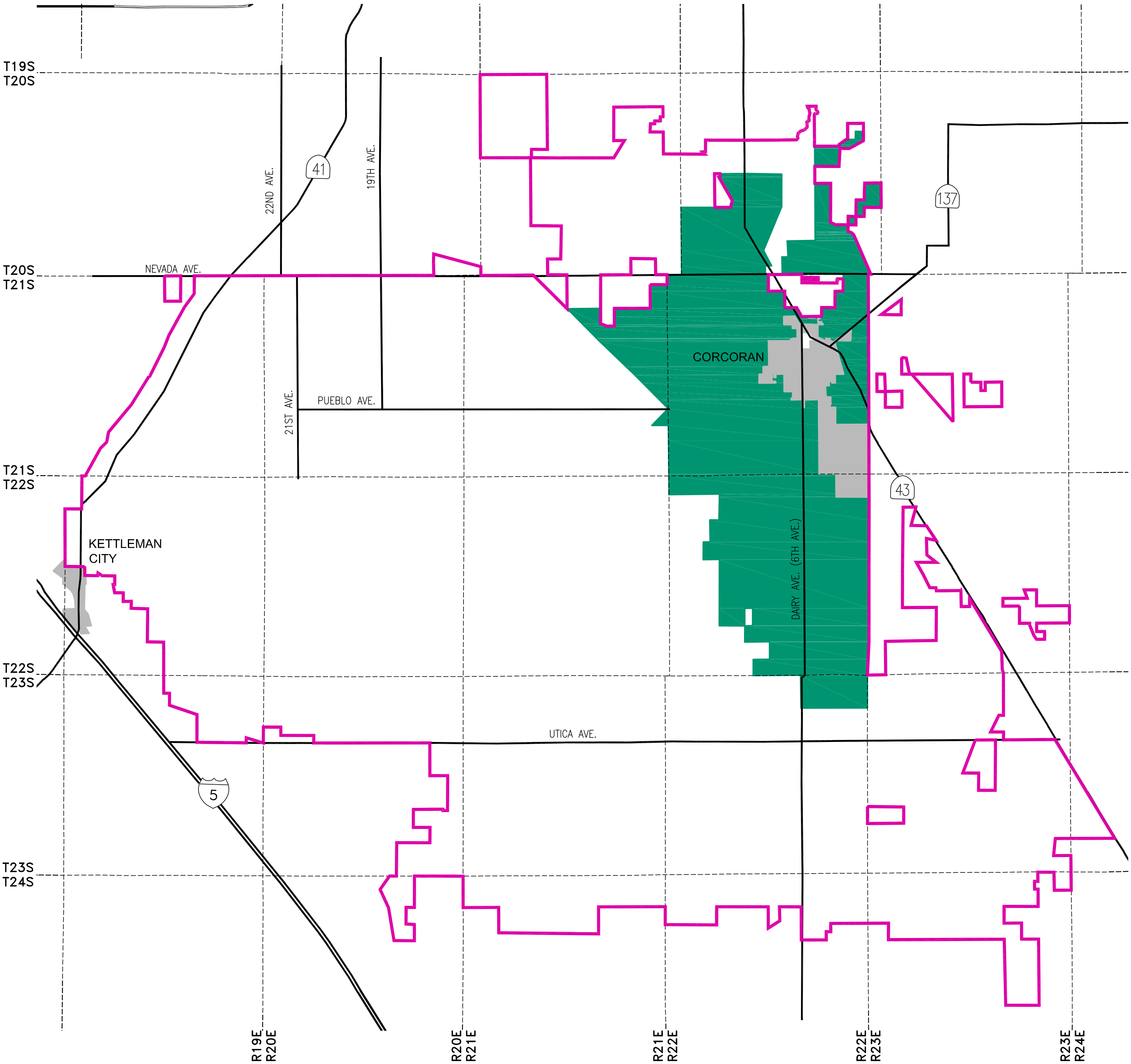
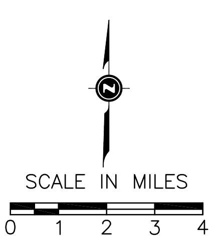
FIGURE 6




***LEGEND***

GROUNDWATER MANAGEMENT PLAN BOUNDARY

CORCORAN IRRIGATION DISTRICT




TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

# CORCORAN IRRIGATION DISTRICT LOCATION MAP

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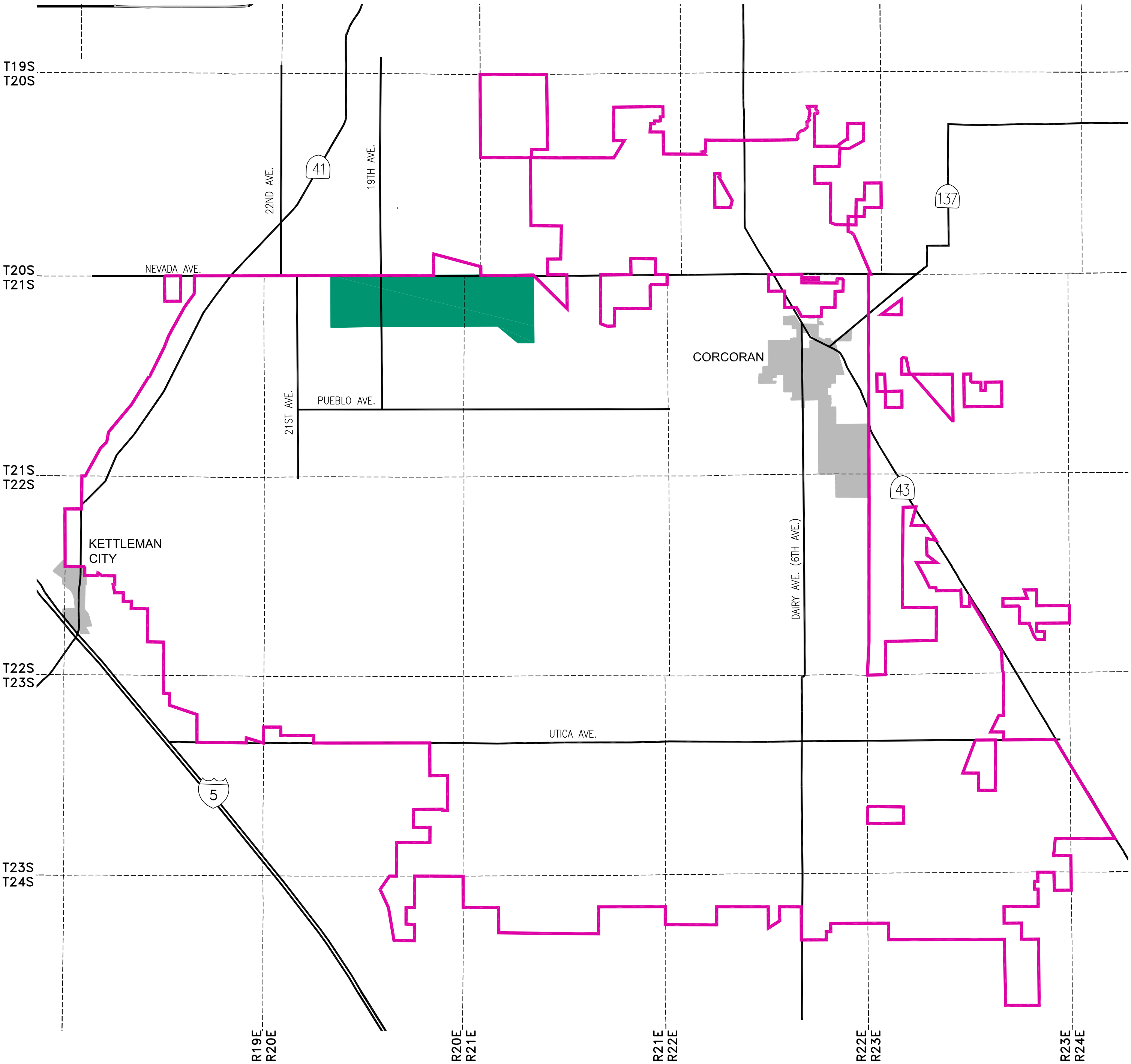
FIGURE 7




***LEGEND***

GROUNDWATER MANAGEMENT PLAN BOUNDARY

LOVELACE RECLAMATION DISTRICT #739

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

# LOVELACE RECLAMATION DISTRICT #739 LOCATION MAP

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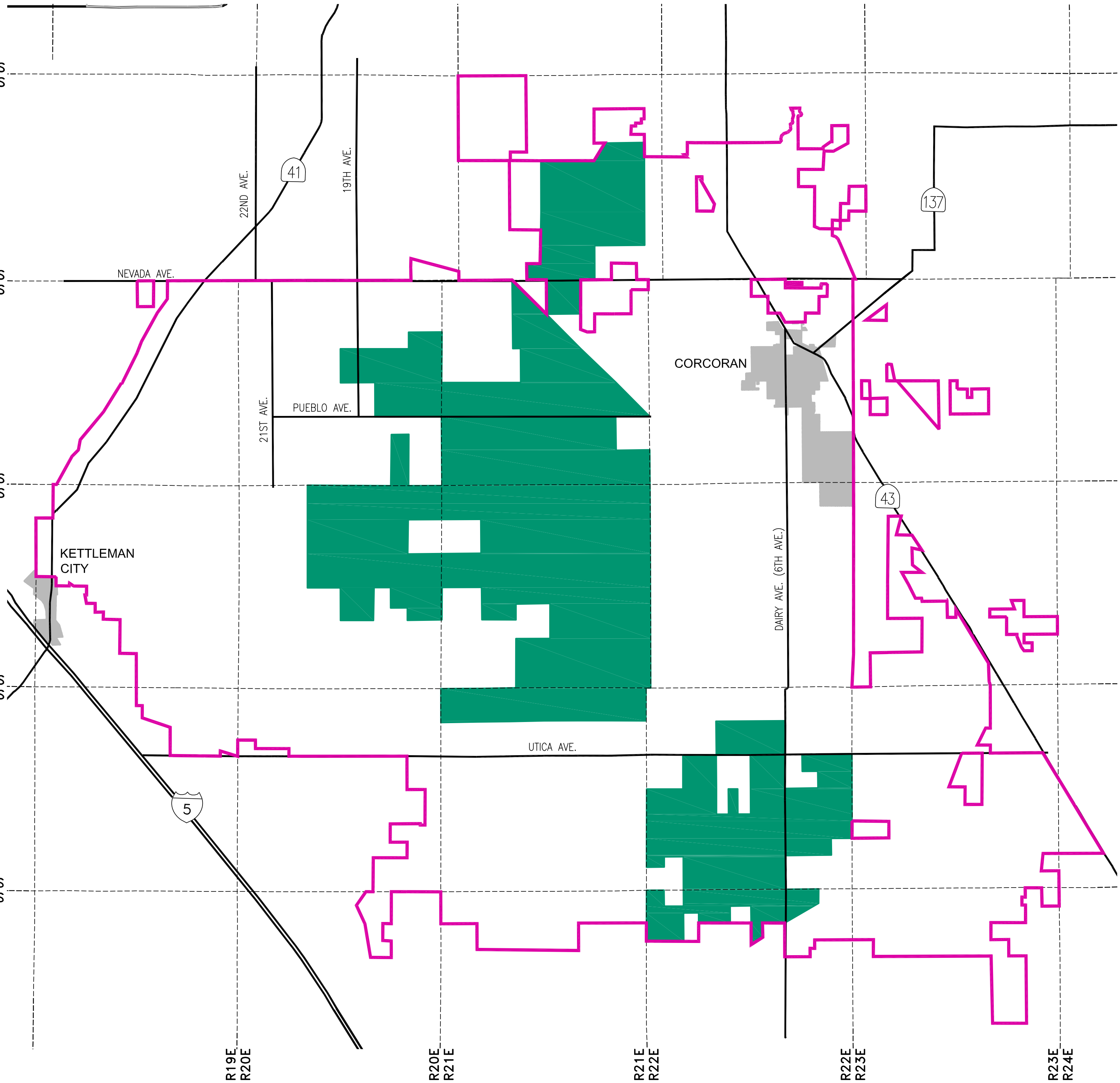
October 2011

FIGURE 8




## LEGEND

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- MELGA WATER DISTRICT

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

# MELGA WATER DISTRICT LOCATION MAP

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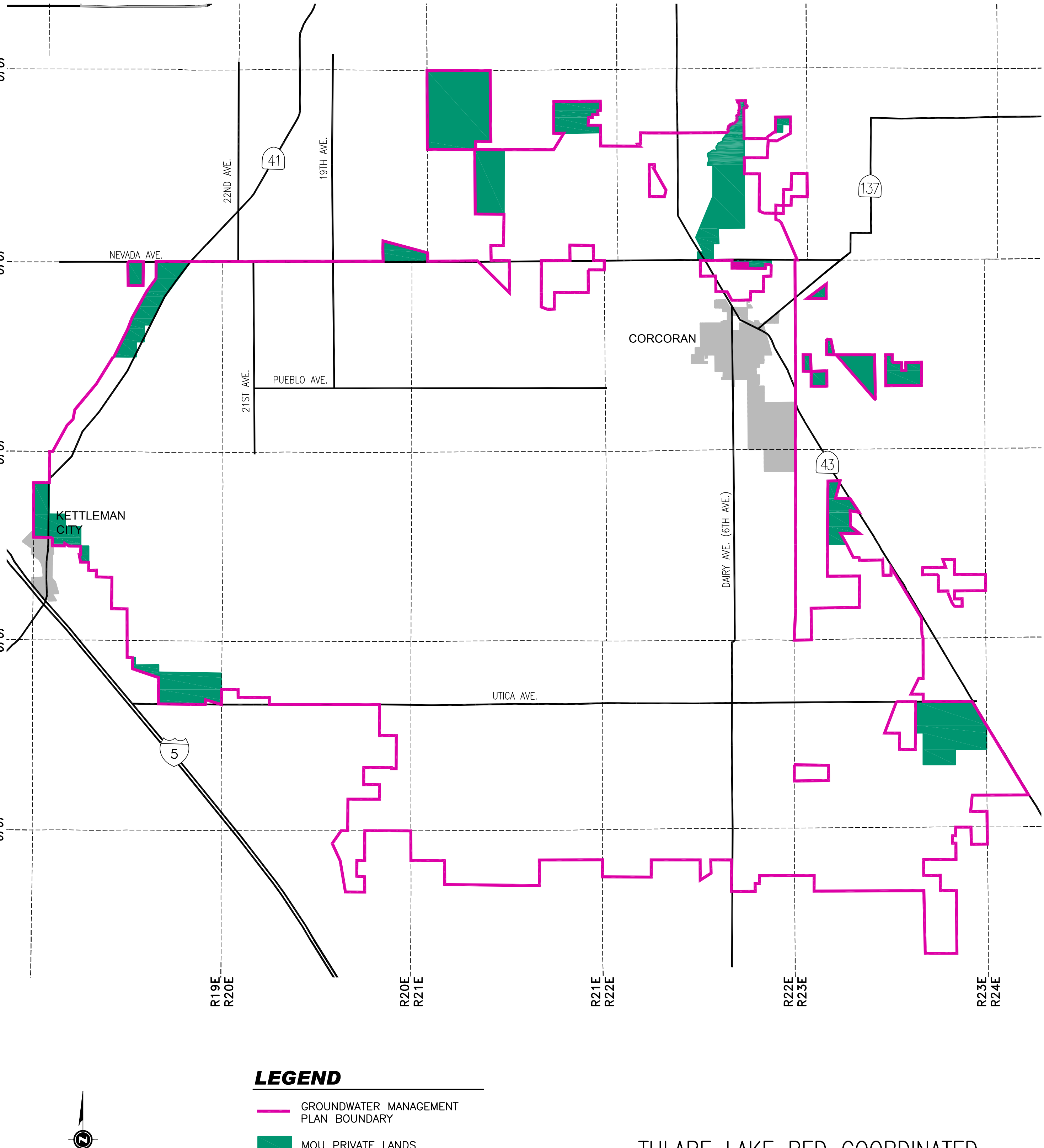


TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

# MOU PRIVATE LANDS LOCATION MAP

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HANFORD CALIFORNIA

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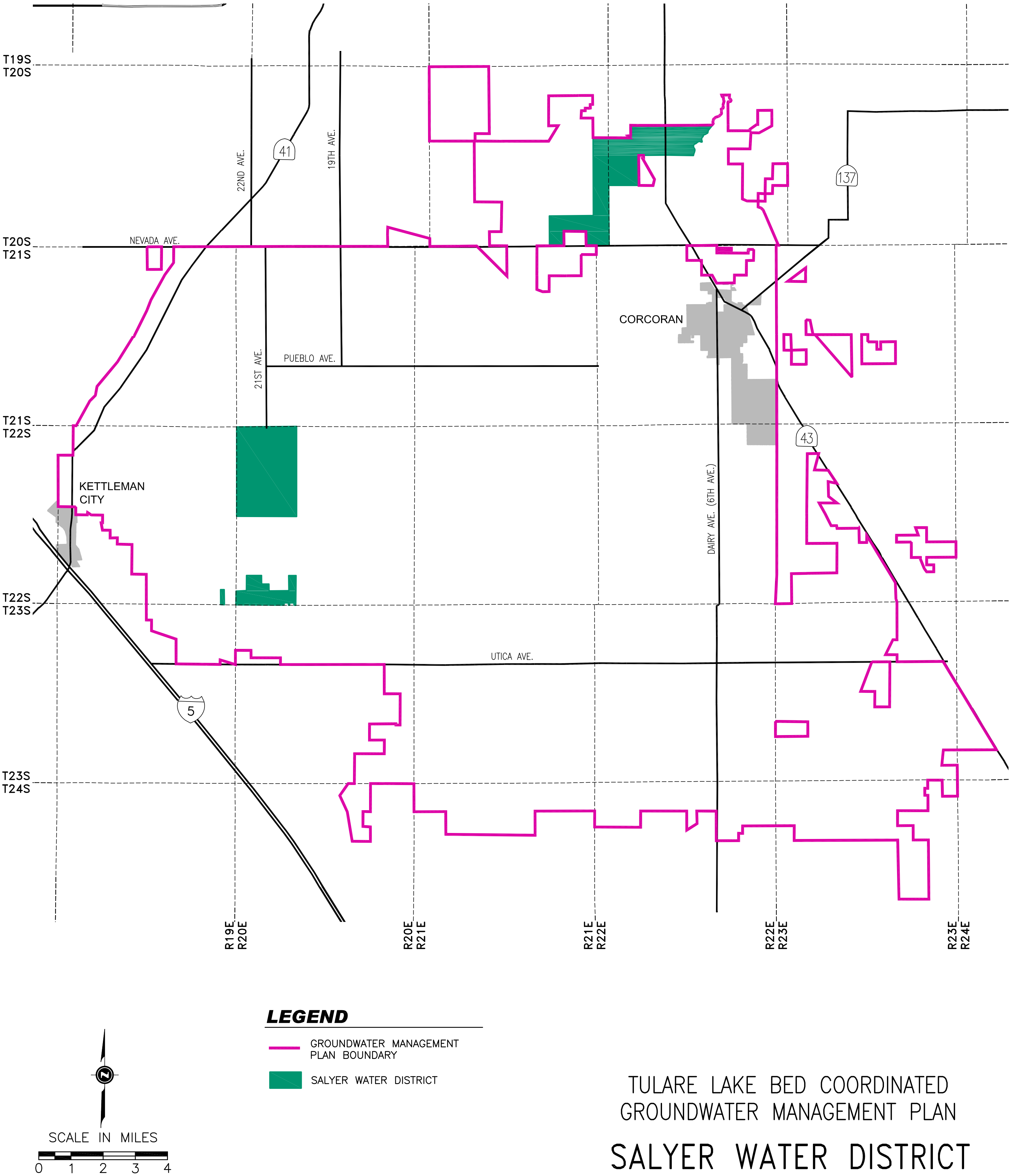
FIGURE 10




TULARE LAKE BED COORDINATED
GROUNDWATER MANAGEMENT PLAN

# SALYER WATER DISTRICT LOCATION MAP

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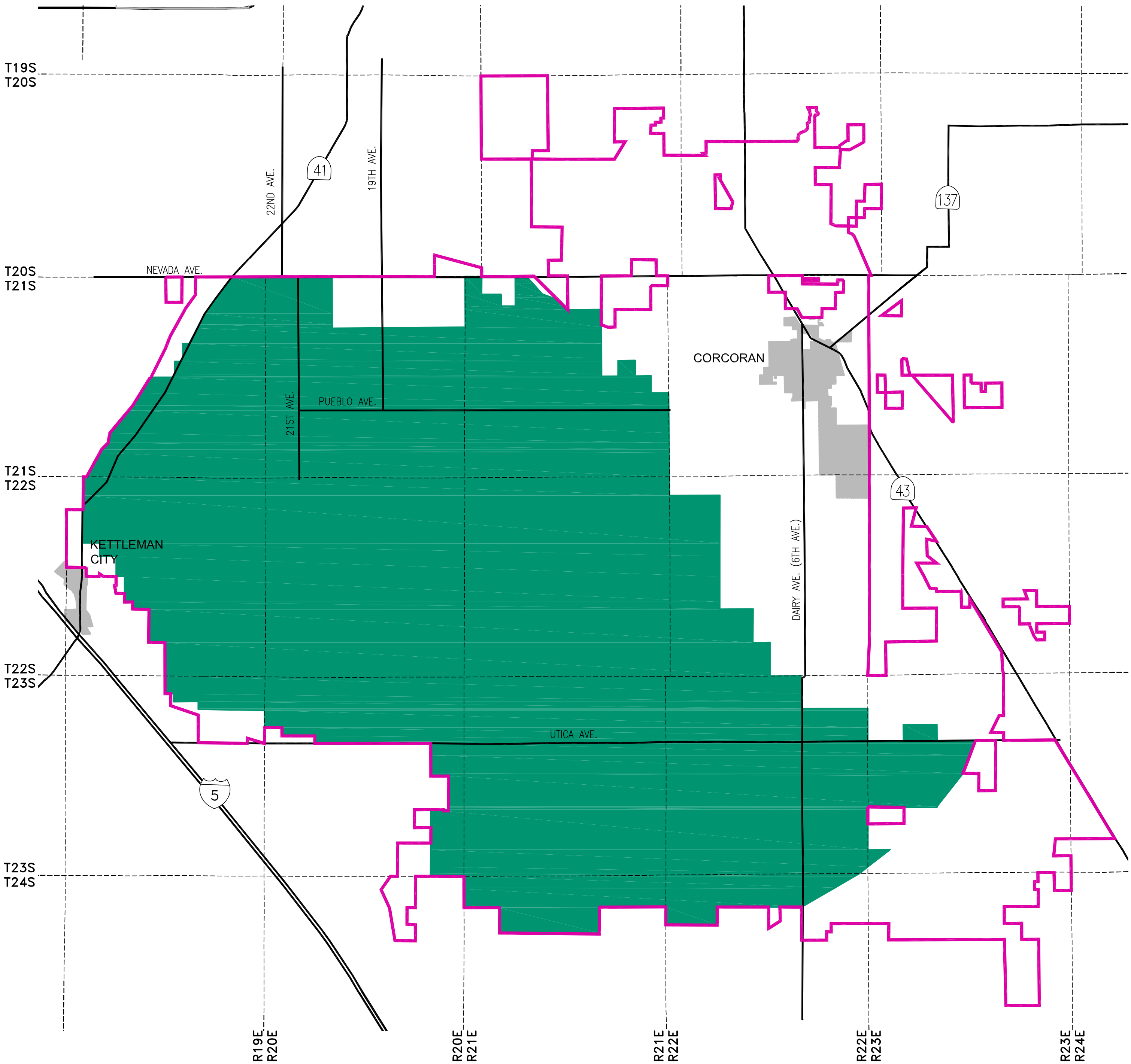
FIGURE 11




***LEGEND***

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- TULARE LAKE BASIN WATER STORAGE DISTRICT

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

# TULARE LAKE BASIN WATER STORAGE DISTRICT LOCATION MAP

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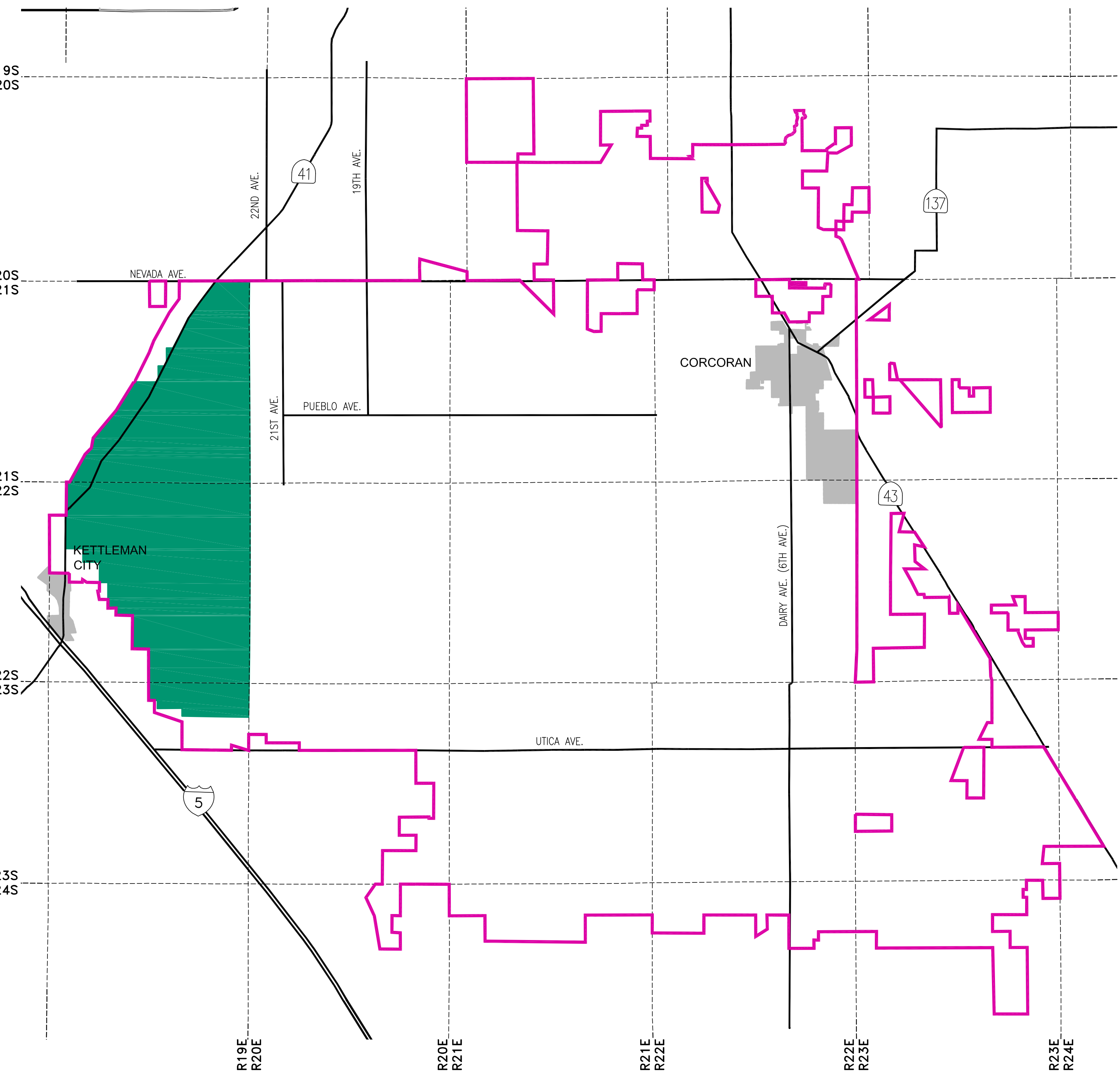
FIGURE 12




***LEGEND***

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- WESTLAKE FARMS RECLAMATION DISTRICT #761

SCALE IN MILES

0 1 2 3 4

TULARE LAKE BED COORDINATED
GROUNDWATER MANAGEMENT PLAN

# WESTLAKE FARMS
# RECLAMATION DISTRICT #761
# LOCATION MAP

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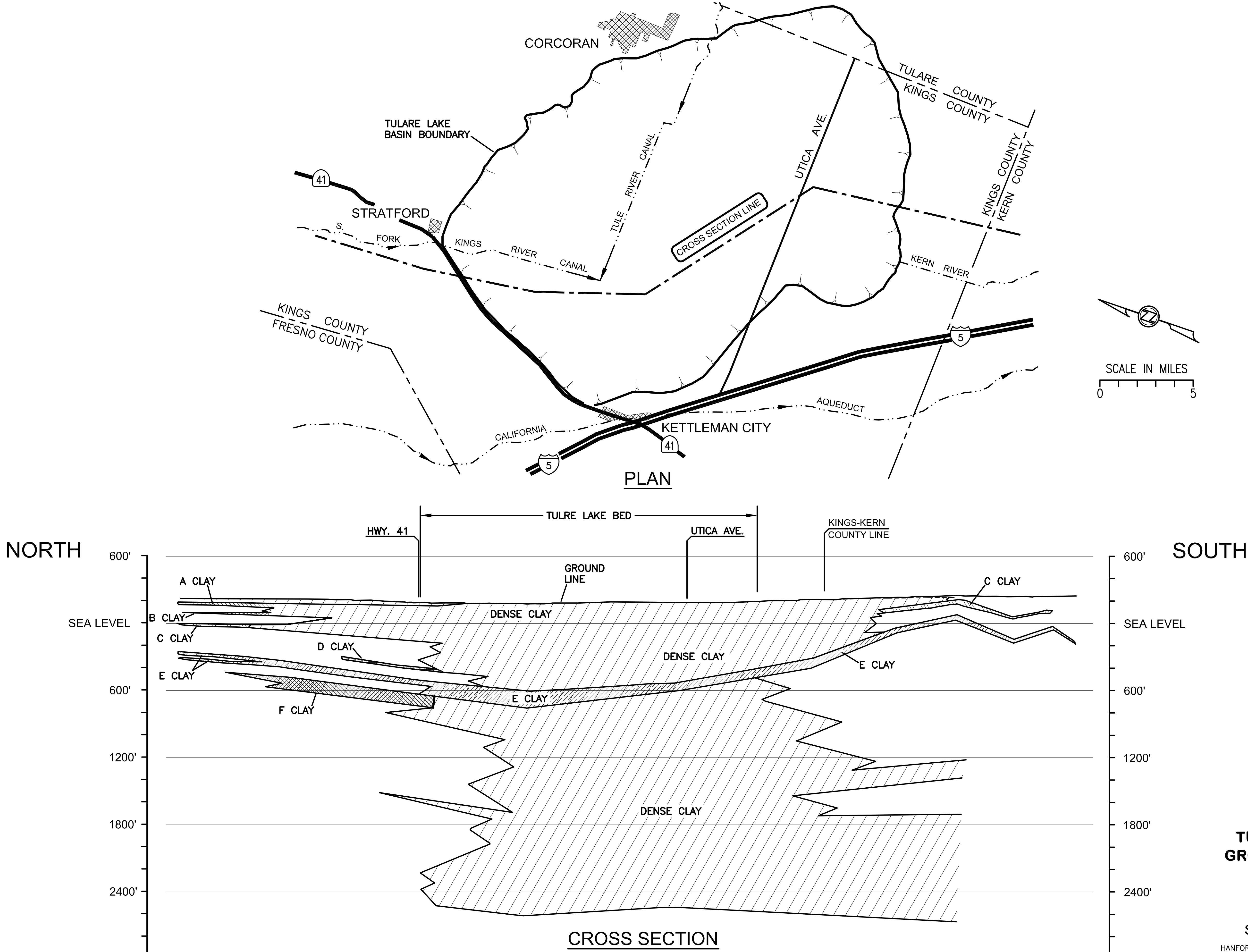
FIGURE 13




SOURCE: USGS WATER SUPPLY PAPER NO. 1999H

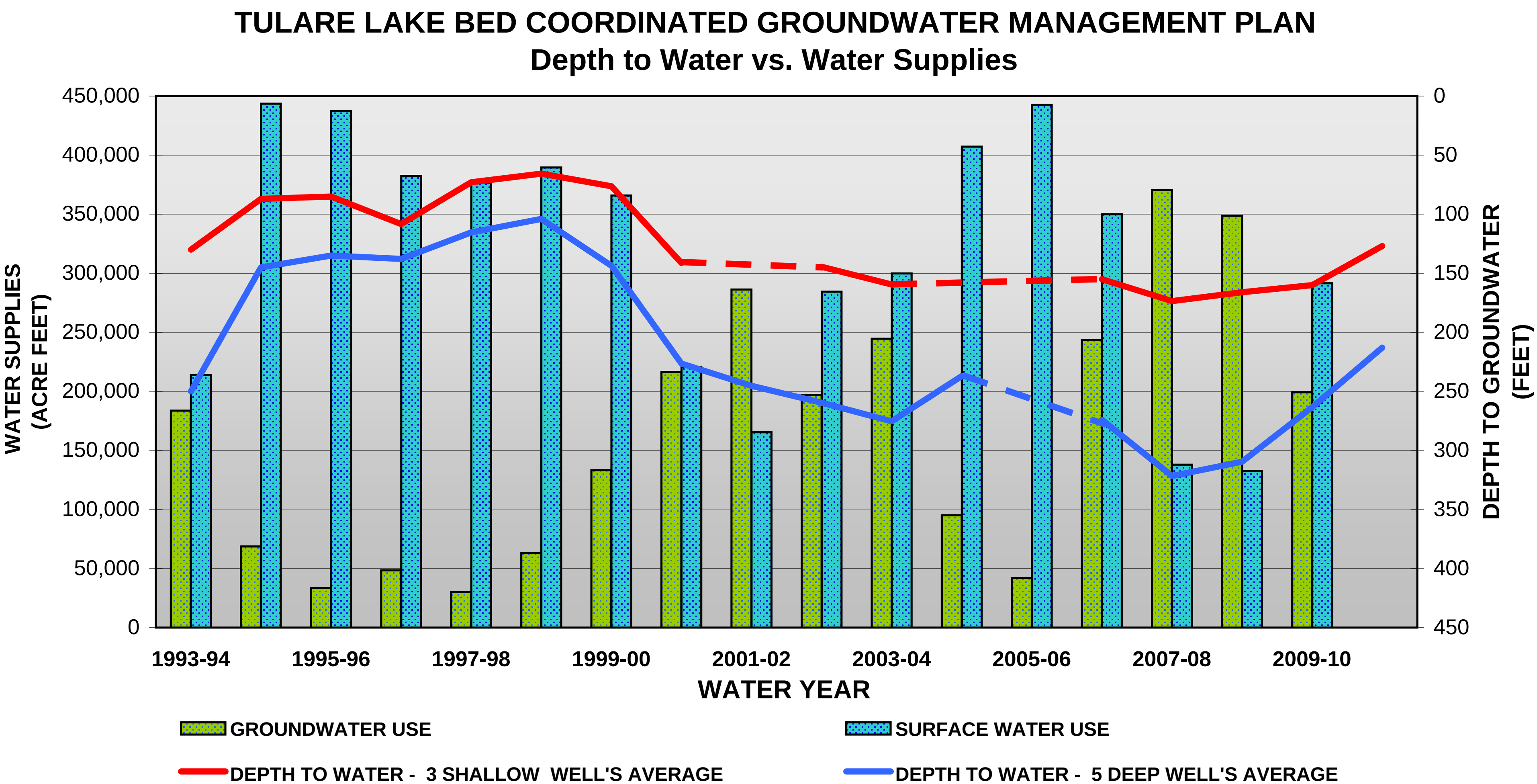
**TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN**

TULARE LAKE BED GEOLOGIC CROSS SECTION

SUMMERS ENGINEERING INC.
HANFORD Consulting Engineers CALIFORNIA

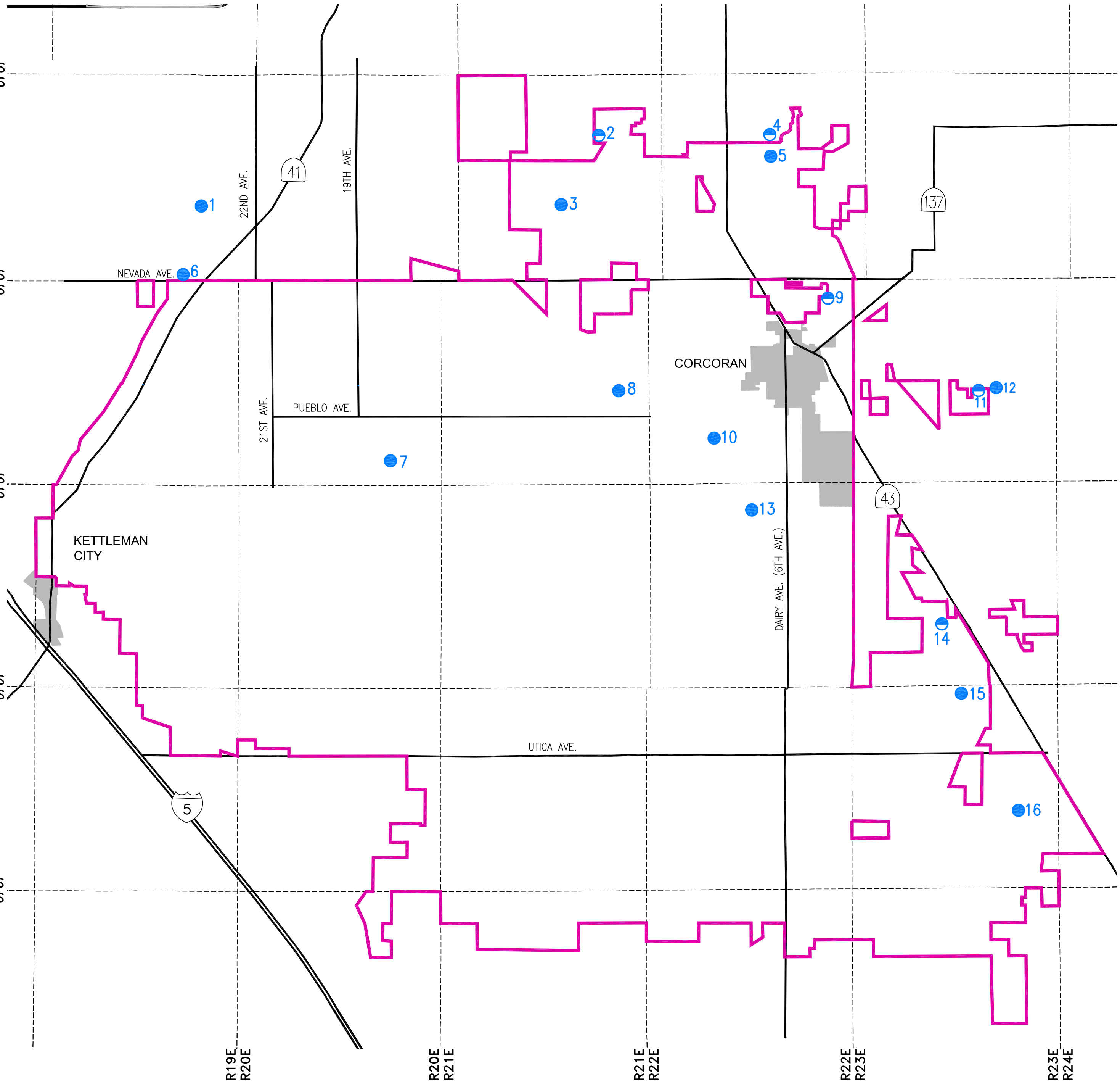
TLB11001.DWG

FIGURE 14



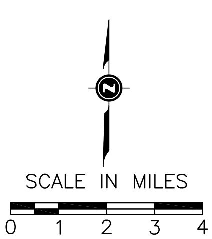

NOTES:
1. DASH LINE REPRESENTS MISSING DATA.
2. DEPTH TO GROUNDWATER IS AN AVERAGE OF THREE (3) SHALLOW WELLS AND FIVE (5) DEEP WELLS LOCATED WITHIN THE PLAN AREA.
3. WATER SUPPLIES EXCLUDE DELIVERIES TO LANDS WITHIN THE TULARE LAKE RECLAMATION DISTRICT NO. 761.

FIGURE 15




**LEGEND**

- GROUNDWATER MANAGEMENT PLAN BOUNDARY
- SHALLOW CASGEM WELL
- DEEP CASGEM WELL




# TULARE LAKE BED COORDINATED GROUNDWATER MANAGEMENT PLAN

# CASGEM WELLS LOCATION MAP

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October 2011

# Appendix D: Water Measurement Practices and Corrective Actions

## Description of Water Measurement Best Practices and Corrective Actions.

All turnouts within Corcoran Irrigation District (CID or District) are metered with totalizing propeller meters. The vast majority of delivery turnouts are through mobile pumping units which are owned and operated by the water users. Because of the mobile nature of these systems, anywhere between 60 and 100 of these pump turnouts may be operating within the District at any given time. These account for approximately 90%of the turnouts within CID and all of them are required to have correctly installed and operating meters in order to take deliveries.

The remaining 10% (two meters) are installed as open flow propeller meters at the end of a submerged pipe downstream of the turnout. As with the pump turnouts, correctly installed and operating meters are required at these turnouts in order to take deliveries. District staff has direct access to each meter.

| | |
|---|---|
|  |  |
| Typical mobile pumping system. | Typical open-flow meter installation. Note the weir wall placed to keep the pipe full. |

Collection of Water Delivery Data: Each meter includes a totalizer that records the delivered volume of water in acre feet. District Staff visit each meter monthly to record the totalizer value, which is entered into the CID data system, where the delivered water is calculated for billing.

Irrigated Acreage: Water users within CID are required to report their cropped (irrigated) acreage at the beginning of the water year.

Corrective Actions/Quality Control Procedures: Meters are visually inspected during each meter reading to confirm that they are operating correctly. If a meter is discovered to be not operating or installed correctly, the delivery is stopped until the water user corrects the problem. Installation and maintenance of the meters are the responsibility of the water user.