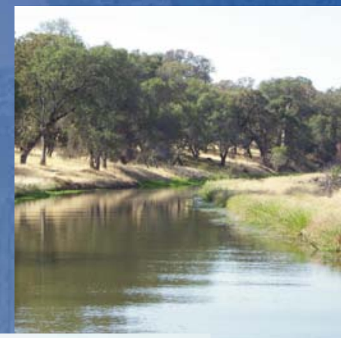

South Sutter Water District

Groundwater Management Plan

October, 2009

South Sutter Water District Groundwater Management Plan

prepared by

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Consulting Engineers, Inc.

October, 2009

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1. Introduction

South Sutter Water District (District) originally adopted a resolution of intention to draft a Groundwater Management Plan (Plan) in 1993. The District's intention at that time was to consider all of the potential components of a groundwater management plan as set forth in Water Code Section 10750. The District subsequently adopted a Groundwater Management Plan and that Plan remains in place today.

In April, 2009, the District adopted a resolution of intention to update its Groundwater Management Plan to meet current legal requirements and reflect current groundwater conditions, since its original Plan was adopted and since local basin conditions were last reported in 1993.

1.1 South Sutter Water District

The District is located in southern Sutter County and western Placer County, east of the Sacramento and Feather Rivers and south of the Bear River (Figure 1). The District was formed in May 1954 in order to develop, store, and distribute surface water supplies to augment and replenish local groundwater supplies. Prior to the development of surface water supplies in 1964, landowners within the District's service area had exclusively relied on groundwater to meet crop irrigation requirements; those rates of pumping had resulted in locally declining groundwater levels. As further discussed in this Plan, the use of surface water to supplement groundwater supplies restored and has maintained groundwater elevations above the depressed levels that preceded supplemental surface water availability.

The District encompasses approximately 66,000 gross acres, of which approximately 59,000 acres are irrigable. In recent years, approximately 45,000 acres within the District's Service Area have been planted to production agriculture and receive surface water from the District to supplement groundwater supplies. Another 7,000 acres within the overall boundaries of the District are irrigated solely with groundwater. Rice is the predominant crop planted within the District, comprising approximately 90% of the total acreage planted within any given year. Additional crops grown within the District include fruit and nut orchards, irrigated pasture, and row and field crops.

1.2 Water Requirements and Supplies

The District's main surface water supply originates from Camp Far West Reservoir on the Bear River. The reservoir was completed in 1963 and enlarged in 1964 to a storage capacity of 104,400 acre-feet (AF). Following a recent aerial and bathymetric survey preformed on Camp Far West Reservoir, the current storage capacity was determined to be approximately 93,740

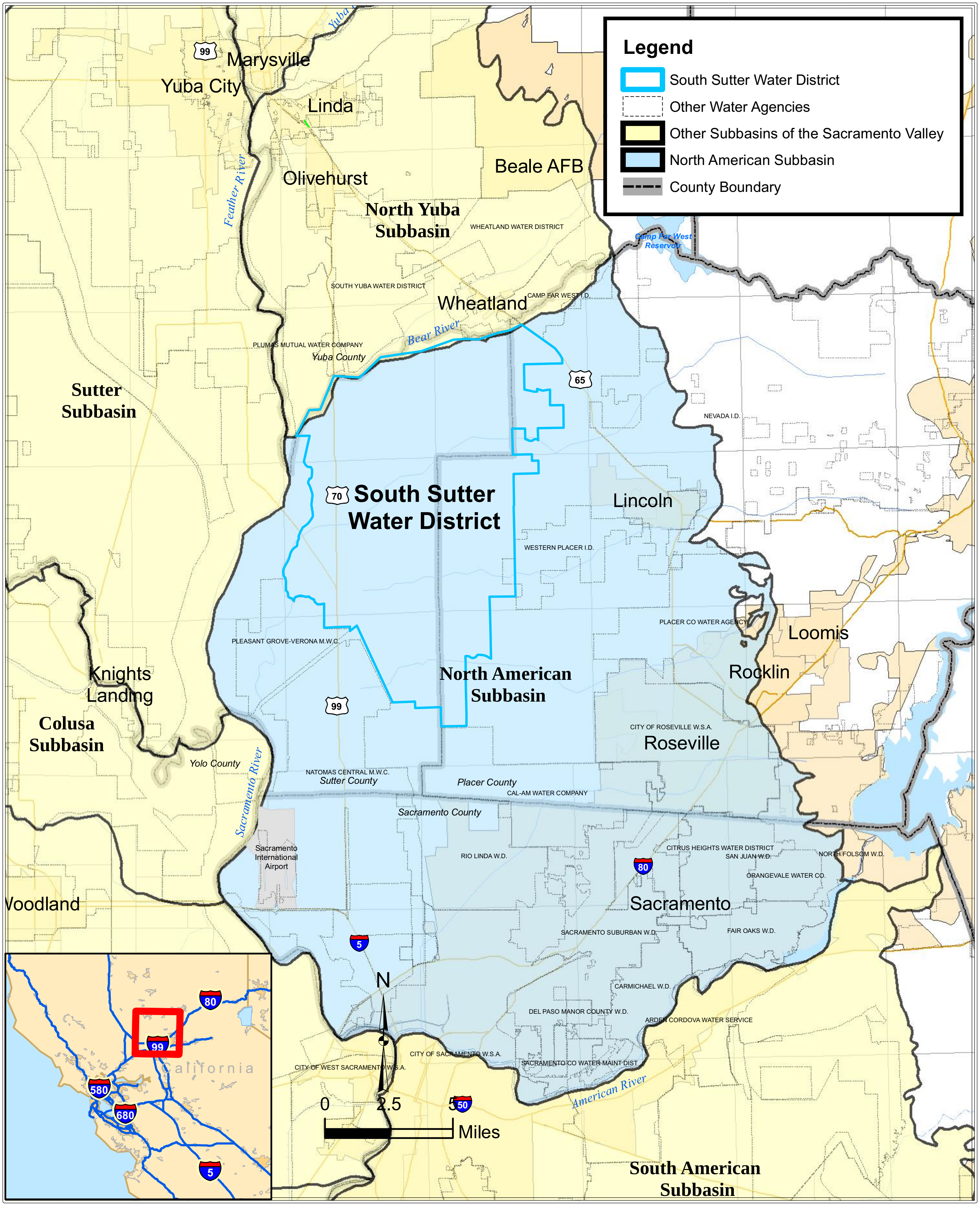

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Figure 1
Location Map - South Sutter Water District
North American Groundwater Subbasin
Sacramento Valley Groundwater Basin

acre-feet. The apparent decrease in storage capacity appears to be attributable to sedimentation and a combination of other factors including more accurate data collection and calculation procedures.

The District holds post-1914 appropriative water rights to store up to 102,100 acre-feet per year of water in the Camp Far West Reservoir, as well as direct diversion rights for the diversion and use of water from the Bear River. The District also holds direct diversion water right Licenses for small streams transecting the District service area.

In addition to its rights and licenses on the Bear River and small streams, the District receives supplemental sources of surface water from Nevada Irrigation District (NID) except during the driest years. The amount of water received from NID ranges from zero to 20,000 acre-feet per year (AFY).

The Camp Far West Dam and Reservoir are located immediately northeast of the District, approximately six miles east-northeast of the town of Wheatland (Figure 1). The dam is owned and operated by the District, and is a 175 feet high earthfill embankment; the spillway crest elevation is +300 feet, mean sea level. The Reservoir fills nearly every year, except during drought periods such as occurred in 1976-1977, 1988, and 1991. Releases from the reservoir exceed its nominal storage capacity in many years. During periods of extreme drought, such as in 1977, little or no surface water is available from the system, resulting in some crop fallowing and increased groundwater extraction within the District by individual landowners. The Reservoir normally fills by early March, normally spills during December through March, and can continue spilling into June during wet years.

Pursuant to an agreement between Camp Far West Irrigation District (CFWID) and the District during the construction and enlargement of the Reservoir, CFWID is entitled to the first 13,000 AF released from the Reservoir each year to satisfy its senior water rights along the Bear River. Diversions of Reservoir releases to CFWID are made at the CFWID North Canal along the Diversion Dam pool and at the CFWID South Canal along the District's main conveyance canal.

Diversions of Reservoir releases to the District are directed into the District's main conveyance canal for delivery to the service area. A pipeline and manmade and natural conveyance channels including creeks, ravines and sloughs convey water from the main canal to points of delivery along the District's conveyance system. Natural conveyance channels utilized for conveyance include the lower reaches of Yankee Slough, Coon Creek, Markham Ravine, Auburn Ravine, King Slough, and Pleasant Grove Creek (Figure 2).

Water is used conjunctively within the District, meaning that both groundwater and surface water supplies are utilized to meet total water demand. However, not all landowners within the District

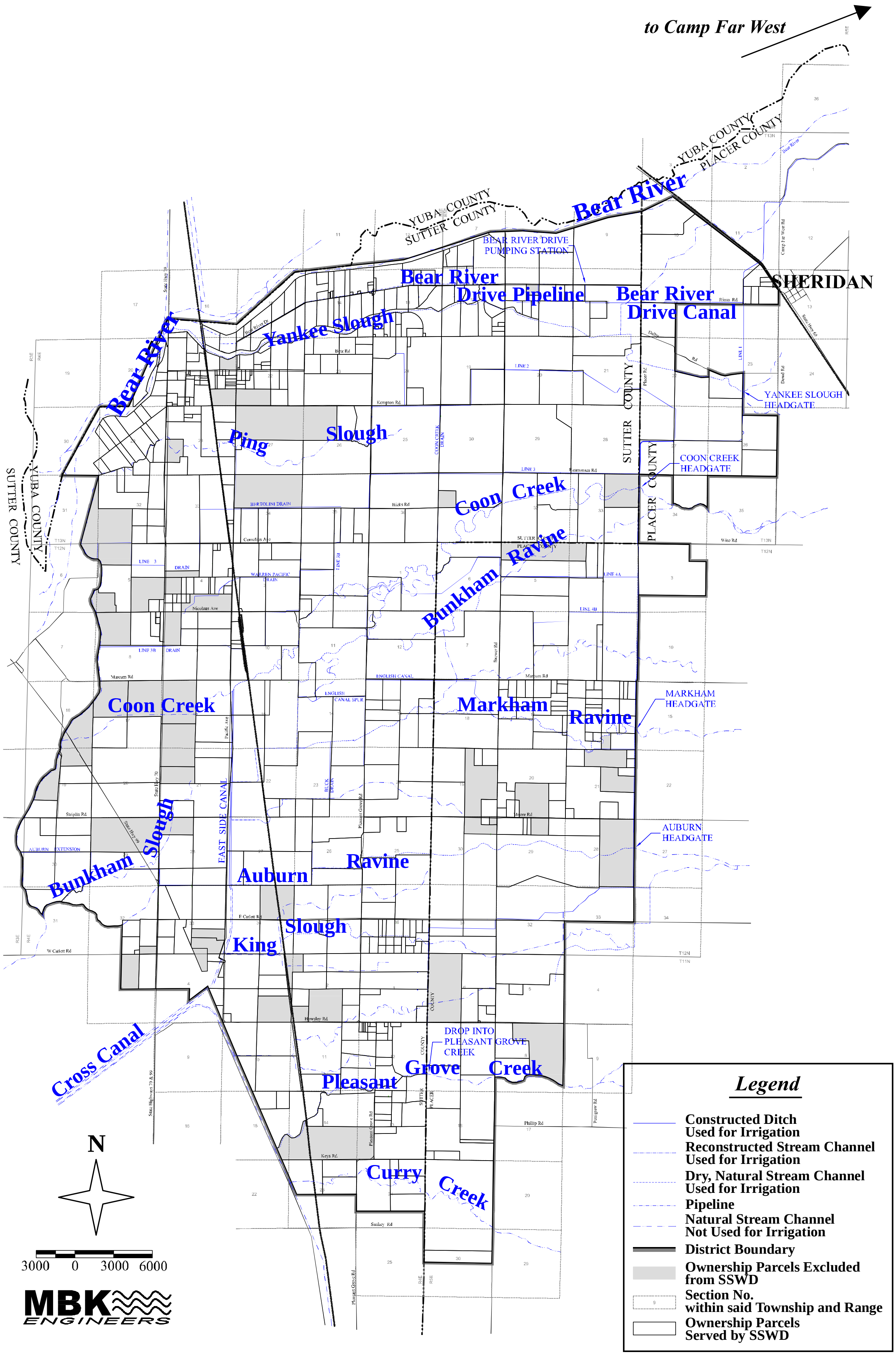

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Figure 2
Conveyance Map
South Sutter Water District

are District members; non-members do not receive surface water and thus irrigate solely with groundwater. While deliveries from the District have historically ranged between 0.0 and 2.5 AF of surface water per acre, deliveries to District members have averaged approximately 1.8 acre-feet of surface water per acre per year since the first year of full operation, 1964. Based on available records since 1968, the District has delivered an aggregate total of 3.4 to 4 million acre-feet of surface water to augment groundwater pumping by individual landowners. On average, approximately one-third of the total irrigation demand on those lands served by the District is met by surface water deliveries and approximately two-thirds of the total irrigation demand is met by individual landowner groundwater pumping.

1.3 Legislation and Water Code Provisions Related to Groundwater Management

In 1992, the California State Legislature adopted Assembly Bill 3030 (AB 3030) and in 2002 the Legislature enacted Senate Bill 1938 (SB 1938). These two pieces of legislation have been incorporated into the California Water Code, Section 10750 et seq., to encourage local public agencies/water purveyors to voluntarily adopt formal plans to manage groundwater resources within their jurisdictions. The District has prepared this update to the Plan to be compliant with AB 3030 and revisions to the Water Code pursuant to SB 1938.

The potential components of a groundwater management plan originally included in AB 3030 and now listed in Section 10753 of the Water Code include:

- control of saline water intrusion
- identification and management of wellhead protection areas and recharge areas
- regulation of the migration of contaminated groundwater
- administration of a well abandonment and well destruction program
- mitigation of conditions of overdraft
- replacement of groundwater extracted by water producers
- monitoring of groundwater levels and storage
- facilitating conjunctive use operations
- identification of well construction policies
- construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects
- development of relationships with state and federal regulatory agencies
- review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.

Amendments to the Water Code regarding the implementation of local groundwater management plans as a result of SB 1938 did not alter the potential components of a local groundwater management plan, as listed above, but did add the following provisions:

- The local agency, in preparing a groundwater management plan, shall make available to the public a written statement describing how interested parties may participate in developing the plan. For that purpose, the local agency may appoint, and consult with, a technical advisory committee consisting of interested parties.
- In order to qualify for funding assistance for groundwater projects, for funds administered by DWR, a local agency must accomplish all the following relative to groundwater management:
    - prepare and implement a groundwater management plan that includes basin management objectives for the groundwater basin that is subject to the plan.
    - include groundwater management components that address monitoring and management of water levels, groundwater quality degradation, inelastic land subsidence, and changes in surface flows and quality that either affect groundwater or are affected by groundwater pumping
    - include provisions to cooperatively work with other public (and presumably private) entities whose service area or boundary overlies the groundwater basin.
    - include mapping of the groundwater basin, as defined in DWR's Bulletin 118, and the boundaries of the local agency subject to the plan, plus the boundaries of other local agencies that overlie the basin.
    - adopt monitoring protocols designed to detect changes in groundwater levels, groundwater quality, inelastic land subsidence (for basins where subsidence has been identified as a potential problem), and flow and quality of surface water that either directly affect groundwater, or are directly affected by groundwater pumping.

In summary, the District has prepared this updated Plan to be compliant with the AB 3030 and SB 1938 requirements embedded in the Water Code as part of its interest in developing and sustaining reliable water supplies. To ensure the reliability of groundwater supplies to meet part of existing and projected water requirements, this Plan establishes a set of objectives for groundwater and interrelated surface water in the Plan area, continues the originally adopted components of groundwater management, and expands those components as appropriate.

Of the potential groundwater management activities listed in the Water Code, those already being investigated and actively implemented by the District include mitigation of conditions of overdraft, replacement of groundwater extracted by water producers, monitoring of groundwater levels, facilitating conjunctive use programs, and development of relationships with state agencies. The historic focus of groundwater management in the District has been on water supply, quantity and quality, to avoid conditions of overdraft, primarily by developing a supplemental surface water supply to augment local groundwater supplies and thus contribute to recovery and subsequent maintenance of groundwater levels and storage. While that focus is continued in this updated Plan, and others added as appropriate, the potential management provisions not implemented are more focused on groundwater quality and contamination issues that are not relevant to the Plan Area, e.g. control of saline water intrusion, and control or cleanup of groundwater contamination.

The balance of this Plan is organized to first establish a set of management objectives for the area; to then describe existing groundwater conditions; and to finally present a set of groundwater management elements which, in aggregate, comprise this overall groundwater management plan.

2. Management Objectives (Goals) for the Plan Area

The District's primary goal in preparing its initial groundwater management plan in 1993 was "to work cooperatively with landowners within the District to most efficiently manage groundwater resources and to continue with an efficient and effective conjunctive use program". That goal derived directly from recognition that development of a supplemental surface water supply by the District had led to the successful recovery and stabilization of groundwater levels via a conjunctive use program involving District deliveries of surface water and individual landowner pumping of groundwater. That original primary goal remains in place to continue the successful maintenance of groundwater levels as the balance of the original groundwater management plan is updated herein.

This Plan provides a management framework for maintaining a high quality, reliable, and sustainable supply of groundwater within the District, built on continuation of conjunctive use operations to meet local requirements while also providing opportunities to participate in other water supply programs within the sustainable yield of local surface water and groundwater resources. Management objectives intended to be achieved in the Plan area via implementation of this Plan thus include the following:

- Development of groundwater at a sustainable rate, in conjunction with supplemental surface water, to meet in-District water requirements and, as possible, to support dry-year or other out-of-District water supply programs.

- Avoidance of overdraft and associated undesirable effects such as declining groundwater levels, migration of poor groundwater quality, and land subsidence; in effect, continue the successful integrated use of groundwater with supplemental surface water that resulted in groundwater level recovery after introduction of surface water in the 1960's, followed by fluctuating but generally constant (not declining) groundwater levels over the last several decades.

- Preservation of groundwater quality for beneficial use in the Plan area, and for beneficial uses of surface water and groundwater discharges/outflows from the Plan area.

- Preservation of interrelated surface water resources through maintenance of surface water flows and non-degradation of surface water quality.

Quantitatively, the preceding goals translate into general preservation of groundwater levels and quality, including fluctuations in seasonal demands and varying local hydrologic conditions (wet and dry periods), to be confirmed by groundwater level and quality monitoring as included in this Plan. Specific issues to be considered include evaluation of available groundwater storage capacity, determination of sustainable groundwater yield, assessment of river-aquifer interconnection, and avoidance of land subsidence.

Over the long-term, if in-District water requirements change, or as out-of-District water supply opportunities develop, the District will seek to respond by utilizing its conjunctive use operations to meet those opportunities while remaining within the sustainability of its surface water and groundwater supplies. For example, future water transfers may become possible through the DWR Drought Water Bank or other mechanisms, and the District will determine the feasibility of a water transfer within the overall context of this Plan, while maintaining a reliable water supply for its customers and minimizing any undesirable impacts that could potentially result.

3. Groundwater Basin Conditions

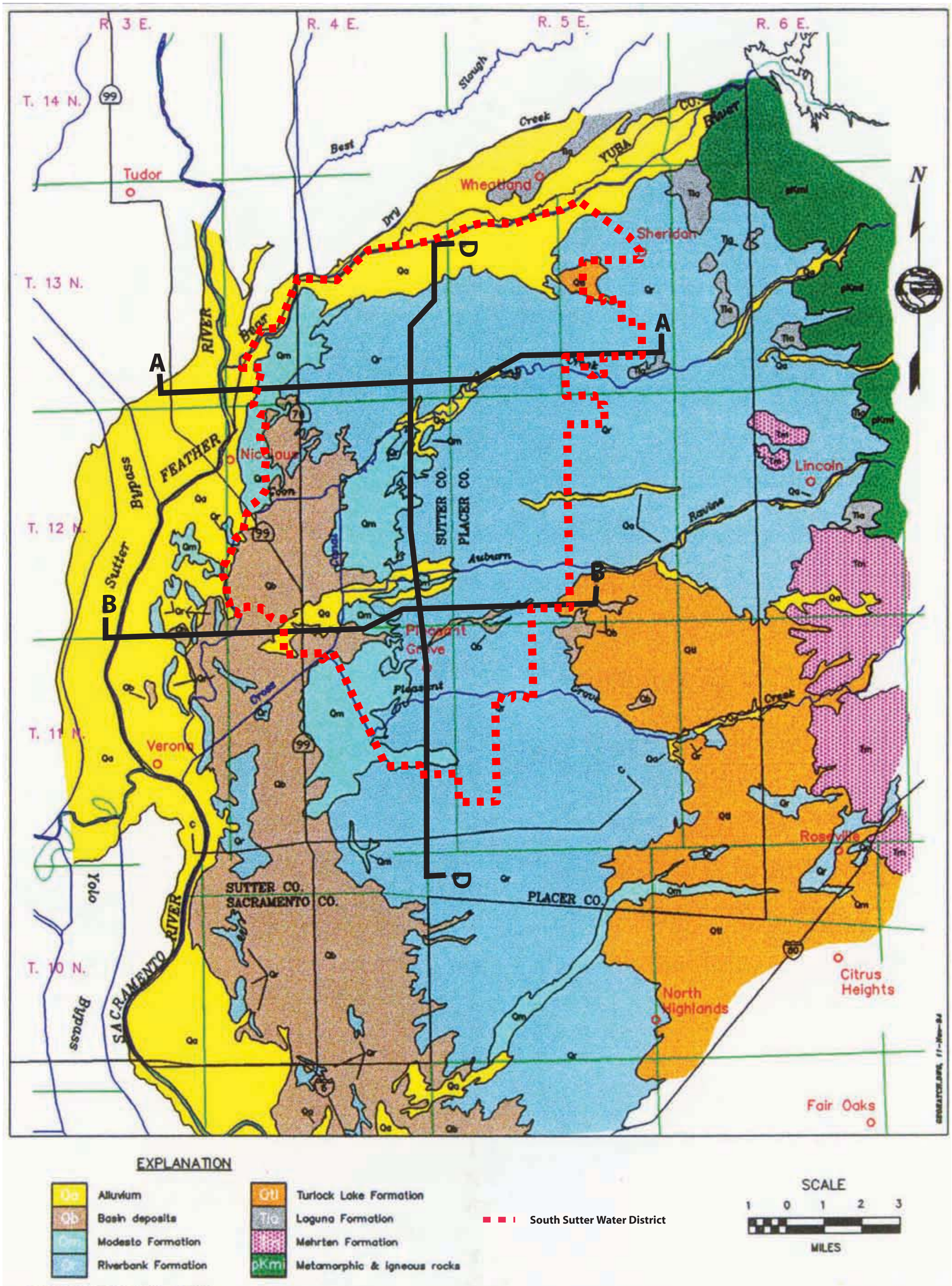
3.1 North American Groundwater Subbasin

The District, and thus the Plan Area, is located in the southeastern portion of the Sacramento Valley Groundwater Basin, at the northern end of the North American Groundwater Subbasin, (Basin No. 5-21.64 in DWR Bulletin 118-2003), which is one of eighteen subbasins in the Sacramento Valley Groundwater Basin. The North American Subbasin is bounded on the north by the Bear River, on the west by the Feather and Sacramento Rivers, on the south by the American River, and on the east by the approximate edge of the alluvial aquifer in the Sierra Nevada foothills (Figure 1). The western portion of the subbasin is a nearly flat flood basin for the Bear, Feather, Sacramento, and American rivers, and several small streams originating from the foothills that are tributaries to those rivers. The subbasin drains in a generally west-southwest direction at an average grade of about five percent. Precipitation in the subbasin ranges from 18 to 20 inches in the western half of the subbasin to 20 to 24 inches in the eastern half of the subbasin (DWR, 2006).

3.2 Geologic Setting – Water Bearing Formations

DWR's Bulletin 118 (2006) and Feasibility Report (1997) include descriptions of the subsurface water bearing materials in the North American Subbasin. From deepest/oldest to shallow/youngest, those materials are known as the Mehrtan Formation, the Laguna and Turlock Lake Formations, the Riverbank and Modesto Formations, and Flood Plain Deposits and Alluvium. Surface outcrop locations for those materials are illustrated in Figure 3. Within those water bearing materials, the base of fresh water deepens westward from about 400 feet below sea level near the Sierra Nevada foothills to over 1,200 feet below sea level at the axis of the Sacramento Valley (DWR, 1997).

Mehrten Formation – The oldest freshwater bearing sediments in the subbasin are known as the Mehrten Formation, a sequence of late Miocene through middle Pliocene fragmented volcanic rocks, that unconformably overlie marine and brackish-water sediments of Eocene age. The Mehrten Formation can be divided into two distinct units based on composition, and is exposed only on the eastern side of the subbasin, east of the District near Lincoln and south toward Roseville. One of these units is a sedimentary unit consisting of gray to black andesitic sands and gravels deposited by fluvial activity and originating from andesitic source rocks in the Sierra Nevada. The other distinct unit, which is interbedded with intervals of the previous unit, is composed of dense, hard, gray tuff breccia derived from volcanic eruptions in the Sierra Nevada. The Mehrten Formation provides highly permeable intervals of sand and gravel as well as confining layers composed of the tuff breccia intervals. Depending on location, the Mehrten



adapted from DWR, 1997 Feasibility Report, American Basin Conjunctive Use Project

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Figure 3
Generalized Geologic Map with Cross-Section Locations
North American Subbasin

Formation is between 200 and 1,200 feet thick, and wells completed in the sand and gravel units have reported pumping capacities of over 3,000 gallons per minute (gpm).

Laguna and Turlock Lake Formations – The Pliocene-age Laguna Formation and the early Pleistocene-age Turlock Lake Formation unconformably overlie the Mehrten Formation. The Turlock Lake Formation can be distinguished from the Laguna Formation in outcrop due to the presence of a preserved clay soil horizon, which had been stripped by erosion in the Laguna Formation. The Laguna Formation outcrops very rarely in the subbasin, surfacing near Wheatland and towards the east and south of the North American Subbasin in small areas. The Turlock Lake Formation outcrops in the southeast of the subbasin, and in a small area just southwest of Sheridan. The Laguna and Turlock Lake formations are lithologically indistinguishable in the subsurface, both consisting of a heterogeneous mixture of tan to brown interbedded silt, clay, and sand with a few gravel lenses that are poorly sorted and have relatively low permeability. The two formations have a combined thickness of less than 200 feet. Due to the predominantly fine-grained character of these two formations, wells completed in them reportedly have low to moderate yields, usually less than 1000 gpm.

Riverbank and Modesto Formations – The Pleistocene-age Riverbank and Modesto formations are the most widely exposed geologic units in the study area; they unconformably overlie the Turlock Lake, Laguna, and Mehrten formations and pre-Cretaceous metamorphic and igneous rocks. The Riverbank and Modesto formations are lithologically indistinguishable in the subsurface, composed of mixtures of silt, sand, gravel, and clay that are very heterogeneous laterally and vertically. The combined thickness of these two formations can be up to 75 feet. As a whole, these two formations are moderately permeable, but include highly permeable coarse zones.

Flood Basin Deposits and Alluvium – These sediments are also known as the Younger Alluvium as they are the youngest geologic units in the subbasin. Laterally extensive outcrops of the Alluvium deposits occur along the Bear, Feather, and Sacramento Rivers, while the Flood Basin deposits outcrop on the western margin of the subbasin; immediately east of the Sacramento River. The Alluvium is composed of stream channel deposits, originating in the channels of active streams as well as overbank deposits of those streams, terraces, and local dredge tailings. Flood Basin deposits consist primarily of poorly drained silts and clays, although interbedded local lenses of sand and gravel may occur from the deposition of migrating ancestral river channels. The thickness of each of these units may be up to 100 feet. The sand and gravel zones of the Alluvium deposits are highly permeable and yield significant quantities of water to wells, whereas the Flood Basin deposits have low permeability and generally yield low quantities of water to wells.

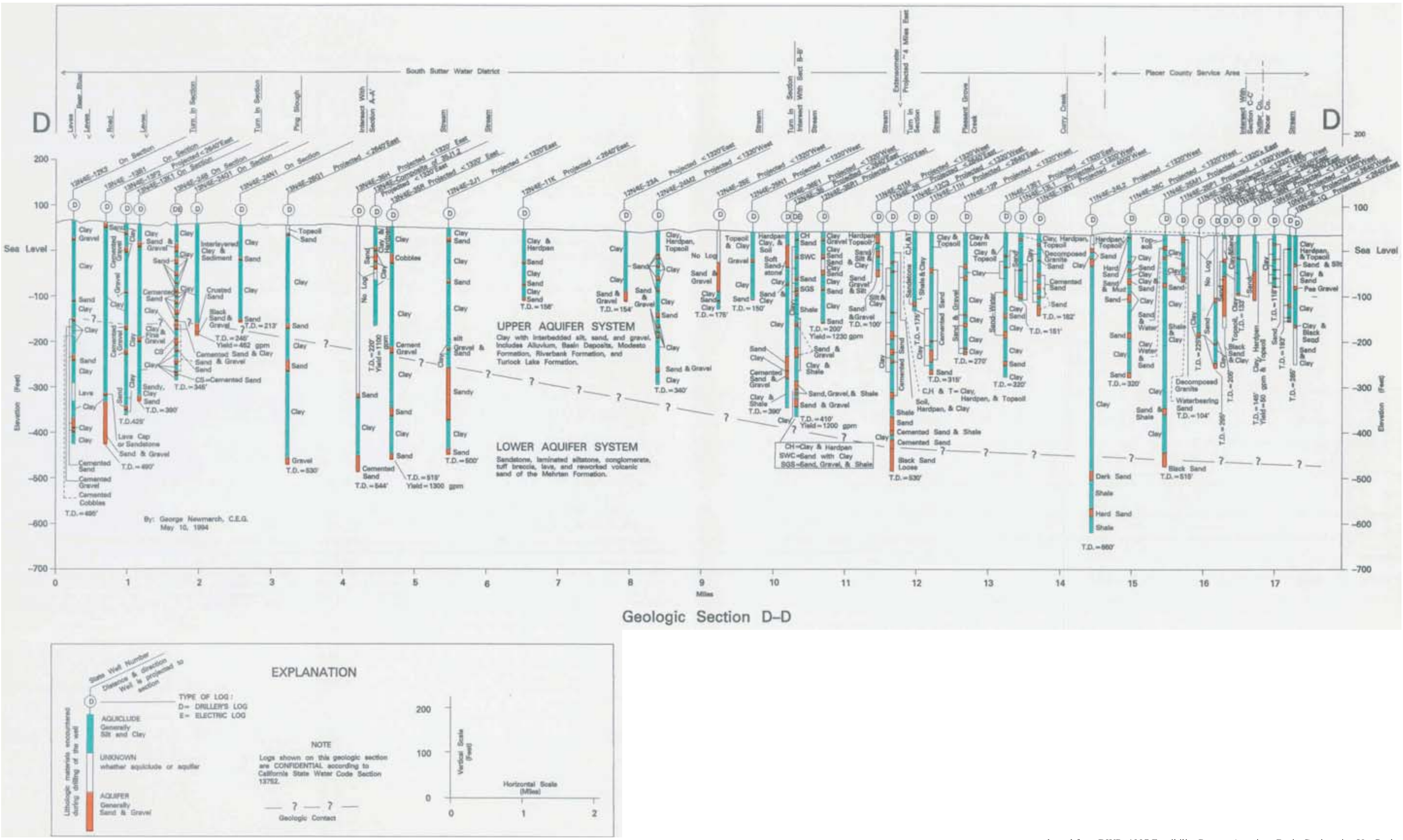
The geologic units described above have been grouped and separated into two aquifer units in the District area. The upper aquifer includes saturated Laguna Formation and younger unconfined sediments (Riverbank and Modesto Formations, and Flood Basin Deposits and Alluvium) consisting of generally thin and laterally discontinuous sands and gravels separated by thick sequences of clay strata. The lower aquifer consists of Mehrten Formation continental deposits, including a significant amount of fine-grained materials. Sand and gravel units are generally thicker than the upper aquifer, but are still laterally discontinuous. DWR has been monitoring a site near the southern border of the District with multiple completion monitoring wells, where water levels show a vertical gradient between the two aquifer units, and some hydraulic interconnection. Most of the production wells located throughout the District are thought to be completed in the upper aquifer. With time, implementation of this Plan is intended to produce a more thorough definition of well construction and completions throughout the District.

Three of the geologic cross-sections in DWR's American Basin Conjunctive Use Feasibility Report (1997) illustrate the approximate delineation of the upper and lower aquifer systems beneath the District. Cross-section D-D, oriented north-south shows the thickness of the upper aquifer ranging from about 200 feet in the north to about 500 feet at the southern border of the District (Figure 4). Cross-section A-A trends east-west in the northern portion of the District; it indicates that the thickness of the upper aquifer ranges from 250 feet to almost 300 feet (Figure 5). The other east-west trending cross-section, B-B, located in the southern part of the District, shows more of a dip in the depositional units, with the upper aquifer thickening to the west, from about 300 feet in the east to just over 500 feet in the west (Figure 6).

3.3 Groundwater Elevations

Prior to the 1960's, groundwater was the sole source of water supply in most parts of the North American Subbasin, including the District area. A strong dependence on groundwater existed in the southern central portion of the Subbasin, generally south of the District, resulting in groundwater declines at an average rate of up to about one and a half feet per year for about 50 years, through the 1980s to mid-1990s. The introduction of surface water sources has subsequently resulted in stabilization to some recovery of groundwater levels, although an elongated groundwater depression remains to the south of the District, in the McClellan Air Force Base area in northern Sacramento County where groundwater levels are tens of feet lower than in surrounding areas. Throughout the North American Subbasin, groundwater levels continue to fluctuate seasonally and through varying climatic conditions.

In the vicinity of the District, DWR has historically monitored over 150 wells for water level elevations. Approximately 79 of those wells are located within the District service area, with a composite period of record from 1932 to 2009. In and near the District, groundwater elevations



adapted from DWR, 1997 Feasibility Report, American Basin Conjunctive Use Project

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Figure 4
Cross-Section D
North American Subbasin

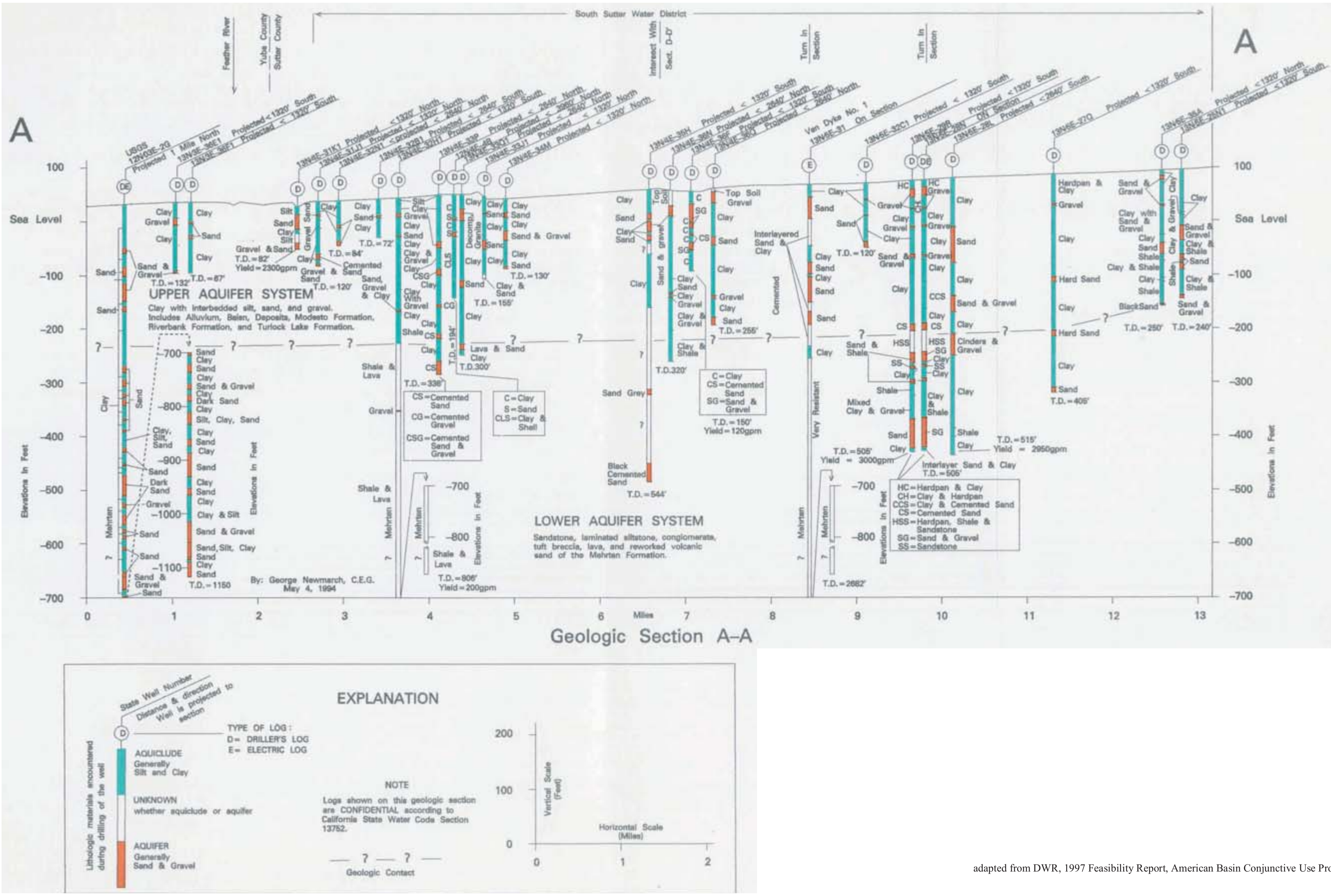

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Figure 5
Cross-Section A
North American Subbasin

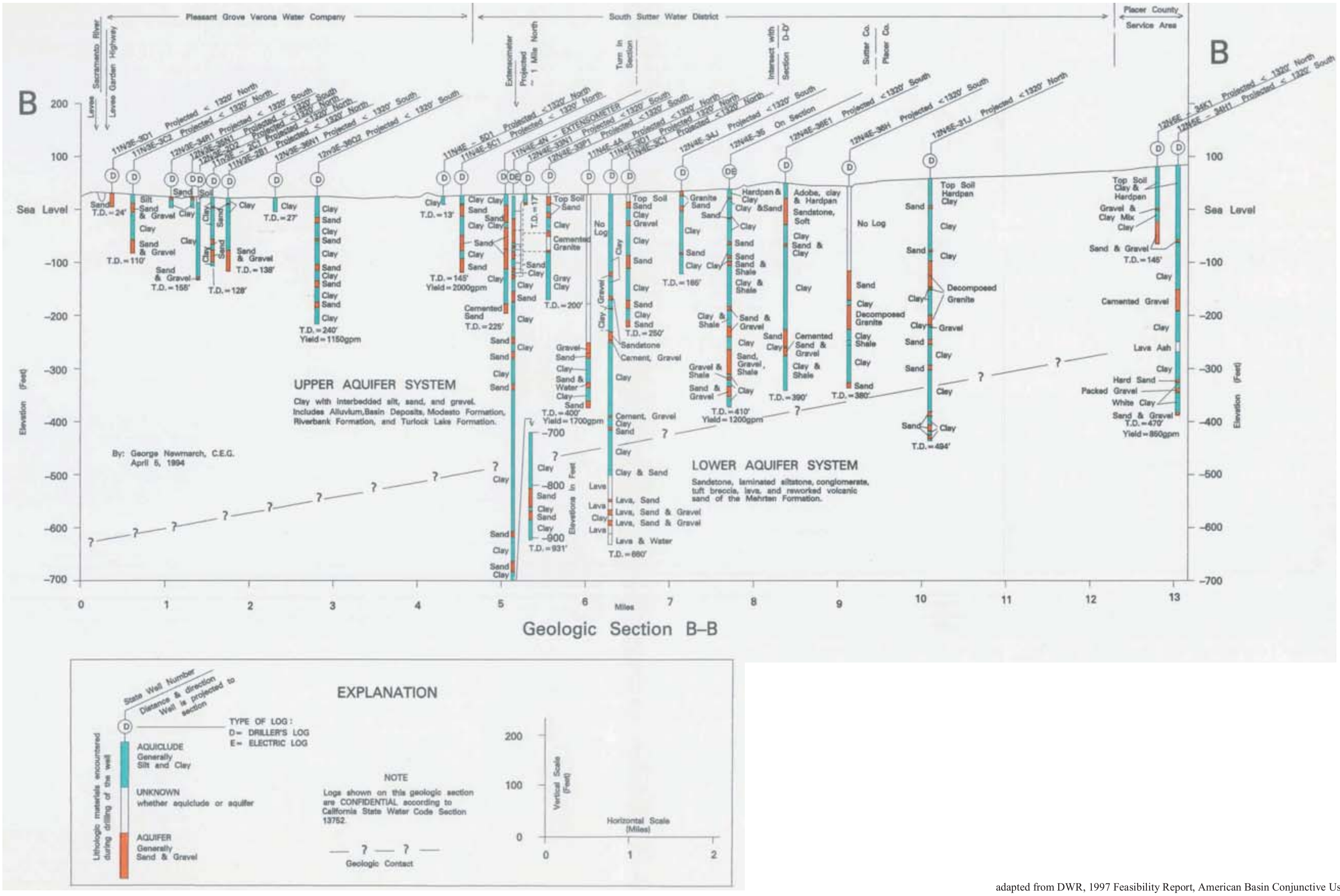

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Figure 6
Cross-Section B
North American Subbasin

are typically higher to the north and east, and lower to the south and west in both aquifer units. A collection of representative long-term hydrographs illustrates the history of groundwater level fluctuations in the District area (Figure 7). In general, groundwater levels had declined as much as 45 feet before construction of the Camp Far West Reservoir. Subsequent delivery of surface water resulted in recovery of groundwater levels by the early 1970s, to near recorded high elevations in the 1930s-1950s. Critically dry conditions in 1976 and 1977 curtailed the surface water supply, with no surface water delivered in 1977. The corresponding increase in groundwater pumping to meet irrigation requirements caused groundwater declines of as much as 40 feet, but subsequent wet conditions through the early to mid-1980s resulted in full groundwater level recovery. Despite dry conditions in the late 1980s through the early 1990s, the District maintained some deliveries of surface water, in turn contributing to generally stable groundwater conditions during that period. Since then, wet conditions through the mid-1990s, followed by dry conditions over the last couple of years, are reflected in rising and subsequent decrease in groundwater levels over that period.

The District's ability to maintain a successful conjunctive use policy has resulted in increased groundwater level stability in the area as seen in the representative hydrographs. Groundwater is typically stable throughout the District area, with small amounts of fluctuation (10 to 20 feet in the southwest, and 30 to 40 feet to the east and north) reflecting seasonal and climatic conditions. There is no indication of overdraft, as water levels are not continuously dropping in any part of the District.

A set of contour maps of equal groundwater elevations illustrates historical changes in groundwater elevations and flow directions from pre-surface water (1963) through the recovery and subsequent fluctuations illustrated on Figure 7 and described above. Previously prepared contours of equal groundwater elevation for 1963, 1971, 1978, and 1993 are included from two Groundwater Conditions reports prepared for the District (MBK, 1970; MBK, 1994), and two additional maps were created for 2003 and 2008 to illustrate recent conditions for this Plan.

The first map displaying contours of equal groundwater elevation, for the spring of 1963, was based on water level data from wells completed in both the upper and lower aquifers (Figure 8). It reflects conditions in the year before the District started delivering surface water, which was the historic low point for groundwater levels in the District area. The direction of groundwater flow was toward two pumping depressions, one at the center of the District and the other to the south. Groundwater elevations ranged from as high as 120 feet above sea level immediately east of the District where groundwater was flowing toward the pumping depressions, the deeper of which was about 20 feet below sea level at the south end of the District.

Contours of equal groundwater elevation for spring 1971 (Figure 9), again based on groundwater data from wells completed in the upper and lower aquifers, show groundwater conditions near

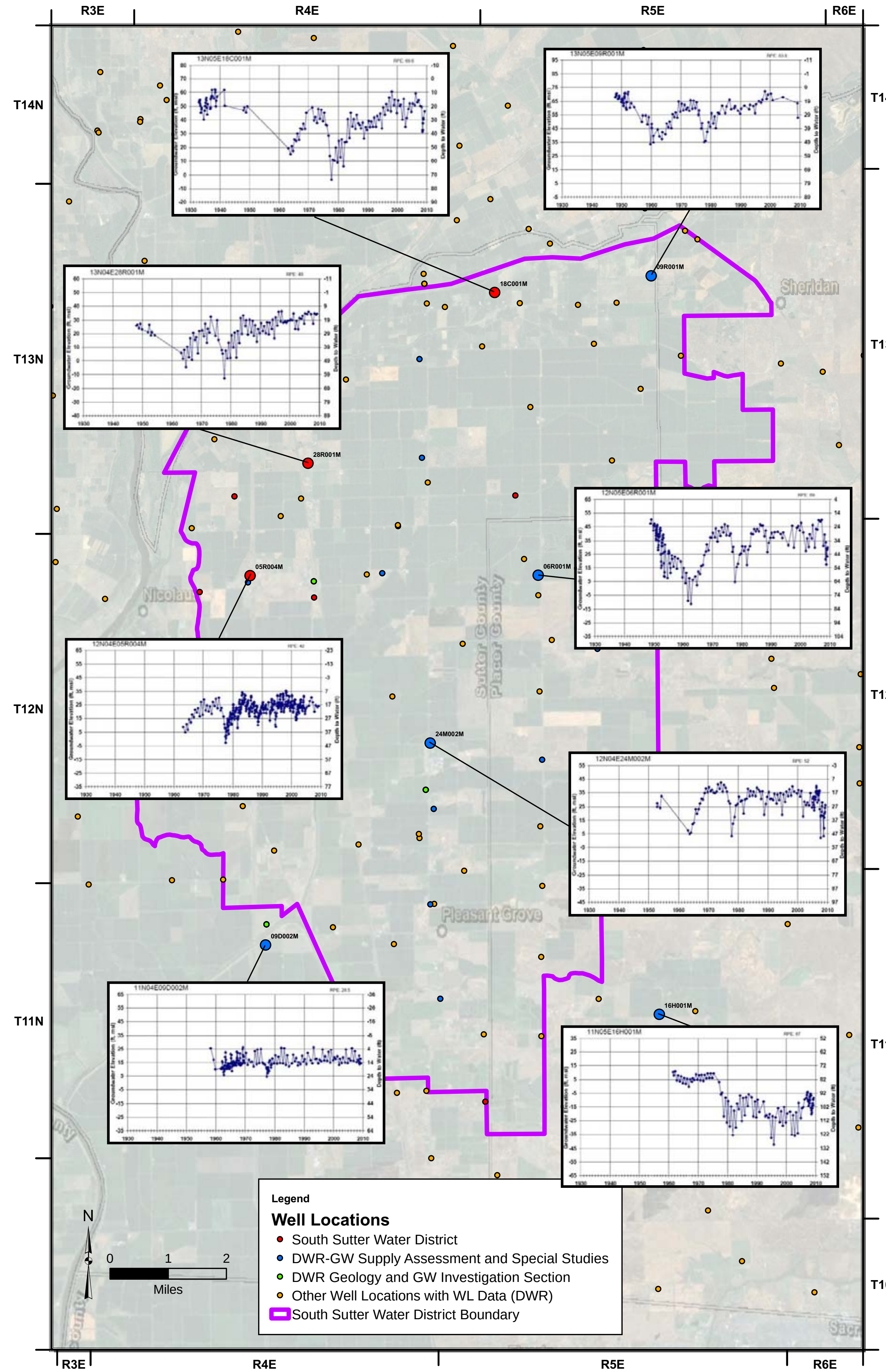

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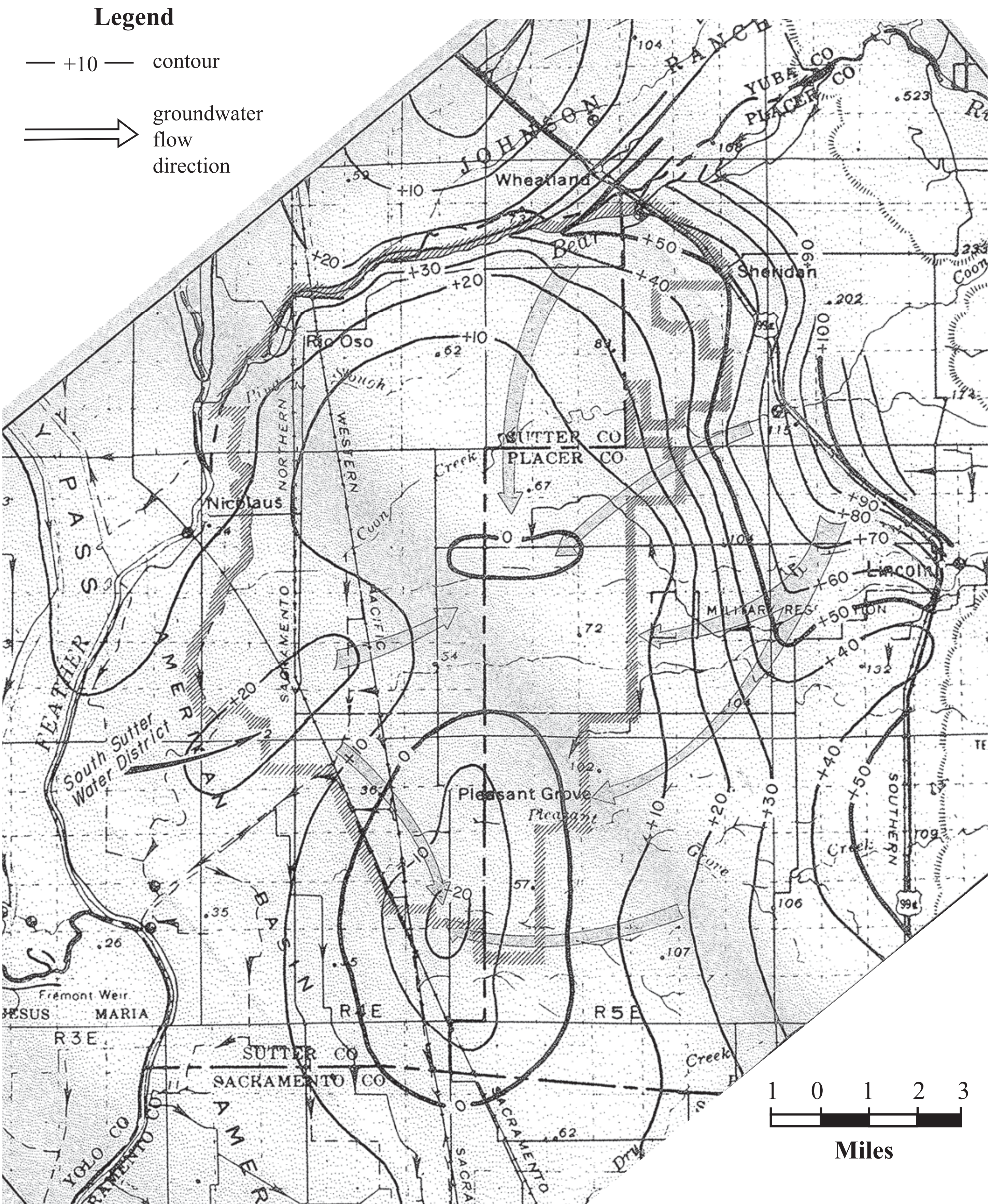
Figure 7
Groundwater evel ydrographs
South Sutter Water District



adapted from MBK, 1970

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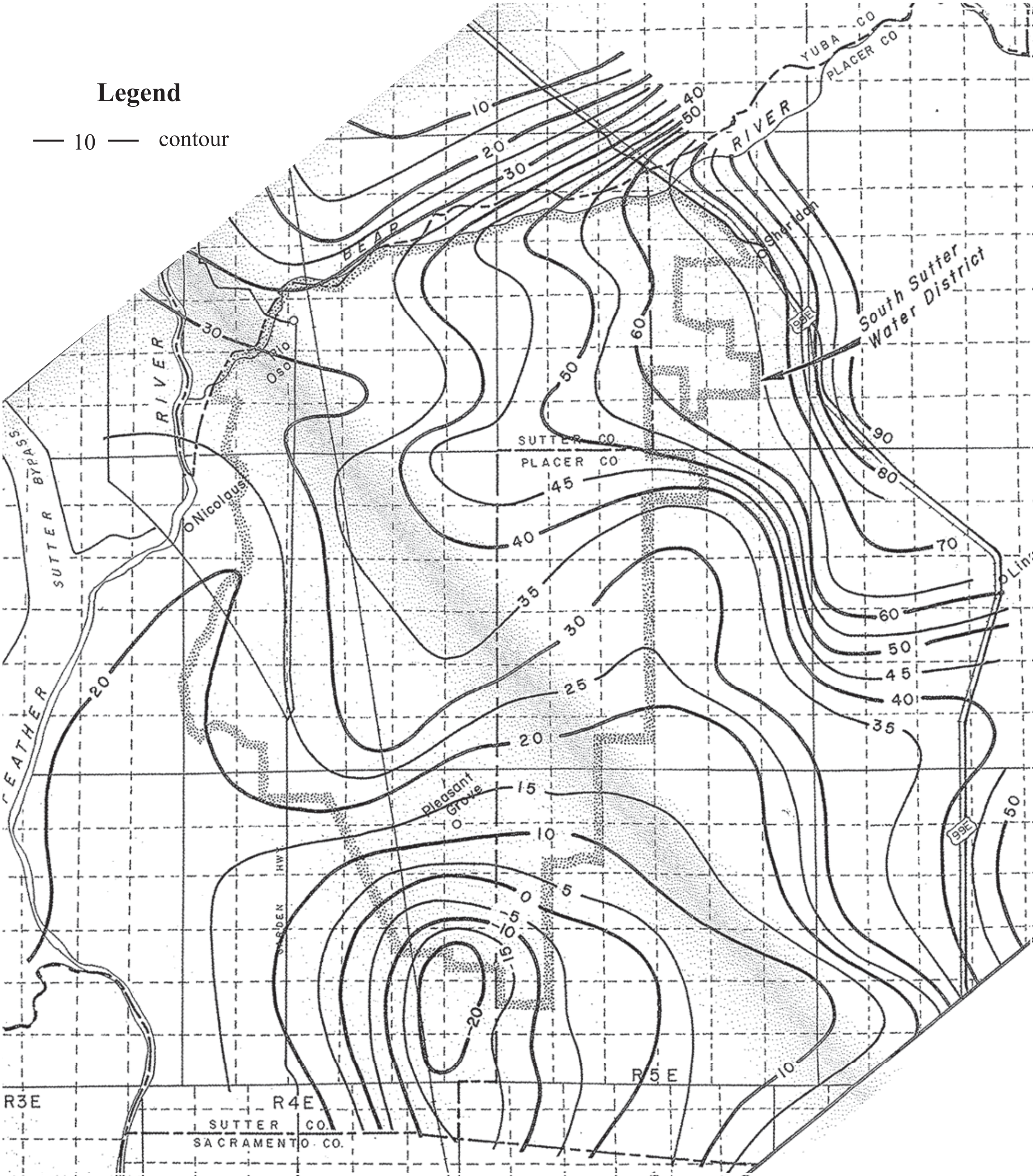
Figure 8
Contours of Equal Groundwater Elevation - SSWD
Spring 1963



adapted from MBK, 1994

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Figure 9
Contours of Equal Groundwater Elevation - SSWD
Spring 1971

maximum historic levels after surface water deliveries from Camp Far West Reservoir. Groundwater in the north of the District generally flowed from the northeast to the southwest while groundwater in the southern part of the District flowed toward a remaining depression at the central southern edge of the District boundary. The prior pumping depression in the center of the District had largely recovered. Groundwater elevations ranged from about 90 feet above sea level northeast of the District boundary, to about 20 feet below sea level in the groundwater depression in the southernmost central part of the District.

Contours of equal groundwater elevation for spring 1978, based on data from wells completed in the upper and lower aquifers, show evidence of the 1976-77 drought reflected in lower overall groundwater elevations in the District (Figure 10); however, groundwater elevations were still generally five to ten feet higher than the historic low of 1963. Groundwater typically flowed from the northeast to the south and from the west to the southeast, towards two groundwater depressions (one continuing at the southern border of the District and a smaller one that had formed in the northwest corner of the District). Groundwater elevations ranged from over 80 feet above sea level in the northeast to less than 20 feet below sea level in the southern depression. The two groundwater depressions in this time period reflect dry conditions that resulted in little or no surface water deliveries in the two preceding years.

Figure 11 shows contours of equal groundwater elevation in the District area in spring 1993, based on data from wells completed in the upper and lower aquifers, after several consecutive dry years from 1987 to 1992. As noted above, the District was able to continue surface water deliveries so the drought conditions during that time period had little effect on groundwater elevations in the District area. Groundwater elevations ranged from over 80 feet above sea level in the northeast to 30 feet below sea level in the southern groundwater depression. A groundwater depression had formed adjacent to the Feather River, outside the western boundary of the District, but generally stable between less than 20 feet to 30 feet above sea level, similar to previous years, inside the District's western boundary. The groundwater depression to the south was still present at that time, with slightly lower groundwater elevations (30 feet below sea level) at its center.

The contours of equal groundwater elevation in the spring of 2003, based on data from wells completed in the upper aquifer, illustrate minimal effects of two consecutive dry years (2001 and 2002) on the water table surface (Figure 12). Groundwater flowed from the northeast to the southeast except in the central and southwestern portions of the District, where groundwater flow was to the south and southeast toward the enlarged groundwater depression beyond the southern end of the District. Groundwater elevations ranged from above 80 feet above sea level in the northeast to about 30 feet below sea level at the south end of the District.

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Contours of equal groundwater elevation for spring 1978, based on data from wells completed in the upper and lower aquifers, show evidence of the 1976-77 drought reflected in lower overall groundwater elevations in the District (Figure 10); however, groundwater elevations were still generally five to ten feet higher than the historic low of 1963. Groundwater typically flowed from the northeast to the south and from the west to the southeast, towards two groundwater depressions (one continuing at the southern border of the District and a smaller one that had formed in the northwest corner of the District). Groundwater elevations ranged from over 80 feet above sea level in the northeast to less than 20 feet below sea level in the southern depression. The two groundwater depressions in this time period reflect dry conditions that resulted in little or no surface water deliveries in the two preceding years.

Figure 11 shows contours of equal groundwater elevation in the District area in spring 1993, based on data from wells completed in the upper and lower aquifers, after several consecutive dry years from 1987 to 1992. As noted above, the District was able to continue surface water deliveries so the drought conditions during that time period had little effect on groundwater elevations in the District area. Groundwater elevations ranged from over 80 feet above sea level in the northeast to 30 feet below sea level in the southern groundwater depression. A groundwater depression had formed adjacent to the Feather River, outside the western boundary of the District, but generally stable between less than 20 feet to 30 feet above sea level, similar to previous years, inside the District’s western boundary. The groundwater depression to the south was still present at that time, with slightly lower groundwater elevations (30 feet below sea level) at its center.

The contours of equal groundwater elevation in the spring of 2003, based on data from wells completed in the upper aquifer, illustrate minimal effects of two consecutive dry years (2001 and 2002) on the water table surface (Figure 12). Groundwater flowed from the northeast to the southeast except in the central and southwestern portions of the District, where groundwater flow was to the south and southeast toward the enlarged groundwater depression beyond the southern end of the District. Groundwater elevations ranged from above 80 feet above sea level in the northeast to about 30 feet below sea level at the south end of the District.

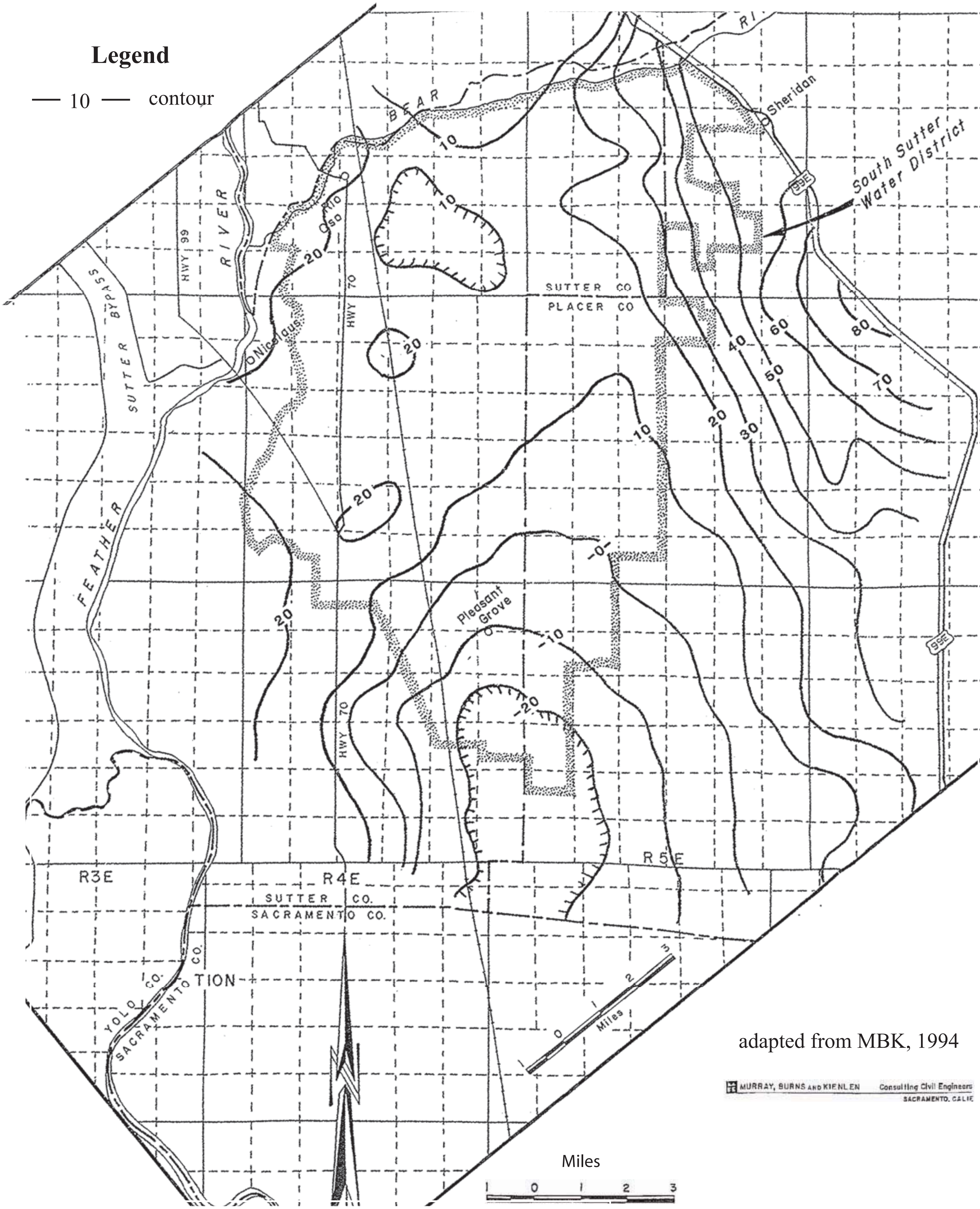

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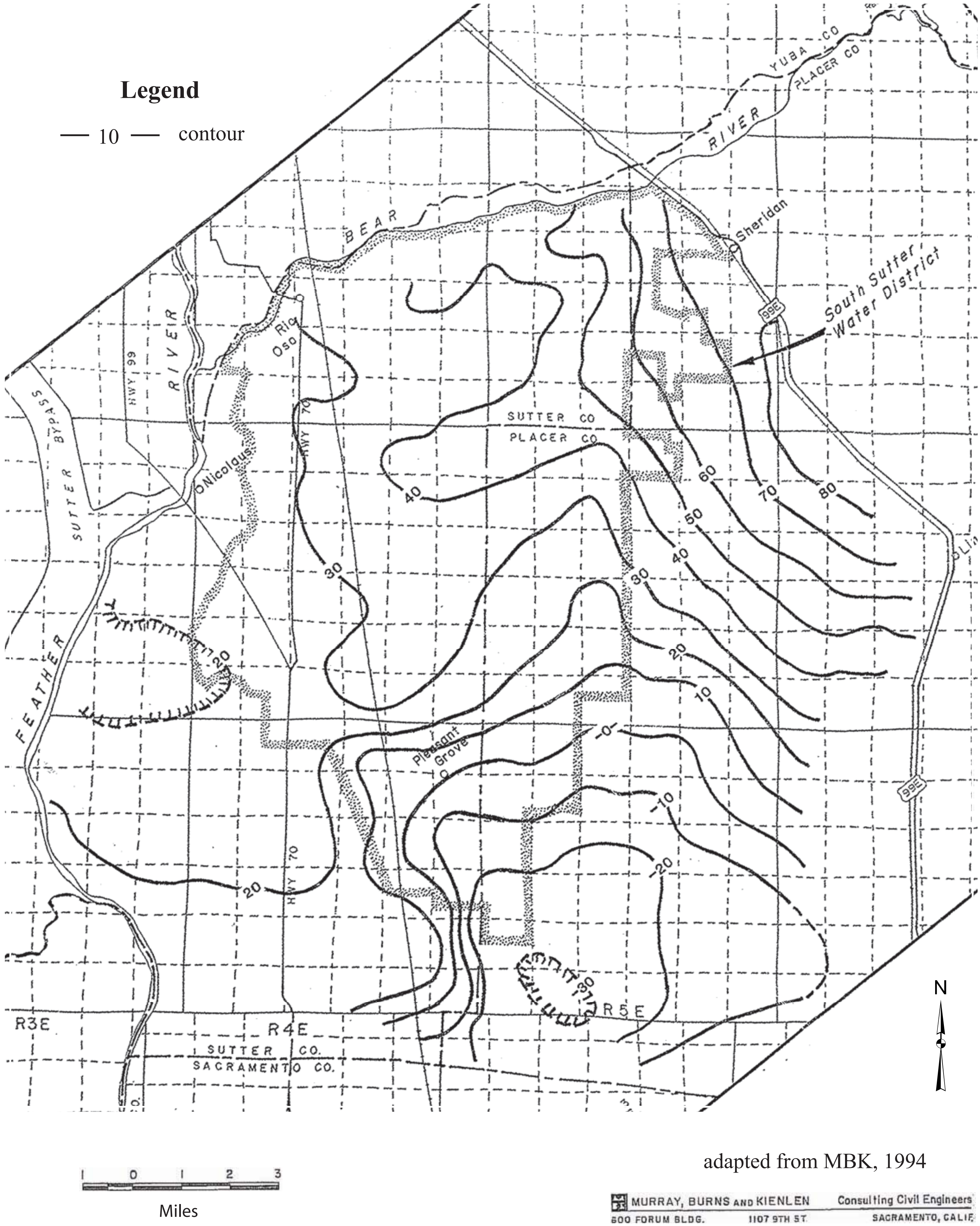
Figure 10
Contours of Equal Groundwater Elevation - SSWD
Spring 1978



adapted from MBK, 1994

MURRAY, BURNS AND KIENLEN Consulting Civil Engineers
600 FORUM BLDG. 1107 9TH ST. SACRAMENTO, CALIF.

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Figure 11
Contours of Equal Groundwater Elevation - SSWD
Spring 1993

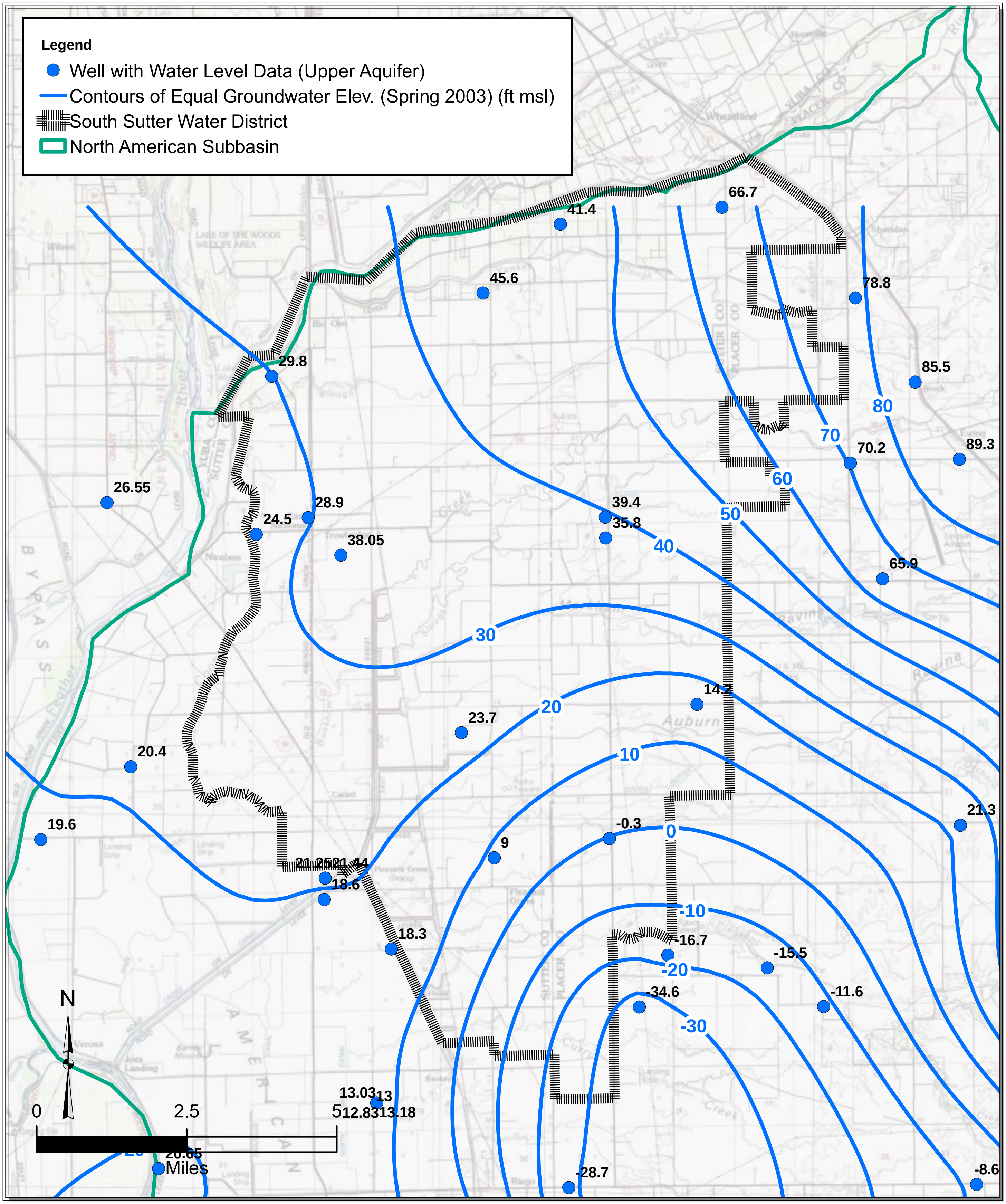

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Figure 12
Contours of Equal Groundwater Elevation - SSWD
Spring 2003, Upper Aquifer

Most recent groundwater conditions in the Plan area are illustrated by contours of equal groundwater elevation for spring 2008, based on data from wells completed in the upper aquifer (Figure 13). Groundwater flows generally from the northeast to the south and southwest, tracing the Bear, Feather, and Sacramento rivers, except at the southern end of the District where flows are drawn into the prevalent groundwater depression to the south. Groundwater elevations range from above 90 feet above sea level in the northeast to about 10 feet below sea level at the south end of the District.

3.4 Groundwater Quality

Groundwater in the greater North American Subbasin has localized areas or, in some cases, individual wells where concentrations of certain water quality constituents are elevated relative to water quality standards and guidelines for drinking water and irrigation supply, including total dissolved solids (TDS)/specific conductance, chloride, sodium, nitrate, boron, iron, manganese, arsenic, and fluoride (DWR, 2006). For all practical purposes, however, none of those is a constraint or major concern in the District's Plan area.

DWR and the USGS monitor groundwater quality in the subbasin, and groundwater quality data is mainly available from the USGS. In the vicinity of the District, about 110 wells have some water quality data between 1950 and 2008; approximately 30 of those wells are located within the District boundary. The following summary derives from that data.

Total Dissolved Solids (TDS) concentrations above 450 mg/L may be undesirable for crops under certain conditions. For drinking water supplies, the recommended and upper secondary MCLs are 500 and 1,000 mg/L respectively. Maximum TDS concentrations for wells with TDS data between 1961 and 2008 in the vicinity of the District are illustrated in Figure 14. All of the wells in the District have had a maximum TDS concentration below 600 mg/L; most are below 300 mg/L.

Chloride concentrations above 106 mg/L have been reported to be potentially undesirable for some crops, such as fruit orchards (CVRWQCB, 2008). For drinking water, the recommended and upper secondary MCLs are 250 and 500 mg/L, respectively. The maximum chloride concentrations in wells with water quality data between 1950 and 2008 in and around the District indicate that, with the exception of one anomalous well, where chloride was reported to be 120 mg/L, all other historical observations are less than 50 mg/L, and most are below 30 mg/L.

Sodium is naturally occurring in groundwater because most rocks and soils contain sodium compounds from which sodium is easily dissolved. The Central Valley Regional Water Quality Control Board published an Agricultural Water Quality Limit of 69 mg/L for sodium (CVRWQCB, 2008). There is no quantitative drinking water standard for sodium. The

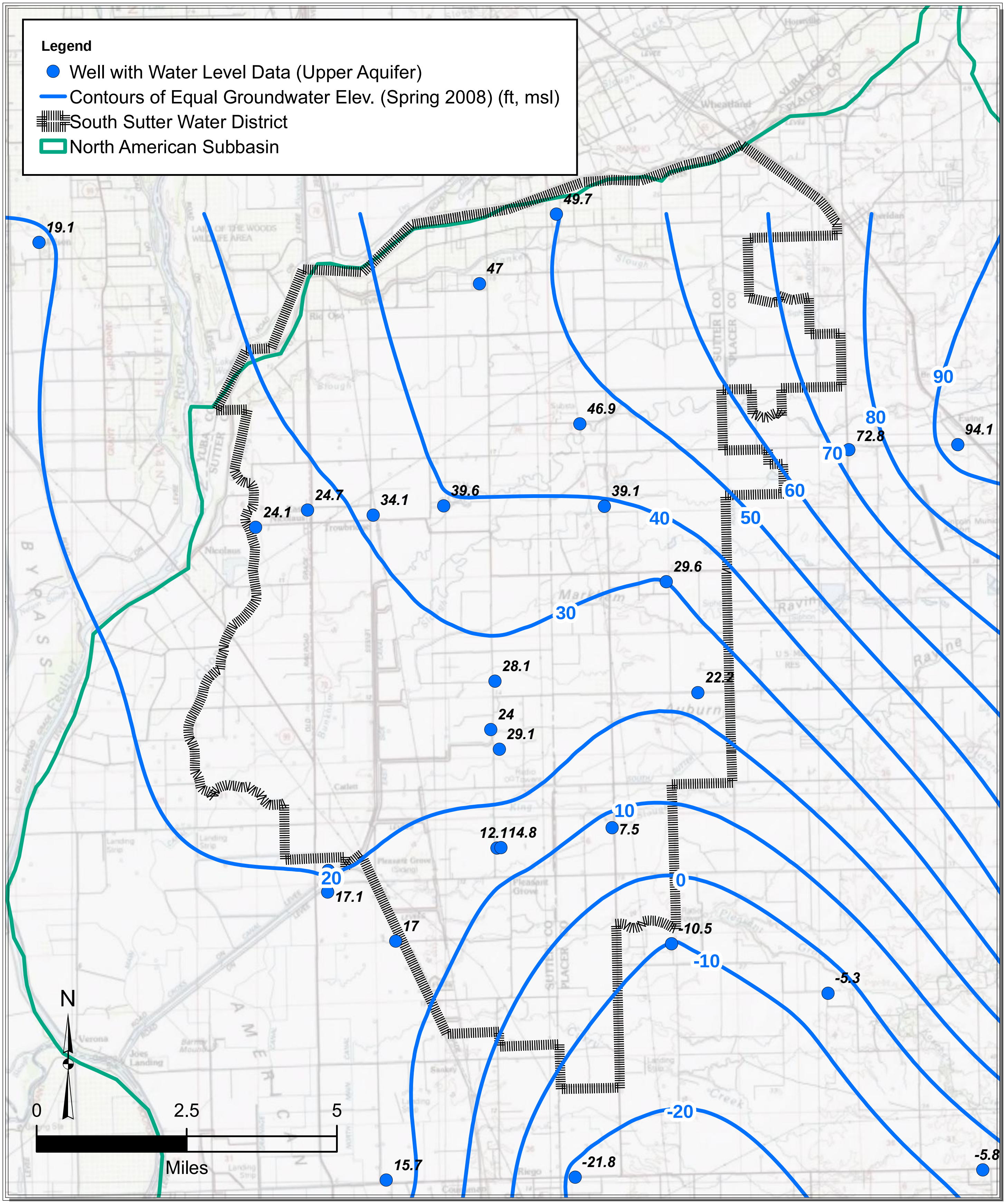

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Figure 13
Contours of Equal Groundwater Elevation - SSWD
Spring 2008, Upper Aquifer

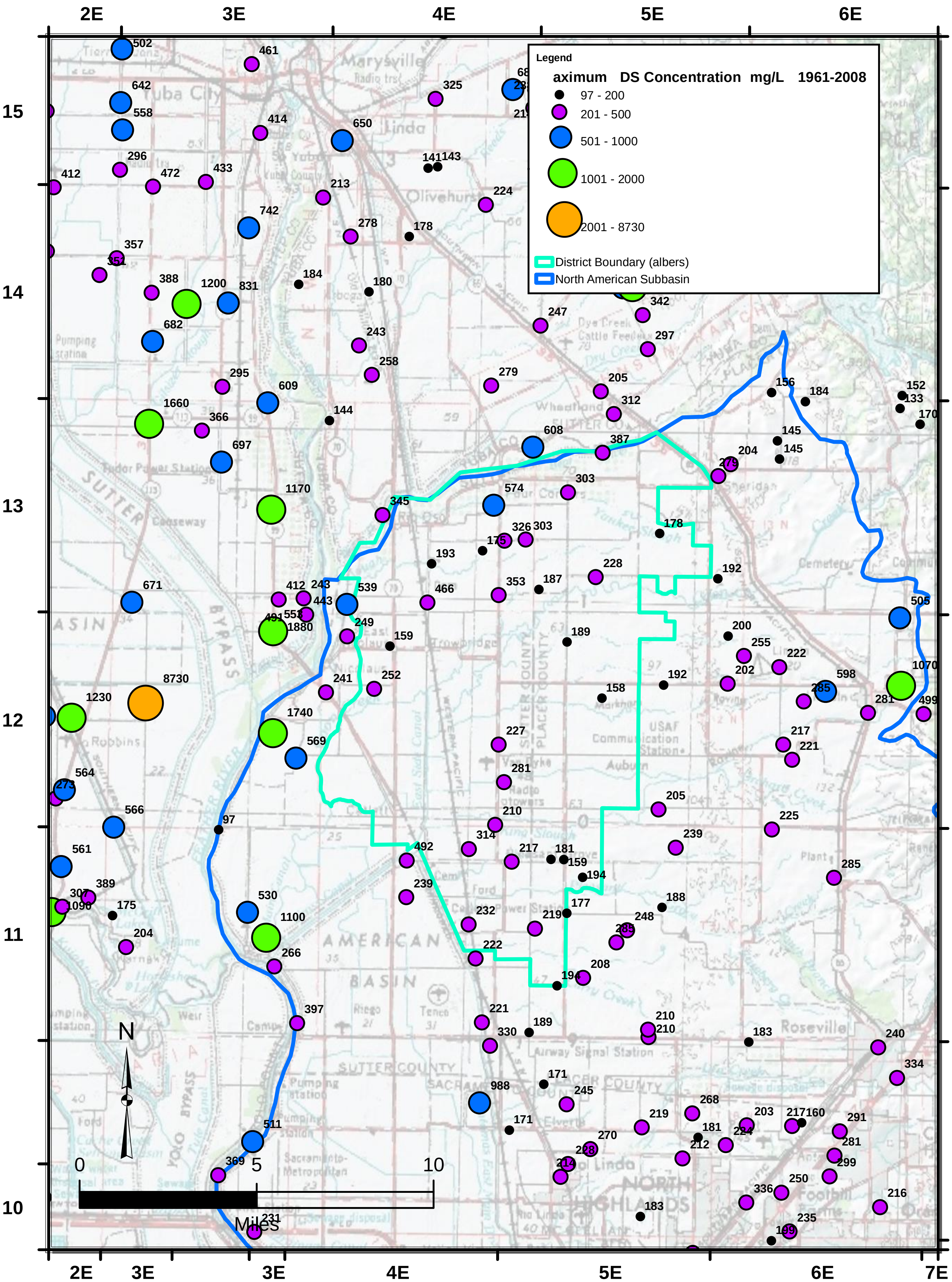

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Figure 14
Maximum Total Dissolved Solids (TDS) Concentration for Wells In and Near South Sutter Water District, 1961 to 2008

maximum concentrations of sodium for wells with water quality data in and around the District between 1953 and 2008 indicate that all of the wells within the District's boundary have sodium concentrations well below the agricultural limit; most concentrations are less than about 25 mg/L.

The primary drinking water MCL for ***nitrate*** (as nitrate) is 45 mg/L; there is no reported agricultural water quality limit (CVRWQCB, 2008). The maximum concentrations of nitrate in groundwater in the vicinity of the District between 1955 and 2008 show that except for some slightly elevated concentrations in one local area near the northern boundary of the District at the Bear River, where maximum reported concentrations are between 15 and 30 mg/L, reported nitrate concentrations throughout the District have all been below 13 mg/L, with most less than 10 mg/L.

The agricultural water quality limit for ***boron*** is 0.7 mg/L (CVRWQCB, 2008), and the Sacramento/San Joaquin Basin Plan objective for boron is 2.0 mg/L. Although boron concentrations to the southwest of the North American Subbasin have been reported to be slightly elevated (greater than 2 mg/L) (Fogelman, 1983), in and around the District, boron concentrations have historically been less than 0.5 mg/L. In fact no wells in the District have exceeded the lower agricultural water quality limit between the period of available data (1953-2008).

The agricultural water quality limit for ***iron*** is 5.0 mg/L, and the secondary MCL for drinking water is 0.3 mg/L. Maximum available iron concentrations for groundwater in the vicinity of the District between 1957 and 2008 show that although iron concentration data in the District are sparse (five wells), all of the measurements have been below the secondary MCL of 0.3 mg/L. The secondary drinking water MCL for ***manganese*** is 0.050 mg/L and the agricultural water quality limit is 0.20 mg/L. Similar to iron, manganese concentrations in groundwater in the District are sparse; six wells in the District have data ranging from 0.39 mg/L on the northwest edge to 0.001 mg/L in the northwest-central part of the District.

Elevated ***arsenic*** concentrations in water can be toxic to humans and can cause crop damage. The agricultural water quality limit for arsenic is 100 ug/L, and the primary MCL for drinking water is 10 ug/L (CVRWQCB, 2008). Maximum arsenic concentrations in available groundwater data between 1967 and 2008 are shown in Figure 15**.** While the data are sparse, most arsenic data in the District are below the drinking water standard and significantly below the agricultural water quality limit. There is some suggestion of an increasing trend from the north, where maximum concentrations have been on the order of 1 to 3 mg/L, toward the south where maximum concentrations have been in the range of 5 to 10 mg/L.

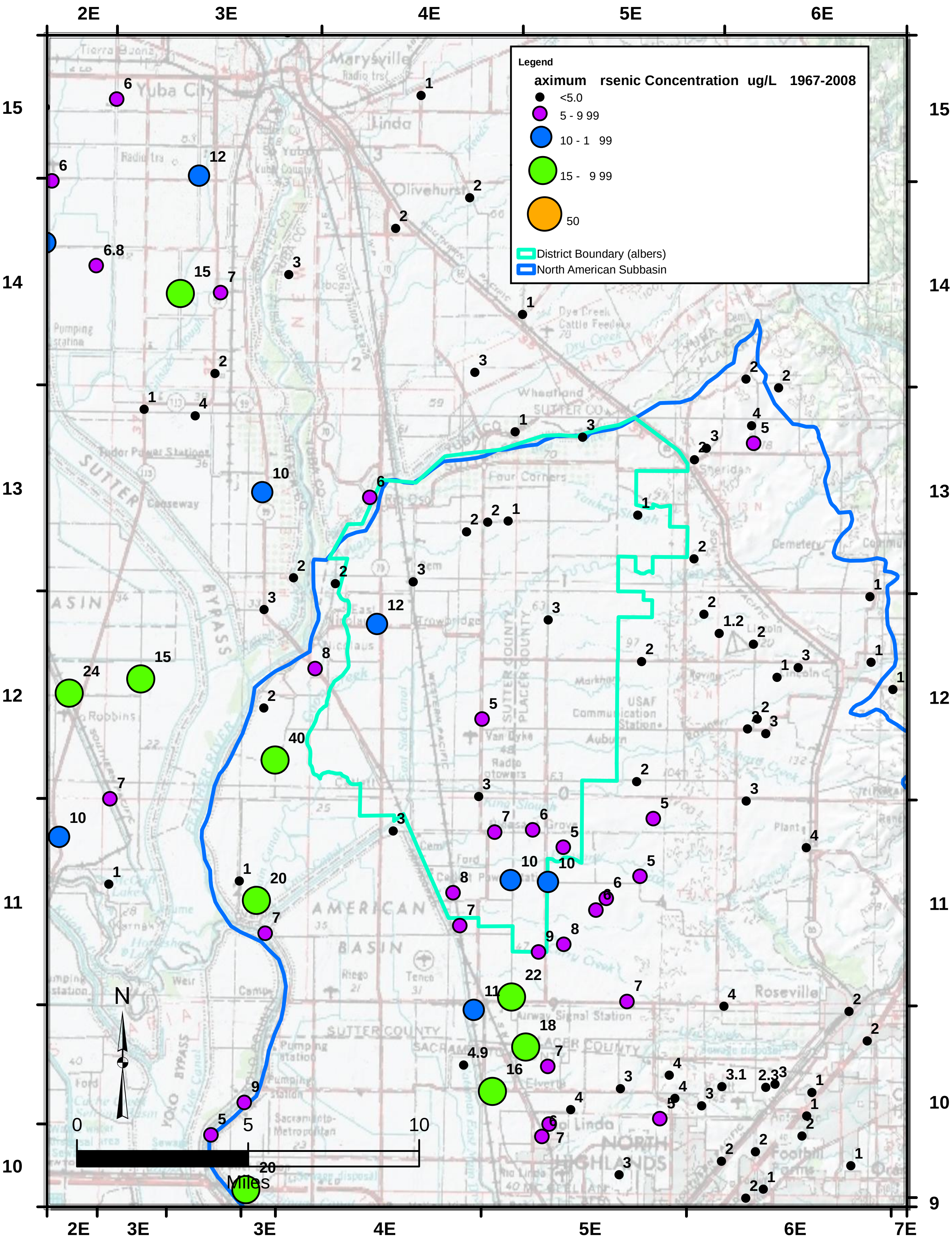

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Figure 15
Maximum Arsenic Concentration
for Wells In and Near South Sutter Water District, 1967 to 2008

Fluoride is a naturally occurring chemical present in groundwater from the breakdown of rocks and soils or weathering and deposition of atmospheric volcanic particles, but may also originate from chemical fertilizers in agricultural areas. The CVRWQCB has set an agricultural water quality limit for fluoride of 1.0 mg/L, while the California Department of Public Health publishes a primary drinking water MCL of 2.0 mg/L (CVRWQCB, 2008). Maximum fluoride concentrations in wells with water quality data between 1955 and 2008 in and around the District indicate that the District and vicinity generally have low maximum fluoride levels. Except for two anomalous data points, all maximum concentrations are fractional, typically between 0.1 and 0.3 mg/L.

3.5 Groundwater Pumping

Groundwater supplies in the District are obtained from wells owned and operated by individual landowners; the District does not own or operate wells to augment its surface water supplies. The District makes annual estimates of total water supply available to lands within the District and allocates the surface water on an acre-foot per acre basis to augment groundwater pumping and fulfill total water demand. Consequently, there is no ongoing mechanism to estimate total groundwater pumping within the District, i.e. for a combination of those lands with access to supplemental surface water and those lands solely dependent on groundwater. Implementation of this Plan is intended to improve estimates of groundwater pumping by utilization of land uses (cropping patterns), applied water duties, and surface water delivery records.

3.6 Land Subsidence

Land subsidence is the lowering of the ground surface through compaction of compressible, fine-grained strata. In the greater Sacramento Valley, it is most commonly considered to be the result of groundwater pumping from unconsolidated, interbedded aquifer-aquitard systems. Compaction can be fully reversible (elastic) or permanent (inelastic). Elastic compaction and expansion generally occur in response to seasonal groundwater level fluctuations. Inelastic compaction is more likely to occur when prolonged dewatering of clay units occur during periods when pumping is not fully recharged and groundwater levels reach historic lows.

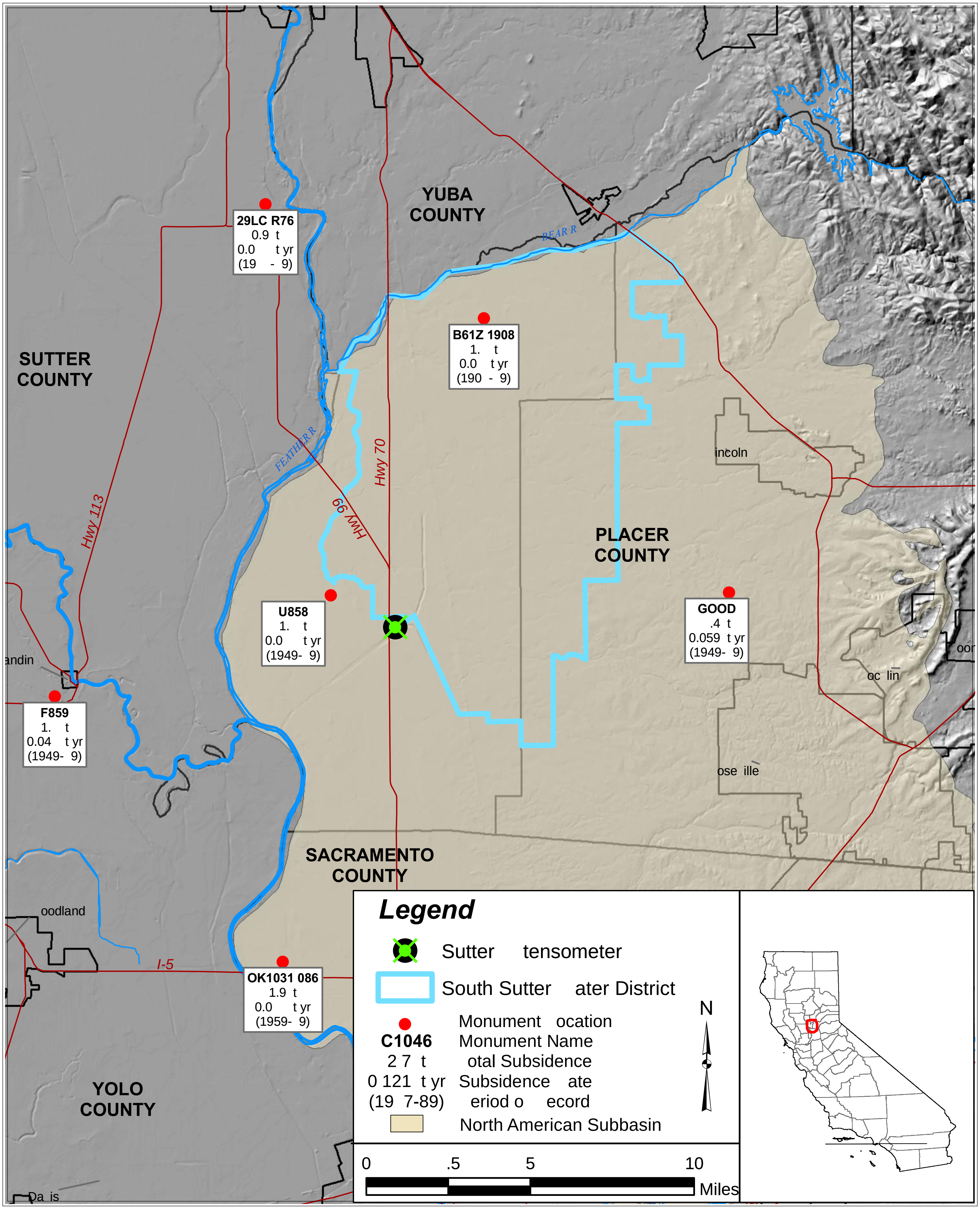
Monitoring of land subsidence has been limited in the North American Subbasin. Historically, land subsidence was monitored along transects by comparing periodic spirit level surveys conducted by the USGS and the National Geodetic Survey (NGS). In the mid-1980s, a transition was made from spirit level surveys to global positioning system (GPS) surveys. GPS surveys were conducted in the southern portion of the Sacramento Valley from 1985 through 1989 (Blodgett et al., 1990; Ikehara, 1994). Like spirit level transects, GPS monitoring of subsidence relies on periodic resurveying of a network of monuments. The accuracy of GPS surveys has gradually improved and is currently on the order of plus or minus one centimeter (about 0.4 inch, or about 0.03 feet).

Ikehara (1994) estimated subsidence rates in the southern Sacramento Valley by comparing 1989 GPS survey data with historical data from spirit level transects. Although the accuracy of the 1989 survey (plus or minus 0.1 meter, or about 0.33 ft., or about 4 inches) was an order of magnitude less than more recent GPS surveys (Ikehara, 2004, pers. comm.), those are considered to be the best available data to estimate subsidence prior to 1989 at multiple locations. With those relative accuracies in mind, total subsidence over varying time periods prior to 1989 was reported as shown in Figure 16. Within and near the District, the monument location with the longest period of record is located near the north-central District boundary. At that location, total subsidence over an 81 year period (1908-89) was interpreted to be about 1.6 feet, or a long-term average rate of about 0.02 feet (about 0.25 inch) per year. Corresponding groundwater level data are not available prior to the 1930s; however, based on available data since then, it is logical that subsidence prior to 1989 was a result of the groundwater level declines that preceded surface water deliveries in the 1960s.

Land subsidence is also monitored at specific locations in the Sacramento Valley using borehole extensometers. Borehole extensometers are typically more accurate than GPS monitoring stations (detecting changes in land surface elevation to 0.001 foot, or about 0.01 inch). The nearest extensometer to the District, the Sutter Extensometer, is located just outside the southwestern border of the District (Figure 16); it is also the only borehole extensometer in the North American Subbasin. This extensometer is operated by DWR and is located adjacent to the DWR multiple-completion monitoring wells at 11N/04E-04N. The Sutter Extensometer is a pipe extensometer that measures compaction from the ground surface to its total depth of 780 feet.

The Sutter Extensometer began operation in April 1994, and has continuously tracked ground compaction/expansion since then. The complete record through February 2009 is plotted in Figure 17. Also plotted in Figure 17 are water levels for the deepest adjacent monitoring well (11N/04E-04N1), which is perforated from 880 to 890 feet. The compaction/expansion data show mostly elastic subsidence that corresponds to seasonal and longer periodic fluctuations in groundwater levels. The cumulative land subsidence from Spring 1995 to Spring 2008 shown on Figure 17 was 0.013 feet (0.16 inches).

Subsidence at the Sutter Extensometer has been relatively small as expected given high and relatively stable groundwater levels at this location. Subsidence throughout the District would also be expected to be small for the same reasons.



FILE: \\server_pe2900\Public\SouthSutterWD 08-1-074\GIS\Figure 4-11 Total estimated Subsidence Rates.mxd Date: 7/6/2009

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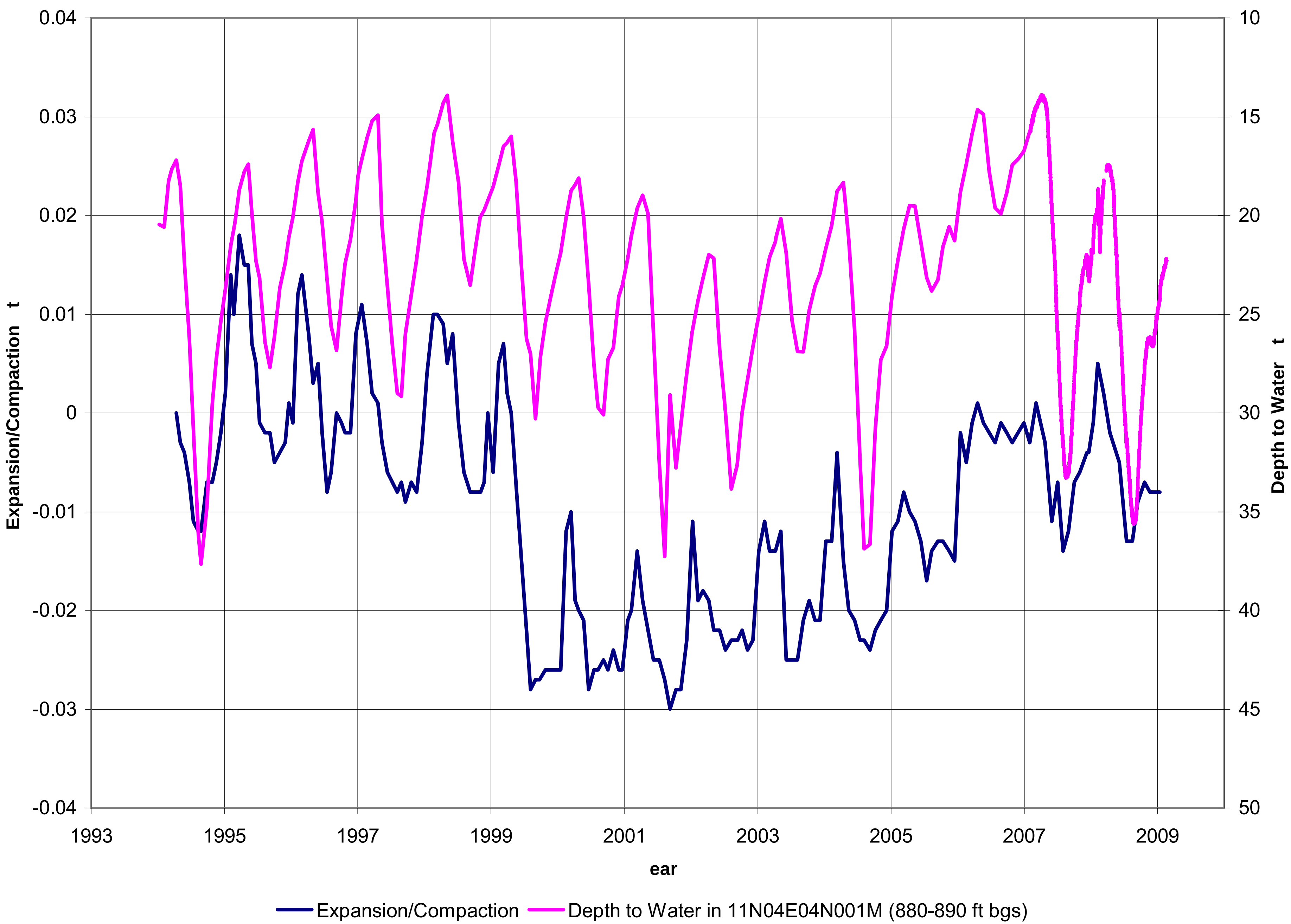
Figure 16
Total Estimated Subsidence and Subsidence Rates in Southern Sacramento Valley as of 1989



Y:\Natomas Central\2009 Update\subsidence\DWR_Data\Subsidence_DWR.xls\SutterExtensometer

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Figure 17
Compaction and Water Level Data or the Sutter Extensometer

3.7 Areas of Concern/Identified Problems

There are no significant problems or areas of concern related to groundwater in the District. Where declining groundwater levels were once a concern, leading to the construction of Camp Far West Reservoir in the 1960's, conjunctive use of surface water from that project with local groundwater has successfully eliminated the previous decline, caused groundwater levels to recover, and resulted in general groundwater level stability, with some seasonal and other fluctuations.

Beyond the District's boundaries, a large groundwater depression remains south of the District (the North Sacramento County depression). Groundwater flow in the southern part of the District is dominated by that feature, as seen in all of the groundwater contour maps in this Plan. The District might otherwise be concerned about growth and impacts of that depression extending northward into its area; however, the District understands that groundwater management objectives in northern Sacramento County are to constrain such expansion, and the District thus plans to manage groundwater within its Plan area on the assumption that the southerly depression will not adversely impact its planned management actions or management objectives.

4. Elements of the Groundwater Management Plan

As part of long-term supply management in the Plan area, the District began conjunctive use operations in the 1960s by storing and delivering supplemental surface water from the Camp Far West Reservoir and integrating it with local groundwater to meet irrigation water requirements in the District. Prior to that time, and continuing to the present, the District and others have collected groundwater level and related data which in turn have been interpreted to progressively define and understand basin conditions, and to continue to meet water demands over the last four decades. Information derived from the monitoring and management efforts to date has allowed the District and various individual pumpers in the basin to continue to rely on the groundwater basin for some or all of their water supply without significant concern that the resource was either overdrafted or otherwise negatively impacted.

In light of the preceding, complemented by the District's original Groundwater Management Plan adopted in 1993, local groundwater management has already been initiated consistent with the opportunity provided by Water Code Section 10750 et seq. Despite those ongoing accomplishments, however, the District recognizes a number of evolving opportunities related to groundwater and other water supplies in the basin and, consistent with provision in the original plan to periodically update it, the District has prepared this broader-based groundwater management plan.

The management objectives, or goals, for the South Sutter Water District plan area are the following:

Goal 1: Development of Local Groundwater, in Conjunction with Supplemental Surface Water for Regular and Dry-Year Water Supply
Goal 2: Avoidance of Overdraft and Associated Undesirable Effects
Goal 3: Preservation of Groundwater Quality
Goal 4: Preservation of Interrelated Surface Water Resources

To accomplish those goals, this Plan incorporates a number of components which are divided into ten elements. The elements formally recognize the effectiveness of a number of ongoing water resource management activities, and they recognize the need for additional activity, such as potentially expanded use of supplemental surface water with local groundwater. They also reflect a wider focus on local groundwater management, such as continuing cooperation with the land owners in the District including those who make use of supplemental surface water as well as those who rely solely on groundwater, and with other water resource management entities in the region to address regional resource opportunities and/or challenges. In summary, this Groundwater Management Plan is intended to enable the District, individual landowners, and their regional neighbors to continue use of local groundwater for regular water supply, to expand their use of local groundwater during dry periods or emergencies, and to work with other agencies via implementation of the following management plan elements.

Element 1: Monitoring of Groundwater Levels, Quality, Production and Land Subsidence
Element 2: Monitoring and Management of Surface Water Storage, Flows, and Quality
Element 3: Determination of Basin Yield and Avoidance of Overdraft
Element 4: Development of Regular and Dry Year Water Supplies
Element 5: Continuation and Potential Expansion of Conjunctive Use
Element 6: Development and Continuation of Federal, State, and Local Agency Relationships
Element 7: Public Education and Water Conservation Programs
Element 8: Well Construction, Abandonment and Destruction Policies
Element 9: Management and Protection of Recharge Areas and Wellhead Protection Areas
Element 10: Provisions to Update the Groundwater Management Plan

Each of the elements as discussed in limited detail as follows.

Element 1 – Monitoring of Groundwater Levels, Quality, Production and Land Subsidence

Prior to the 1964 initiation of surface water deliveries from the Camp Far West Reservoir, all water supply in the District was developed from local groundwater. Since 1964, surface water has become an important component of overall water supply in the District, but groundwater continues to be an important part of agricultural water supply. Long term development and use of groundwater in the area has led to a substantial amount of historical groundwater level data, some dating back to the early 1930's. Groundwater quality data, although less complete and available compared to groundwater levels, is publically available for many wells in and around the District. The District does not own or operate its own wells and, as a result, does not have a regular groundwater quality monitoring network, nor does it maintain records of groundwater production by various individual pumpers throughout the District. Subsidence has not been an issue in the District; an extensometer, located near the southwestern boundary of the District and maintained by DWR, provides compaction and expansion data paired with groundwater level data to quantify the status of subsidence

<u>Groundwater Levels</u>

Currently, the District monitors 16 wells within the District boundary (Figure 18) on a semi-annual basis to measure the spring and fall groundwater levels. That monitoring is complemented by a larger network of wells monitored by DWR. That network has historically varied but in the last couple of years, has included about 100 wells in the vicinity of the District,

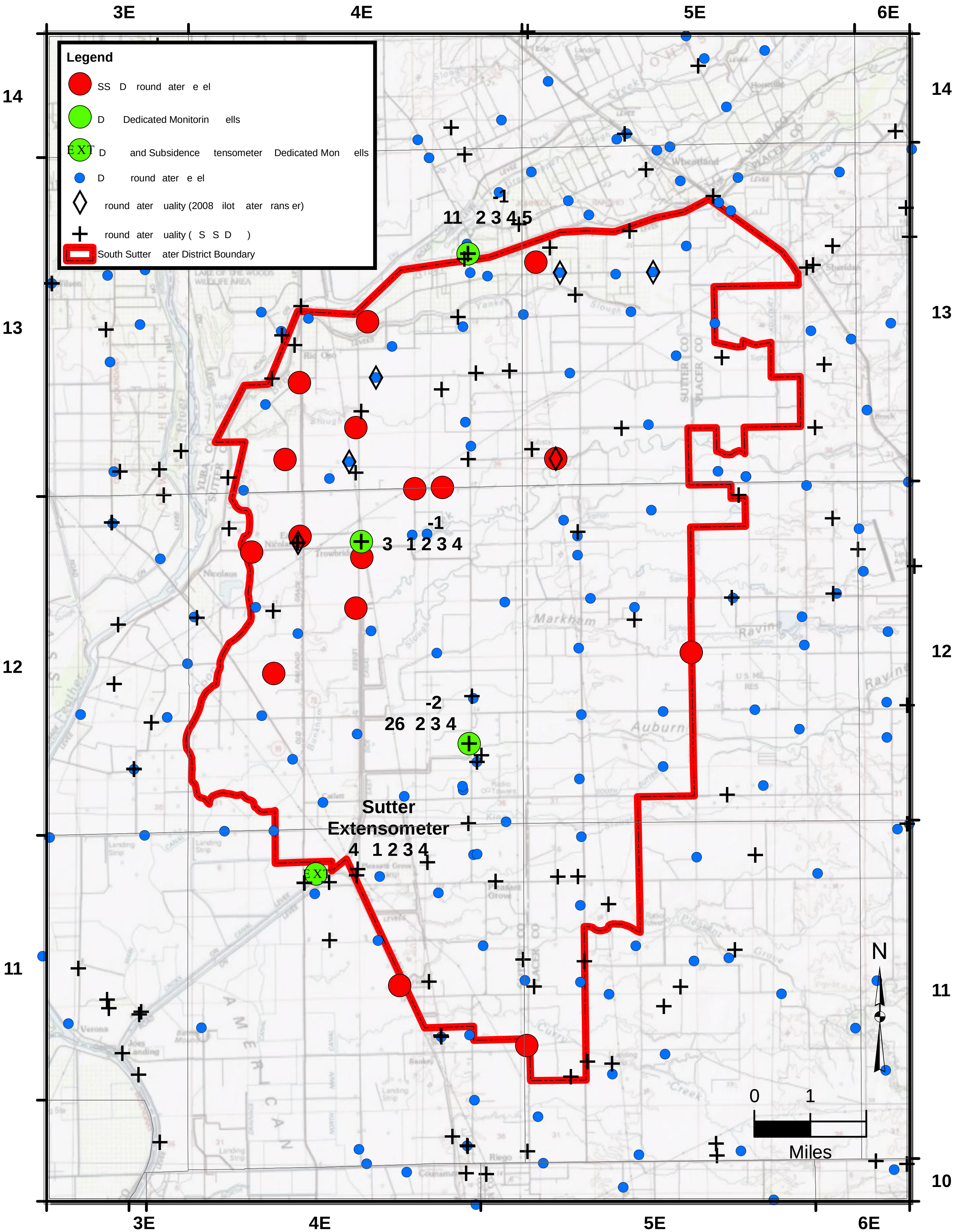

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Figure 18
Groundwater Monitoring Network
South Sutter Water District

40 of which are located within the District's boundary. That monitoring includes four dedicated multiple completion monitoring wells within and in close proximity to the District boundary (AB-1, AB-2, Sutter Extensometer, and BR-1), which provide groundwater levels on a more frequent basis. The publicly available DWR groundwater level data vary in frequency, ranging from semi-annual measurements to monthly measurements, to fifteen minute measurements in some wells. The District uses a combination of its monitoring data and groundwater level data recorded by DWR to interpret groundwater level conditions in the District.

Groundwater Quality

Some groundwater quality data is maintained by the U.S. Geological Survey, but there is no regular groundwater quality monitoring program in the District. The District participated in two recent water transfers in 2008 and 2009, which resulted in a cooperative monitoring effort by the District and DWR, and included measurements of groundwater quality field parameters in five wells, as well as laboratory analysis of one sampled well for general minerals and some heavy metals. Future opportunities for water transfers will be considered by the District; and associated groundwater quality monitoring will consider the adequacy of the 2008 and 2009 monitoring program, and continue or revise it as appropriate. The publicly available groundwater quality data will be complemented by an effort of monitoring for indicator parameters (e.g. pH, EC) in order to track groundwater quality in selected wells and on a frequency to be determined by the District. Implementation of this Plan is intended to develop a regular groundwater quality monitoring plan different than what might be required during water transfer years.

Groundwater Pumping

As part of its annual allocation of available surface water, the District receives estimates of planted acreage and specific crops from landowners prior to the irrigation season. Based on those acreage estimates and applied water duties for various crops, the District estimates total water requirements, and then allocates surface water deliveries by dividing the total available surface water supply by the total applied water demand. In order to estimate groundwater pumping within the District following an irrigation season, the total measured surface water deliveries at the main canal are subtracted from the applied water use demand. While this residual reflects estimated pumping by growers eligible for surface water deliveries, it does not include or reflect pumping by others who do not receive surface water from the District. Thus, part of this Plan is to incorporate an effort to estimate District-wide groundwater pumping, to track it over time, and to incorporate it in analyses of overall groundwater conditions as described in other elements of this overall Plan.

Land Subsidence

Land subsidence is continuously monitored by DWR at the Sutter Extensometer, located at the southwest corner of the District. This data is maintained in the DWR Water Data Library and will continue to be used to assess any local subsidence, as well as the potential for land subsidence in the District.

Although the District does not currently have an ongoing groundwater quality monitoring program and has not historically estimated District-wide pumping, the available data are sufficient to generally describe basin conditions. Continuation and potential expansion of groundwater level and groundwater quality data collection, continuation of land subsidence data collection, and initiation of an effort to estimate all groundwater pumping are key to accomplishing all of the goals in this management plan. Monitored groundwater levels and quality, estimated pumping, and subsidence data will be organized into a computerized data base for the entire District and, collectively, will be the bases for defining basin conditions and developing operational protocols that allow conjunctive use to support ongoing groundwater supply while avoiding undesirable conditions such as chronically depressed groundwater levels, degraded groundwater quality, and inelastic subsidence. Thus, the first element of this Plan is to develop and implement a groundwater monitoring program that is comprised of a network of wells, such as illustrated in Figure 18, with subsets of the entire network for groundwater level and groundwater quality monitoring. This data will be complemented by ongoing subsidence monitoring at the Sutter Extensometer, and by annual estimates of groundwater pumping. The frequencies and types of groundwater data collection will vary as a function of specific monitoring objectives in various parts of the basin.

Element 2 – Monitoring and Management of Surface Water Storage, Flows, and Quality

Groundwater is readily recharged by a combination of precipitation, natural surface water flows, and return flow from applied agricultural irrigation, as well as subsurface inflow from other areas. The District owns and operates the Camp Far West Reservoir and the Camp Far West Diversion Dam. A storage analysis was performed most recently for the District in 2009 to determine the storage capacity of Camp Far West based on aerial and bathymetric surveys. The District uses the results to calculate volumes of storage based on water elevation in the reservoir. The District also measures surface water at the Camp Far West Diversion Dam, fish flow bypass structure, the CFWID North Canal, the Main Canal, and several other stream channels on the east side of the District, which collectively represent the surface water deliveries to the District service area.

The USGS measures surface water flow on the Bear River at USGS Gage 11423800, Bear River Fish Release, and at USGS Gage 11424000, Bear River Near Wheatland, both sites located below Camp Far West Reservoir and Diversion Dam. DWR also maintains a stream flow gage at Pleasant Grove Road (BPG) along the Bear River. Historic water quality data is also available at one of the Bear River gages (USGS 11424000).

Ongoing monitoring of surface water storage and flows are generally considered to be sufficient for this element, but the flows in concert with surface water and groundwater quality data will be essential to incorporating surface water considerations into management of the underlying aquifer system. Therefore, monitoring of surface water quality will also be part of this Plan, and the resultant data will be incorporated into the database for analysis and understanding of interrelated groundwater effects on surface water. Implementation of this Plan element will be important to accomplishment of the fourth management objective for the Plan area.

Element 3 – Determination of Basin Yield and Avoidance of Overdraft

In order to accomplish all the goals for the basin, it will be essential to determine what yield can be developed on both a regular and an intermittent, i.e. dry period, basis. Such a determination of basin yield will be made to accomplish the main objective of operating within that yield and thus avoid overdraft.

On a long-term basis, since the implementation of the Camp Far West project in the 1960s, there has not been any widespread, steady degradation of groundwater conditions that might be indicative of overdraft, i.e. decrease in groundwater levels or storage as a result of pumping in excess of the yield of the basin. There have been, and continue to be, short-term fluctuations in groundwater levels that are basically related to variations in local hydrological conditions, and reflective of alternating increases and decreases in groundwater storage in response to wet and dry conditions (and associated fluctuations in recharge and pumping). Such fluctuations are typical of groundwater basin conditions in any conjunctive use setting; groundwater is utilized from storage during dry years, or dry periods, and that storage is replenished during subsequent wet years, or periods. The observation of these historical groundwater conditions, in combination with knowledge of water requirements and surface water availability, has led to current operational practices as well as general expectations regarding the approximate yield of the local groundwater system.

While historical operating experience, complemented by observed groundwater conditions, will remain an appropriate basis for generally planning for available groundwater supplies, it is possible to more precisely analyze the basin to determine values or ranges of yield under varying hydrologic conditions, and to assess the impacts of various management actions that might be implemented in the basin. The ultimate intent of this Plan element is to develop an understanding and quantification of the yield of the basin, under varying hydrologic conditions and developing local cultural conditions, so that groundwater development and use can be managed in such a way to meet an appropriate fraction of total water demand while avoiding levels of groundwater use that would result in overdraft conditions. Thus, implementation of this Plan element is essential to accomplishing the first and second management objectives (goals) for the basin.

Element 4 – Development of Regular and Dry Year Water Supplies

A major consideration in this Plan will be accomplishing this element in concert with Element 3, i.e. development of both regular and dry year groundwater supply within the yield of the basin in order to avoid overdraft. Toward that goal, the monitoring described in Elements 1 and 2 will be interpreted in Element 3 to understand basin response to variations in the amounts and distribution of pumping throughout the District. The result will facilitate ongoing distribution of supplemental surface water, as well as planning for additional supplemental water supplies, and potentially planning for the addition of proactive recharge activities to augment basin yield as necessary to meet groundwater supply requirements. Thus, implementation of this Plan element, within the confines of Element 3, will be essential to accomplishment of the first management objective (goal) for the basin.

Element 5 – Continuation and Potential Expansion of Conjunctive Use

Beginning with the initial deliveries of surface water from the Camp Far West Project in the 1960s, the District and individual groundwater pumpers have collectively been practicing the conjunctive use of surface water and local groundwater. Conjunctive use in this setting has consisted of directly meeting water demands with a combination of supplemental surface water and local groundwater; surface water has not been separately dedicated, for example, to artificial groundwater recharge. Groundwater pumping has remained within a range that has not caused any evidence of overdraft, or associated undesirable impacts, and has fluctuated within that range to meet a varying fraction of total water requirements, for example a larger fraction of water demand during periods of reduced surface water availability, such as in 1976-77 and at the end of the 1987-1992 drought and for several years immediately thereafter.

Conjunctive use of local groundwater and conserved surface water will continue to be a key element in meeting all of the goals for the basin, most notably continued utilization of groundwater for water supply without overdrafting the basin. Historical experience with groundwater pumping and aquifer response to varying hydrologic conditions has shown that the groundwater basin can support variations in pumping during wet and dry periods, but it could not support continuous pumping at rates high enough to meet the total local water demands that preceded the deliveries of supplemental water from the Camp Far West Project.

As part of conjunctively using surface water and groundwater, it is recognized that there will continue to be variations in the amount of available surface water supply from year to year. Similarly, there are expected to be variations in local groundwater conditions as a function of local hydrologic conditions which affect, among other things, the natural recharge to the groundwater basin from year to year. Thus, conjunctive use management is necessary to ensure that the groundwater basin is maintained to be a regular component of water supply and to also provide a larger component of water supply during dry periods that affect supplemental surface water availability. Conjunctive use management is similarly important to ensure that local groundwater can be replenished, via reduced pumping and/or as a result of wetter local hydrologic conditions, during periods of wet/normal surface water availability. One possibility that is evident from the historic success of ongoing conjunctive use and awareness of potentially larger water requirements in the overall District area, and also evident from a successful initial participation in a water transfer in 2008, would be the potential expansion of conjunctive use for irrigation or other water supply, or for direct groundwater recharge in wet years, or for participation in other water supply programs, e.g. Drought Water Bank or other transfers, that would not be detrimental to in-District requirements. Implementation of this Plan Element is intended to consider that potential for expansion of ongoing conjunctive use. Overall, continued utilization of surface water in conjunction with local groundwater is essential to the management of groundwater for water supply without overdrafting that resource; thus, implementation of this Plan element will be essential to accomplishing all the management objectives (goals) for the basin.

Element 6 – Development and Continuation of Federal, State, and Local Agency Relationships

The District has a working relationship with DWR for coordinated groundwater monitoring in the Plan area. The District cooperated with DWR in its study of the "Feasibility Report, American Basin Conjunctive Use Project." More recently, the District participated in two water transfers through DWR to various State Water Contractor Agencies (SWRCB Corrected Order 2008-0039-DWR) in 2008 and again in 2009. The water transfer projects resulted in increased monitoring of groundwater levels and quality to serve as a basis for interpreting groundwater response to increased pumping during times of surface water transfer. This Plan envisions continued cooperation with DWR on programs of that type.

The District maintains a relationship with the State Water Resources Control Board, which involves an ongoing Settlement Agreement requiring the release of surface water into the Bear River during dry and critical years for in-stream beneficial uses within the Delta. The Settlement Agreement, and the subsequent SWRCB Order 2000-10 identify that there is a less than significant impact to export supplies available to State and Federal Contractors as a result of the

Settlement Agreement and associated increased groundwater pumping. The District worked cooperatively with DWR and the SWRCB to provide the necessary data and materials and will continue to do so.

The District maintains relations with nearby local irrigation districts, including Camp Far West Irrigation District and Nevada Irrigation District. The District is working with the Federal Energy and Regulatory Commission (FERC) for relicensing of the Camp Far West Dam.

This Plan element is primarily included to formalize the historical local and state agency working relationships as part of comprehensively managing local groundwater, in concert with currently developed supplemental surface water, and possibly with expanded surface water supplies, to accomplish all the management objectives (goals) for the Plan area.

The District will work with other State and Federal regulatory agencies when appropriate to protect the groundwater basin and achieve broader local and regional benefits. The District will expect to review land use plans and coordinate with land use planning agencies to assess activities which create a reasonable risk of groundwater impacts or contamination.

Element 7 – Public Education and Water Conservation Programs

As part of its conjunctive use operations, the District obtains land use and cropping plans from landowners who receive surface water from the District each year. The obtained data are utilized to estimate water requirements and to allocate supplemental surface water deliveries to maintain groundwater conditions. Part of that allocation effort includes public education about the extent and availability of supplemental surface water supplies.

In addition, the District continues to maximize the beneficial use of water, both groundwater and surface water, by implementing numerous water conservation efforts including, but not limited to improving conveyance canal control structures, recirculation of tailwater, limiting outflow from the District boundaries, and educational tools for District staff and its landowners. District staff works closely with landowners to provide water use efficiency information techniques and technologies. The District's landowners have implemented numerous individual water conservation efforts including, but not limited to land leveling, irrigation scheduling techniques and technologies, soil moisture monitoring, varietal changes, crop shifts, drainage improvements, reduced spill from rice fields, and minimum tillage techniques. All of these efforts contribute to improved water conservation efforts and improved water use efficiency of groundwater and surface water supplies throughout the District's service area.

This Plan Element is included to reflect a direction toward continued conservation and water use efficiency efforts in this conjunctive use system. This Plan Element also includes the opportunity for expanded public education regarding groundwater and surface water conditions, relative to agriculture water demand and the management goal to avoid overdraft and any related undesirable effects.

Element 8 – Well Construction, Abandonment and Destruction Policies

Well construction permitting in the basin is administered by the Sutter and Placer County Health Departments, which effectively implement the State Well Standards for water wells and monitoring wells. Permitting of municipal supply wells is also within the purview of the State Department of Public Health. One goal of this Management Plan, protection and preservation of groundwater quality, requires that all wells be properly constructed and maintained during their operational lives, and properly destroyed after their useful lives, so that they do not adversely affect groundwater quality by, for example, serving as conduits for movement of contaminants from the ground surface and/or from a poor quality aquifer to one of good quality. Toward that end, this element is included in the overall Plan to support well construction and destruction policies, and to participate in their implementation in the Plan area, particularly with regard to surface and inter-aquifer well sealing and proper well destruction, which are critical in the management of an aquifer system that has some connection with the Bear River and possibly other surface waters.

Element 9 – Management and Protection of Recharge Areas and Wellhead Protection Areas

Aquifers beneath the Plan area are recharged by precipitation, streamflow, applied irrigation water, and subsurface inflow from other areas. Land use in the area has historically been primarily agricultural.

Groundwater management activities will continue to generally monitor land uses and associated impacts on groundwater recharge, potentially leading to participation in land use planning to protect critical recharge areas. Similarly, wellhead protection areas within which pumping of individual wells directly affects groundwater flow towards those wells will be analyzed and mapped as appropriate, with the intent to protect them if necessary. This is not expected to be of major importance in light of prevailing good groundwater quality and as local groundwater use continues to be primarily for irrigation supply.

Implementation of this Plan element is expected to contribute to accomplishment of the first three management objectives (goals) for the Plan Area.

Element 10 – Provisions to Update the Groundwater Management Plan

The elements of this local area Groundwater Management Plan reflect the current understanding of the occurrence of groundwater in the overall District area. The management components are designed to achieve certain goals to protect and preserve groundwater quantity and quality for overlying beneficial use into the foreseeable future. At the same time, the management components of this Plan are intended to create an opportunity for development of additional local groundwater, and to conjunctively utilize it with the historical surface water supplies available to the area. The planned conjunctive use of surface water and groundwater is also intended to create opportunities for transfer of surplus water, either locally or otherwise, to contribute toward solution of nearby or other water supply problems.

Ultimately, however, it is also recognized that, while the Groundwater Management Plan provides a framework for present and future actions, new data will be developed as a result of implementing the Plan. That new data could define conditions which will require modifications to currently definable management actions. As a result, this Plan is intended to be a flexible document which can be updated to modify existing components and/or incorporate new components as appropriate in order to recognize and respond to future groundwater conditions and to address changing management objectives as they evolve in the Plan area.

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