Contents

Chapter 8 Tulare Lake Hydrologic Region ................................................................. 8-1
Setting ......................................................................................................................... 8-1
Watersheds ................................................................................................................. 8-1
Ecosystems .................................................................................................................. 8-2
Climate ....................................................................................................................... 8-2
Demographics .......................................................................................................... 8-3
Population ................................................................................................................ 8-3
Land Use Patterns .................................................................................................... 8-4
Regional Water Conditions ...................................................................................... 8-6
Water in the Environment .......................................................................................... 8-7
Water Supplies ........................................................................................................... 8-7
Water Uses ................................................................................................................ 8-8
Water Quality .......................................................................................................... 8-8
Project Operations .................................................................................................... 8-10
Water Governance ................................................................................................... 8-10
Flood Management ................................................................................................. 8-10
Historic Floods ......................................................................................................... 8-10
Flood Hazards .......................................................................................................... 8-10
Institutions ............................................................................................................... 8-10
Existing Flood Damage Reduction Measures ......................................................... 8-10
Constructed Flood Protection Facilities ................................................................. 8-11
Flood Governance ................................................................................................. 8-11
Operating Procedures ............................................................................................. 8-11
Emergency Procedures ........................................................................................... 8-11
Relationship with Other Regions ............................................................................ 8-12
Regional Water and Flood Planning and Management ............................................ 8-12
Integrated Regional Water Management ............................................................... 8-13
Accomplishments ..................................................................................................... 8-14
Challenges ................................................................................................................ 8-15
Drought and Flood Planning .................................................................................... 8-17
Looking to the Future ............................................................................................... 8-18
Future Scenarios ...................................................................................................... 8-18
Climate Change ....................................................................................................... 8-18
Response Strategies ............................................................................................... 8-18
Implementation Next Steps ..................................................................................... 8-19
Water Portfolios from 2002–2005 .......................................................................... 8-19
Selected References ................................................................................................. 8-19
Water Quality ........................................................................................................... 8-19
Flood Management ................................................................................................. 8-19

Tables
PLACEHOLDER: Table 8-x Watershed characteristics of Tulare Lake Basin ......... 8-2
PLACEHOLDER: Table 8-xx Watershed Groups in California’s Central Valley .... 8-2
PLACEHOLDER Table 8-xx California’s top agricultural export commodities ... 8-6
PLACEHOLDER Table 8-1 Tulare Lake Hydrologic Region water balance summary (taf) .... 8-7
PLACEHOLDER Table 8-3 Tulare Lake Hydrologic Region water use and distribution of dedicated supplies (taf) .......................................................... 8-7
PLACEHOLDER Table 8-4 Tulare Lake region water portfolio (taf) ....................... 8-7
PLACEHOLDER Table 8-2 Percentage of acreage of each crop category by irrigation method used, Kern County .................................................. 8-19
Figures
PLACEHOLDER Figure 8-x Tulare Lake Hydrologic Region................................................................. 8-1
PLACEHOLDER Figure 8-XX Group interests (2 charts) ................................................................. 8-2
PLACEHOLDER Figure 8-XX Group activities ................................................................................. 8-2
PLACEHOLDER: Figure 8-2 Tulare Lake Hydrologic Region population ........................................ 8-4
PLACEHOLDER: Figure 8-3 Tulare Lake region water balance for water years 1998-2005 ............. 8-7
PLACEHOLDER Figure 8-xx Percentage of sprinkler irrigation by crop, 1984, 1998, 2006 ............ 8-19
PLACEHOLDER Figure 8-xx Percentage of surface irrigation by crop, 1984, 1998, 2006 ............. 8-19
PLACEHOLDER Figure 8-xx Percentage of micro irrigation by crop, 1984, 1998, 2006 ............... 8-19

Boxes
PLACEHOLDER: Box 8-x Abbreviations and Acronyms Used in this Chapter.............................. 8-1
PLACEHOLDER: Box 8-x California Watershed Council ............................................................... 8-2
PLACEHOLDER: Box 8-xx Recent Legislation and Agency and Watershed Community Activities in California ............................................................. 8-2
PLACEHOLDER: Box 8-xx Q&A from Regional Economic Vitality Conversations, San Joaquin Region... ......................................................................................................................... 8-4
PLACEHOLDER: Box 8-xx Work Group: Water Quality, Supply, Reliability and Environmental Restoration ........................................................................................................ 8-13
Chapter 8 Tulare Lake Hydrologic Region

The Tulare Lake Hydrologic Region is in the southern end of the San Joaquin Valley. This region includes all of Tulare and Kings counties and large portions of Fresno and Kern counties. Major cities include Fresno, Bakersfield, and Visalia. The Tulare Lake region is one of the nation’s leading areas in agricultural production with a wide variety of crops on about 3 million acres. Agricultural production has been a mainstay of the region since the late-1800s.

Setting

The largest river is the Kings River, which flows west from the Sierra Nevada near the northern border of the region. The California Aqueduct extends the entire length of the west side of the region, delivering water to State Water Project (SWP) and Central Valley Project (CVP) contractors in the region and exporting water over the Tehachapi Mountains to Southern California. Significant rivers in the region include the Kings, Kaweah, Tule and Kern rivers, which drain into the valley floor of this hydrologically closed region. The Kings and Tule rivers historically terminated at the Tulare Lake, which was once the largest freshwater lake in the western United States. The Kern River historically terminated in two small lakes, Kern Lake and Buena Vista Lake. These lakes have been dry for many decades, and the waters that once fed them were long ago diverted for irrigation, such that the lake bottom lands are now heavily farmed. No significant rivers or creeks drain eastward from the Coast Ranges into the valley.

PLACEHOLDER: Box 8-x Abbreviations and Acronyms Used in this Chapter

Watersheds

The Tulare Lake Basin comprises the drainage area of the San Joaquin Valley south of the San Joaquin River and encompasses approximately 10.5 million acres and includes the historical lakebed. The Tulare Lake Basin is essentially a closed basin since surface water drains north into the San Joaquin River only in years with well above average rainfall. It is divided into six watershed management areas: Kern County, Tulare Lake, Tule, Kaweah, Kings, and Westside basins (Table 8-x Watershed characteristics of Tulare Lake Basin). Each area is defined as the designated groundwater basin. Thus, the Kern County Basin Management Area includes the Kern River and the Poso Creek drainage areas, as well as the drainage areas of westside streams in Kern County. The Tulare Lake Basin Management Area consists of the historical lakebed. The Tule Basin Management Area includes the Tule River, Deer Creek, and White River drainage areas. The Kaweah Basin Management Area includes the Kaweah River and Yokohl Creek drainage areas. The Kings Basin Management Area includes the Kings River drainage area as...
well as the drainage area for the tributaries and distribution systems of the Kings River. The Westside Basin includes the drainage areas of westside streams in Kings and Fresno counties (Watershed Management Initiative Chapter 2001).

PLACEHOLDER: Table 8-x Watershed characteristics of Tulare Lake Basin

PLACEHOLDER: Box 8-x California Watershed Council

PLACEHOLDER: Box 8-xx Recent Legislation and Agency and Watershed Community Activities in California

PLACEHOLDER: Table 8-xx Watershed Groups in California’s Central Valley

[From (below) http://endeavor.des.ucdavis.edu/groups/results.html]

A survey was conducted of approximately 500 watershed groups thought to be active in California. The vast majority of groups (82 percent) identified themselves as being interested in water quality issues. Additionally, the issues of habitat restoration, endangered species, land use, biological diversity, and ecosystem management were identified as interests by 70 percent or more of the groups (Figure 8-XX Group interests).

PLACEHOLDER Figure 8-XX Group interests (2 charts)

Add brief overview of local regional activities and groups

PLACEHOLDER Figure 8-XX Group activities

[Below text to be added by flood team]

• Introduction of principal streams of the region.
  o **Subject:** Kings River at Piedra, Kings River at Army Weir, Kern R near Democrat Springs, Kaweah R near Hammond
  o **Source:** (DWR1980), (USGS 2001) General Knowledge (GK).

• Origin of floods in the region:
  o **Subject:** Rainfall, Tidal Surge, Snowmelt, Sink flooding
  o **Source:** (DWR 1980), GK.

• **Table.** “Flood Parameters for Principal Streams” outlined in *General Instructions.doc* (GI).
  o **Source:** (USGS 2001).

**Ecosystems**

[Add: Basic Concepts for an Ecosystem Definition and local systems/work]

**Climate**

[Parts from previous bulletin and additional comments and observations]

Land in the region is well-suited for farming. The valley portion of the region is hot and dry in summer with long, sunny days and cooler nights. Winters are moist and often blanketed with tule fog. Nearly all of the year's precipitation falls in the six months from November to April. The Tulare Lake Hydrologic Region comprises the southern end of the San Joaquin Valley, a broad,
flat valley that is surrounded by the Diablo and Coast Ranges to the west and the Sierra Nevada foothills to the east and the Tehachapi Mountains to the south. This results in the comparative isolation of the region from marine effects. Because of this and the comparatively cloudless summers, normal maximum temperature advances to a high of 101 °F during the latter part of July. Valley winter temperatures are usually mild but during infrequent cold spells readings occasionally drop below freezing. Heavy frost occurs during the winter most years and the geographic orientation of the valley generates prevailing winds from the northwest.

The mean annual precipitation in the valley portion of the region ranges from about 6 to 11 inches, with 67 percent falling from December through March, and 95 percent falling during the winter months from October through April. The Tulare Lake Region enjoys a very high percentage of sunshine, receiving more than 70 percent of the possible amount during all but the four months of November, December, January, and February. During periods of tule fog, which can last up to two weeks, sunshine is reduced to a minimum. This fog frequently extends to a few hundred feet above the surface of the Valley and presents the appearance of a heavy, solid cloud layer. These prolonged periods of fog and low temperatures are important to the deciduous fruit industry.

Demographics

[Develop tribal content: Include, enumerate (somehow acknowledge tribal communities). All federally recognized tribes have sovereign governments. BIA map indicates locations of landless tribes, which may be in process of acquiring land. Many non-federally recognized tribes are petitioning for federal status, but may be harder to identify and locate. Contact the California Native American Heritage Commission for a list of tribal governments in a given area (county, zip codes, etc.).]

Population

The rate of population growth throughout the San Joaquin Valley is among the highest in the state, creating a strong demand for housing and urban infrastructure. The population in the Tulare Lake region is now about XX percent of the entire San Joaquin Valley population. While many communities in the region welcome the growth and income from a diversifying economy, the rapid urban growth is beginning to generate impacts on farming and the agricultural industry. In six years, between 1992 and 1998, nearly XXXX acres of farmland were converted to urban uses according to Department of Conservation statistics. Even though there is a concern about accelerated urbanization and the subsequent conversion of farmland, relatively few private agricultural preservation efforts exist in the San Joaquin Valley. The largest regional population centers are the Fresno/Clovis metropolitan area and the cities of Bakersfield and Visalia. Other smaller population centers include the cities of Tulare, Hanford, Porterville, and Delano.

[Update]

Household incomes and housing prices in the Tulare Lake region are lower on an average basis, compared to other regions of the state. New jobs in services, industries, construction, and agriculture are generally low-skilled and low-wage jobs, subject to seasonal fluctuation. As a result, unemployment consistently exceeds the state and national rates by as much as 10 percent. According to an April 2004 Public Policy Institute of California (PPIC) special survey, the most pressing San Joaquin Valley issues for residents of the South San Joaquin survey area were related to population growth and development. These issues included pollution, 32 percent; healthy economy, 13 percent; population growth, 11 percent; crime, 9 percent; and adequate...
water at 6 percent. The most notable trend of annual PPIC surveys is the increasing amount of concern about air pollution and all pollution in general. In 1999, pollution was cited by 9 percent of the survey respondents as the most important issue, 13 percent in 2001, 19 percent in 2002, 28 percent in 2003, and 32 percent in 2004.

Population density varies widely on a county-by-county basis, and large portions of some counties are virtually unpopulated. Much of the population lives in the more densely developed cities and towns. The population in the Tulare Lake region was about 1.55 million people in 1990 and reached 1.88 million by 2000. This is more than a 20 percent growth rate over that 10-year period. Statewide, California experienced a population increase approaching 14 percent from 1990 to 2000. Between 1998 and 2000, the population increased more than 3 percent, and California Department of Finance statistics project continued growth rates of 18 percent to 22 percent for the region’s four counties over the next 10 years. Figure 8-2 shows the Tulare Lake region’s population from 1960 through 2000, with projections to year 2030.

PLACEHOLDER: Figure 8-2 Tulare Lake Hydrologic Region population

The California Center for Regional Leadership and partners have conducted a series of Regional Economic Vitality Conversations around the state with representatives from Governor Schwarzenegger’s Administration and a diverse group of regional business and civic leaders. The intent of these meetings is to solicit and discuss ideas on how the state government can help stimulate and sustain economic growth in California’s regions. See Box 8-xx for key points/comments presented during the San Joaquin region meeting, organized by key questions posed to participants.

PLACEHOLDER: Box 8-xx Q&A from Regional Economic Vitality Conversations, San Joaquin Region

(from N. San Joaquin Valley Economic Vitality Report, CA Ctr for Regional Leadership, under IRWM directory)

Land Use Patterns

[Develop tribal content: total sq-miles of federal tribal trust lands. Large reservations (e.g, Tule River, Round Valley, Hoopa, and the Riverside/San Diego area tribes) should be noted. This info can come from the Bureau of Indian Affairs GIS data which we have, or by contacting the nearest BIA office. BLM also maps these and other categories of federal lands.]

[IWRM, as described in the Integrated Water Resources Management section, calls for coordinated management of natural resources within a given territory. In parallel with water management, a whole set of processes and approaches have been developed that we will group under the name of "land use planning". Is it possible to reconcile the two models, one terrestrial and one aquatic, superimposed within the same territory, the river basin?]

A large portion of the land area in the Tulare Lake Basin consists of forest and similar land cover in the foothill areas of some of the counties, with a part of that in federal or other public lands. However, urbanization of the valley floor has grown rapidly in the last century, and especially in the last 25 years, and is capturing an increasing share of the state’s population. This recent growth is creating new challenges for the region in its transition from rural and agricultural to urban and service oriented. Since 2000, it has been home to one of the nation’s top 10 fastest growing large metro areas—Bakersfield. At the same time, growth and diversification are creating great potential for California families and families in the region. Migration to the region seems to be
driven largely by such things as new jobs, availability of housing and a sense that there is a future for upward mobility. The historical emergence of a regional economy based on agriculture that is being impacted by population growth and urbanization has left in its wake a distinctive land-use pattern that forms the template of the San Joaquin Valley today.

Most of the growth has occurred adjacent to the agricultural towns along Highway 99. Cities such as Fresno, Visalia, and Bakersfield have become major urban centers, with between 100,000 and 500,000 residents. Metropolitan Fresno now approaches 1 million people.

Because of its significance as the major land use, farmland deserves more detailed consideration. As of 2000, The Tulare Lake Basin had about XX million acres of farmland. Of this, about XX million, or XX percent, was classified by the state as prime farmland—that is, land that has the best combination of soil quality, growing season, and water supply, and actually was in irrigated agricultural production within four years of the mapping date. Another XX million, or XX percent, was defined as farmland of state importance even though it was not categorized as prime. Other categories of farmland made up the remaining 20 percent of the farmland in the eight counties. Prime farmland is in a large northwest-to-southeast section of the San Joaquin Valley floor, stretching from the tip of San Joaquin County all the way south to Bakersfield. The Tulare Lake Basin consists mainly of farmland of statewide importance, although it is not categorized as prime farmland. Much of the farmland along the Highway 99 corridor is a mixture of these two categories, and some has been fragmented over time by urbanization. Urban growth is expected to continue to be significant in the San Joaquin Valley. Several forecasts point to declining urban density in the San Joaquin Valley. Development patterns have significant implications for traffic congestion, air quality, and other growth-related problems.

Some projections show at least a 15 percent decline in farmland in the near future. Although this outcome would have implications for the management of natural resources, especially water, it would not necessarily entail an equivalent loss of agricultural income if farmers were to increase the intensity of use on land that remains. Although this outcome would have implications for the management of natural resources, especially water, it would not necessarily entail an equivalent loss of agricultural income if farmers were to increase the intensity of use on land that remains. To be certain, urban growth will partly depend on which public policy goals are emphasized locally. For example, protection of prime farmland would move a significant amount of development away from existing population centers along the Highway 99 corridor. In contrast, the development of the High-Speed Rail would focus development along that corridor and consumes a large amount of prime farmland near existing cities.

The State and federal government agencies own about 30 percent of the land in the region, including about 1.7 million acres of national forest, 0.8 million acres of national parks and recreation areas, and 1 million acres of land managed by the U.S. Bureau of Land Management. Privately owned land totals about 7.4 million acres.

[Update figures, trends, etc.]

[Add data on acreage, value of production, contribution to local economy, trends, changes in crop types and society’s perception of agriculture.]
Regional Water Conditions

Historically, the Tulare Lake Basin relied solely on the flow of the unregulated streams descending from the eastern slopes of the Sierra Nevada. Over time, canals were constructed, irrigation districts established, and dams constructed allowing these streams to be controlled and the water conveyed to the areas of agricultural development. During the early 1900s with the development of the turbine pump, groundwater pumping began and extended the range of valley land that could be reclaimed and farmed with irrigation water.

By the 1920s, the impact of all these new groundwater wells began causing groundwater levels to decline at rates that could not be sustained. Since the late 1800s, many individuals had envisioned various designs of water projects that would tap into the water passing through the Sacramento-San Joaquin Delta and carry water to the southern valley. As the groundwater conditions deteriorated in the south valley, momentum for a water project to move water from the Delta into the southern Valley began being debated in the California Legislature. However, before the project could receive final funding approval, the Great Depression hit, and the effort was dropped. Ultimately, the idea was undertaken by the federal government, ending in the construction of the Central Valley Project. Water supplies to the Tulare Lake Basin were supplemented with the completion of the Friant-Kern Canal. After the passage of the Burn-Porter Act, the State Water Project construction began.

The region’s agriculture and urban areas consequently developed over the years following the construction of these water importation projects. Entire new areas of land were opened up for agricultural development along the western side of the San Joaquin Valley; many eastside areas began operation of highly developed conjunctive use projects.

Other topics

- dependence of class II water for conjunctive use
- groundwater use/reliance and water banking, trading, transfers, optimization projects
- streamflow variability
- imported water reliability issues
- supply/water quality issues
- environmental water needs, CVPIA, fisheries, etc
- rainfall/snow
- water quality concerns, natural and man made
- San Joaquin River restoration; Delta pumping restrictions, global warming possibilities
- areas of drainage problems, major groundwater issues, water rights issues, local perspectives of water marketing/trading, urban growth/ag and air quality, etc.
- localized flooding concerns, Tulare Lake inundation, Caliente Ck, Deer Ck, White River, James Bypass, Arroyo Pasejaro, etc.

PLACEHOLDER Table 8-xx California's top agricultural export commodities
Water in the Environment

Water Supplies

[Develop tribal content: Is this where pending water rights issues would be discussed? BIA knows what tribal water rights proceedings are in progress, for example Tule River Tribe (Tulare County).]

[Describe regional water supplies, origin, storage, reliability, how supplies are changing and why, etc.]

The water balance table for the Tulare Lake Region (Table 8-1) summarizes all of the water supplies, uses, and outflows for years XXXX, XXXX, and XXXX and is supplemented by the detailed regional water accounting information in Table 8-3. As shown in Table 8-3, groundwater supplements available surface water each year to meet the region’s needs. In wet years like XXXX, surface water adds to groundwater storage through a variety of recharge mechanisms. In a drier year like XXXX, groundwater is pumped to meet water needs and results in a removal of groundwater from storage. Table 8-4 (in large format at the end of this chapter) provides more specific information about the developed or dedicated component of water supplies for agricultural, urban, and environmental purposes, as assembled from actual data for XXXX, XXXX, and XXXX. In XXXX, an average water year, about XX percent of the San Joaquin River region’s developed water supply came from local surface sources, XX percent was from imported surface supplies, and groundwater provided about XX percent of the water supply.

PLACEHOLDER Table 8-1 Tulare Lake Hydrologic Region water balance summary (taf)

PLACEHOLDER Table 8-3 Tulare Lake Hydrologic Region water use and distribution of dedicated supplies (taf)

PLACEHOLDER Table 8-4 Tulare Lake region water portfolio (taf)

About XX percent of the developed supply, excluding surface water and groundwater reuse, was used for dedicated natural flows to meet instream flow requirements. Figure 8-3 and Table 8-2 summarize all of the developed urban, agricultural, and dedicated environmental water uses in this region for years XXXX, XXXX, and XXXX.

PLACEHOLDER: Figure 8-3 Tulare Lake region water balance for water years 1998-2005

On the valley floor, many agricultural and municipal users receive their water supply from large irrigation districts, such as the Fresno, Westlands Water District, Kings River Water Agency, and Semitropic Water Storage District. Most of the surface water in the upper San Joaquin River is stored and diverted at Friant Dam, and is then conveyed north through the Madera Canal and south through the Friant-Kern Canal. Average annual diversions from the San Joaquin River through the Friant-Kern and Madera Canals total about 1.5 million acre-feet per year.

The tributaries of the Tulare Lake Basin provide the region with high-quality water that constitutes most of the surface water supplies for local uses. Much of this water is regulated by reservoirs and used on the east side of the San Joaquin Valley. In XXXX, an average water year, agriculture accounted for about XX percent of the San Joaquin River region’s total developed water use, while urban water use was about XX percent and environmental water use for
dedicated purposes was XX percent. Regional average urban per capita water use was about XXX gallons per capita per day. Imported water supplies to this region from the Central Valley Project, the State Water Project, and other federal deliveries, amounted to 1,XXX,000 acre-feet. Environmental demands, including refuges, instream requirements, and wild and scenic flows, totaled X,XXX,X00 acre feet (see Figure 8-3 and Table 8-4).

Groundwater pumping continues to be a major source of water supply for the Tulare Lake region, and in many districts is managed in conjunction with surface supplies. Over the long-term, groundwater extraction cannot continue to meet all of the current and projected water demands without causing negative impacts on the groundwater basins. The primary impact is groundwater overdraft, a condition where the average long-term amount of water pumped out of the basin exceeds the amount of water recharged or naturally replenished into the groundwater basin. A serious consequence of long-term groundwater overdraft is land subsidence and compaction of the aquifer, with a resulting drop in the natural land surface. Land subsidence results in a reduction of aquifer storage space and may damage public facilities such as canals, utilities, pipelines, and roads.

**Water Uses**

[Describe regional water uses, major demand factors and trends, conveyance, uses by sector, competing uses, constraints, issues, etc.]

Table 8-1 (Tulare Lake Hydrologic Region Water Balance Summary (taf)) summarizes all of the water supplies, uses, and outflows for years XXXX, XXXX, and XXXX and is supplemented by the detailed regional water accounting information in Table X.

Normally, all native surface water supplies, imported water supplies, and direct precipitation percolate into valley ground water if not lost through consumptive use, evapotranspiration, or evaporation. Because of the closed nature of the Tulare Lake Basin, there is little subsurface outflow. Thus, salts accumulate within the basin due to importation and evaporative use of the water.

**Water Quality**

**Overarching Water Quality Issues:** Salinity is the primary contaminant affecting water quality and habitat in the Tulare Lake Region, a consequence of agricultural operations compounded by groundwater overdraft. Agricultural runoff and drainage are also the main sources of nitrate, pesticides, and naturally occurring selenium that endanger groundwater and surface water beneficial uses. The basin also has a relatively large concentration of dairies that contribute microbes, salinity, and nutrients to both surface and groundwaters. Nitrate has contaminated over 400 square miles of groundwater in the Tulare Lake Basin. In addition, over 800 oilfields discharge a wide variety of contaminants to the waters of the region.

**Pollutants associated with agricultural irrigation and production:** The Central Valley--which covers San Joaquin River, as well as the Sacramento River and Tulare Lake basins--has 40 water bodies impaired due to agriculture, including 800 miles of waterways, and 40,000 acres in the Delta. The pollutants associated with agricultural irrigation and production include nutrients, selenium, boron, organophosphate pesticides (such as diazinon and chlorpyrifos), and toxicity of unknown origin. Relative to other regions, discharges from irrigated lands--which include managed wetlands and
nurseries--have their greatest impact in the Central Valley, which covers 40% of California’s land area, and contains seven million irrigated acres and at least 25,000 individual agricultural dischargers.

**Drainage Issues:** High salinity is a problem in the San Joaquin basin, because of the greatly altered flow regime of the River; most of the San Joaquin is diverted from its natural course at Friant Dam. Moreover, irrigation water from State and federal projects annually import over a half million tons of salt to the Westside of the San Joaquin River basin. Water released from New Melones Reservoir on the Stanislaus River is currently used to help meet the salinity and dissolved oxygen requirements at Vernalis on the San Joaquin. Agricultural drainage and discharges from managed wetlands are already formally managed under permit in the 370,000 acre Grasslands watershed, which contributes high levels of salts, selenium, boron, and nutrients to Mud and Salt Sloughs, which in turn are the primary contributors of selenium to the San Joaquin River. Water releases from managed wetlands, part of State and federal wildlife refuge system, also discharge salts and nutrients.

In 2002, the U.S. Bureau of Reclamation released the San Luis report, which declared that an “in-Valley” solution to the drainage problem on the Valley’s Westside should be implemented. The proposed alternative includes the following features: a drainwater collection system, regional drainwater reuse facilities, selenium treatment, reverse osmosis treatment for the Northerly Area, and evaporation ponds for salts disposal.

**Dairies, Stockyards, and Poultry Ranches:** Concern in the region for their loadings of pathogens, nutrients, salts, and emerging contaminants (such as antibiotics) to water bodies. Some dairies and other agricultural operations are already subject to regulatory review.

**Pesticides:** Organophosphorous pesticide control generally has been identified as a priority for the basin. *(Add issues and current Status)*

**Delta Drinking Water Policy:** Establishing a policy for protecting Delta drinking water quality was seen as a priority by the Central Valley Regional Water Quality Control Board.

**Erosion:** Erosion of Westside streams is the primary source of organochlorine pesticides in the San Joaquin River. *(Add issues and current Status)*

**Water Temperature:** Migrating and spawning salmonids can face high temperatures in the Stanislaus, Tuolumne, and Merced rivers downstream from dams during certain times of the years, depending upon hydrologic and water supply conditions.

Contamination of fish is also a concern in these three rivers as well as the main stem of the San Joaquin River. For example, the Central Valley Regional Water Quality Control Board cites one study of the 43-mile reach of the San Joaquin, between its confluences with the Merced and the Stanislaus, to be toxic to fish about half the time.

**Depleted freshwater flows** *(Add issues and current Status)*

**Increasing Urbanization:** While agricultural land use currently impacts water quality, rapid urbanization of the Central Valley, converting undeveloped or agricultural lands to residential and commercial use, may present different or new water quality problems in the future. The Central
Valley Water Board has recently begun requiring many municipal dischargers to implement costly tertiary treatment of wastewater.

**Groundwater Quality:** Naturally occurring arsenic and man-made organic chemicals—pesticides and industrial chemicals—have contaminated groundwater used as domestic water supplies in this region. *(Add issues and current Status)*

**Project Operations**
[General description of major projects in region]

**Water Governance**
[Briefly describe the current status and degree, of the structure and nature of water policy, management, and planning in the region.]

**Flood Management**
[annotated outline provided by Flood Team]

**Historic Floods**
- Significant historic floods:

**Flood Hazards**
- Flood Hazard List:
  - **Source:** GK, Local Government Staff (LGS).
- List of Flood Management Challenges.
  - **Subject:** urban protection, Non-urban protection, floodplain regulation, mapping, uncontrolled runoff, bridge failure, levee failure, alluvial fans
  - **Source:** (DWR 1980) Tabulated text on pp. 214-16, GK, Author.

**Institutions**
- **Flood Control Types**
  - **Subject:** Structural works, hydromet networks, emergency response, recovery
  - **Source:** (DWR 1980) pp. 210-212, DFM Hydrology staff, GK.
- **Ownership, Sponsorship, Participation and Maintenance of Major Projects**
  - **Subject:** Agency list summarizing role in ownership (project initiation), financial participation, and maintenance. Research to be done post 1980.
  - **Source:** (DWR 1980) pp. 210-212, G.K.
- **Emergency Response**
  - **Subject:** Responsibility of SEEMS, Flood Center, Corps of Engineers, FEMA
  - **Source:** Flood Center, G.K., reference to SS.

**Existing Flood Damage Reduction Measures**
- Type of facilities found in the Region
Constructed Flood Protection Facilities

- **Flood Control Projects**
  - **Subject**: Big Dry Creek Dam, Stone Corral Watershed, Terminus Dam, Kern River California Aqueduct Intertie
  - **Source**: (DWR 1980), LGS.

- **Table**, “Flood Control Reservoirs”, outlined in General Instructions.doc (GI).
  - **Subject**: Little Panoche Res., Pine Flat Lake, Lake Isabella, Kaweah Lake, Lake Success, Tulare Lake

- **Hydromet Systems and Stations**
  - **Subject**: Stream gages as listed in Setting other stream gages, rain gages, snow gages. Adequacy of existing gage network.
  - **Source**: DFM Hydrology Staff, LGS, (USGS 2001)

Flood Governance

- **List of Governance Methods**
  - **Subject**: Floodplain zoning ordinances, designated floodways (CVFCB), county floodplain management programs
  - **Source**: (DWR 1980), LGS.

- **Status of Floodplain Mapping and FIRMs**
  - **Subject**: Mapped and unmapped areas, planned mapping projects
  - **Source**: DFM Staff (Tom Christensen, 574-1407)

- **Local Government Participation in the NFIP Community Rating System**
  - **Subject**: Participating counties as listed in Appendices A and B to GI.
  - **Source**: DFM staff, reference to SS, GI.

- **Table**, “Community Ratings for NFIP” outlined in General Instructions.doc (GI).
  - **Subject**: Kern County
  - **Source**: See General Instructions.doc (GI)

Operating Procedures

- **General Reservoir Operating Rules**
  - **Subject**: Little Panoche Res., Pine Flat Lake, Lake Isabella, Kaweah Lake, Lake Success
  - **Source**: Flood Center (Corps O&M Manuals).

- **Forecast-coordinated Operations Agreements**
  - **Source**: DFM Staff

- **Status of Response Agreements** (See GI for description)
  - **Source**: Flood Center, LGS

- **Available H&H models**
  - **Subject**: Streams outlined in “Setting”
  - **Source**: DFM Hydrology staff, LGS, reference to SS for Comp Study.

Emergency Procedures

- **Formal Emergency Management Organization**
  - **Subject**: Agency participation and responsibility
The Tulare Lake region receives CVP water from the San Joaquin River region via the Friant-Kern Canal and imported water from the Sacramento-San Joaquin Delta via the SWP California Aqueduct and the CVP San Luis and Delta-Mendota canals. The regional map in Figure 8-1 identifies the amounts of water imports and exports for recent years 1998, 2000, and 2001. The economic health of the region heavily depends on the availability of imported surface water to meet current and future needs. Several water districts within the Tulare Lake region have developed groundwater storage and recovery programs that benefit water districts outside of the region. Groundwater overdraft has created sufficient dewatered storage space to store water for local uses and for extraction and exchange or delivery to other agencies. Revenues generated by these storage and recovery programs have helped finance additional conveyance infrastructure to move surface water to areas that were previously served with groundwater. This type of conjunctive use activity ultimately helps relieve overdraft, while providing additional water supplies to agencies outside of the region.

[UPDATE]

Regional Water and Flood Planning and Management

Tulare Lake regions’ growing interest in the regional planning process is indicated by the rising number of proposals submitted for funding considerations to DWR and SWRCB. Some of the factors that are commonly considered in these regional planning efforts include:

- Population growth, impacts, and resulting water needs
- Groundwater overdraft and associated problems
- Preservation of prime agricultural lands
- Reliability of water supplies in foothill and mountain communities
- Reliability of water supplies for fish, refuges, and the environment
- Potential water transfers and exchanges and their effects
Groundwater banking programs

Groundwater quality issues, particularly for drinking and municipal use

Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, was passed by California voters in November 2002 which authorized the Legislature to appropriate funding for IRWM projects. More recently, Proposition 84 was passed and will add addition funding for this process. SWRCB and DWR adopted the IRWM Program Guidelines in November 2004. The IRWM Guidelines established the process by which SWRCB and DWR jointly solicit applications, evaluate proposals, and award grants. Funding for the IRWM Program is administered jointly between the State Water Resources Control Board (State Water Board) and the Department of Water Resources (DWR). The agencies utilize a combined application process for awarding grants.

SWRCB and DWR coordinated the technical review process of proposals based on criteria outlined in the IRWM Implementation Grant Proposal Solicitation Packages (PSPs). Application can be for Planning Grants or Implementation Grants.

From California Partnership for the SJV, Strategic Plan
The California Partnership for the San Joaquin Valley has developed a strategic plan to address water planning and is currently working to develop a Regional Water Plan. Several other local groups are in the process of developing IRWM plans. In addition, several cities in the region, including Fresno are activity involved in a Blueprint Planning process in an attempt to reconcile “pro-growth” and “anti-growth” forces and attitudes, such as concerns about the need for housing production and regional economic development, on the one hand, and resistance to community change and environmental disruption, on the other. Blueprint planning seeks mainly to coordinate long-range regional and local plans for transportation investment, air quality, and housing, although in some cases such policy areas as energy and habitat planning are also incorporated. An exception is the California Environmental Quality Act (CEQA) – California’s version of NEPA.

PLACEHOLDER: Box 8-xx Work Group: Water Quality, Supply, Reliability and Environmental Restoration

Integrated Regional Water Management

This section is intended to describe the state of IRWM planning at the hydrologic region level. Describe the portions of area covered by IRWMs in this HR. What are the known IRWM efforts and their status? Discuss objectives and main water management strategies to meet objectives in the HR. (In this HR, these are the main objectives; these are the water management strategies to meet those objectives.)

There are currently four Integrated Regional Water Management Plans (IRWMPs) in the Tulare Lake HR at varying stages of function and development. These IRWMPs are located throughout HR, but portions of the HR are void of IRWM planning. IRWMPs are living documents and IRWMPs may change as planning efforts mature, opportunities for collaboration and partnership are discovered, and State guidance is further refined. There may be existing efforts which, at the time of this printing, are not yet known on a statewide basis. The known planning efforts in the region are presented in Fig XX [shape files of known regions]

[Discuss varying status of plans (status includes state of planning, state of outreach, integration, area covered, water management issues...)] The Kings River IRWM is located in the northern central portion of the HR with the Kaweah IRWM adjacent to the south. The Poso Creek IRWM is located in the southern portion of HR. The Westside IRWM spans both the San Joaquin River HR
and the Tulare Lake HR. Within the Tulare Lake HR, the Westside IRWM generally occupies the northwestern portion.

[Discuss objectives and water management strategies in the region]

[Text to be provided by flood team]

- **Flood Management provisions in IRWMPs**
  - **Subject:** Poso Creek IRWMP, Kaweah Delta IRWMP, Upper Kings Basin Water Forum/IRWMP, Westside Regional Drainage Plan/IRWMP, Lower Tule IRWMP

**Accomplishments**

[Text to be added by flood team]

- **Brief descriptions of significant flood management accomplishments, particularly recent accomplishments. Include years of completion or establishment.**

[Add to section’s content from CWP update 2005]

- Agricultural Water Management Council and Districts with approved Agricultural Water Management Plan; irrigated acreage of districts with plans; EWMPs
- Water districts are working with individual growers to improve on-farm irrigation water management systems and efficiency.
- Irrigation System changes/upgrades (more permanent crops)
- DWR survey of irrigation methods
- Benefits to production, applied water, fertigation
- Efforts to reconcile inconsistent year to year contract deliveries from the CVP and SWP
- California Urban Water Conservation Council and “MOU”, cities with approved plans; BMPs, DMMs; SB 221 & SB 610
- Groundwater Management Act of 1992, AB 3030, areas with approved GWM Plans; AB 255; AB 255; SB 1938
- New Surface water treatment plants
- New sewage treatment systems
- New conjunctive use projects, water banks, interconnections, management strategies, etc.
- Broadview Water District change and water transfer
- U.S. Natural Resources Conservation Service agricultural programs
- The Lake Kaweah Enlargement Project
The Coordinated Resource Management and Planning (CRMP) groups in the Tulare Lake region include the Panoche/Silver Creek CRMP, the Stewards of the Arroyo Pasajero Watershed CRMP, and the Cantua/Salt Creek Watersheds CRMP.

- Kern County Water Agency’s Kern River Restoration and Water Supply Improvement Program

### Challenges

[Text to be added by flood team]

- Challenges in ameliorating the hazards listed above.
  - Source: DFM Staff, Author.

#### Below from Previous Bulletin, need to add/subtract ????

Whenever a region looks outside of its borders for more water, statewide water management and integrated resource planning become important considerations. Depending on the package of options chosen, one region’s actions can affect another region’s supplies. Statewide planning involves assessing trends in each region’s water demand and quantifying the cumulative effects of each region’s demand and use patterns on statewide supplies.

It basically parallels planning at the local and regional levels. By working through a statewide planning process, the magnitude of both intra- and inter-regional effects can be analyzed. However, in a number of circumstances, measures that would be taken to manage demand, to increase supplies, or to improve water service reliability are local decisions. These decisions must assess and compare the cost of increased water reliability against the economic, environmental, and social costs of potential shortages.

In the short term, those areas of California that rely on the Sacramento-San Joaquin Delta for all or a portion of their surface water face an unreliable supply due to the evolving protections for aquatic species and water quality. At the same time, California’s water supply infrastructure is severely limited in its capacity to transfer marketed water through the Delta due to those same operating constraints. Until solutions to complex Delta problems are identified and put in place and demand management and supply augmentation options are implemented, some water-dependent regions will experience imported water shortfalls. Such limitations of surface water deliveries will continue to exacerbate groundwater overdraft in the Tulare Lake region because groundwater is used to replace much of the shortfall in surface water. In addition, water transfers within these areas have and will become more common as farmers seek to minimize water supply effects on their operations. In urban areas, water conservation and water recycling will be accelerated to help offset short-term water needs. Proposition 50, also known as “Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002,” provides a mechanism for funding projects to augment systems and supplies, optimize delivery systems, use recycled water, and increase water management efficiency. Distinct environmental water needs exist for each of the four major watersheds in the Tulare Lake Hydrologic Region that encompass the river systems of the Kings, Kaweah, Tule and Kern. There has been significant activity on both the Kings and Kern Rivers to restore flows for habitat as well as recreation. Modification to outlet structures and timing of releases on the Kings River provide cooler water temperatures to protect the resident trout populations. Gravel augmentation is also carried out to provide spawning habitat. The Kern County Water Agency has implemented a successful and innovative program of delivering water supplies down the river through the City of Bakersfield, thus providing water for instream uses which can later be extracted farther downstream through the use of wells.
Environmental water supplies on the Kaweah and Tule rivers are being modified due to the mitigation requirements tied to reservoir enlargement projects on both systems. Groundwater pumping, a major source of supply in the Tulare Lake region, continues to increase in response to growing urban and agricultural demands. If groundwater extraction continues to be used to offset anticipated but unmet surface water imports, it will have negative consequences. One such effect of long-term groundwater overdraft is land subsidence, which also results in a reduction of aquifer storage space. This has already caused some damage to canals, utilities, pipelines, and roads in the region. In an effort to slow this condition, many water agencies have adopted groundwater replenishment programs by taking advantage of excess water supplies available in wet years, incidental deep percolation, and seepage from unlined canals. On the region’s west side, salinity, sulfate, boron, chloride, and selenium limit the uses of groundwater. Salinity is the primary water quality factor affecting use of groundwater for irrigation and native habitat. Where groundwater quality is marginal to unusable for agriculture, farmers use good quality surface water to irrigate crops or blend higher quality surface water with poor quality groundwater to create a larger supply. The inefficiency of some crop irrigation systems can increase percolation of irrigation water into the shallow unconfined aquifers, causing drainage problems and degrading groundwater quality. This marginal to poor quality groundwater has mounded up to reach crop root zones in this area and is threatening the viability of agriculture there. Agricultural runoff and drainage are also the main sources of nitrate, pesticides, and selenium that endanger groundwater and surface water beneficial uses. The basin also has a relatively large concentration of dairies that contribute microbes, salinity, and nutrients to both surface water and groundwater. Nitrate has contaminated more than 400 square miles of groundwater in the Tulare Lake Basin. In addition, oilfield waste has impacted water quality. According to the Regional Water Quality Control Board’s basin plan, there are more than 800 oilfield waste dischargers, of which 250 are regulated under waste discharge requirements.

Naturally occurring arsenic as well as pesticides and industrial chemicals have contaminated some groundwater supplies that are used for domestic water in the region. For example, the lone well that provides water for city of Alpaugh’s 760 residents (40 percent of whom are defined as living at poverty levels) contains unsafe levels of naturally occurring arsenic. By 2006, new federal and State rules will force more than 50 central San Joaquin Valley communities, including Hanford, Pixley, and Tranquility, to cut arsenic levels to one-fifth the current allowable levels. The contamination of 40 wells in Fresno due to high levels of dibromochloropropane (DBCP), trichloroethylene (TCE), and other organic compounds resulted in the installation of activated charcoal filtration systems to remove these contaminants. The quality of local surface water from the Kings River and the San Joaquin River (diverted south through the Friant-Kern Canal) is generally considered excellent for irrigation, municipal, and industrial uses. However the Central Valley Regional Water Quality Control Board has specifically identified salinity in the lower Kings River as a water quality priority in its 2002 Triennial Review. On the west side of the region, the California Department of Water Resources (DWR) has sought solutions to the flooding on the Arroyo Pasajero, which threatens the California Aqueduct. The aqueduct, which forms a barrier to arroyo floodwaters and sediment flow, is at risk of failure during major rainstorms in the watershed. Also, the naturally occurring asbestos in the arroyo sediments that enter the aqueduct during floods has raised questions of possible health risks. Both Panoche and Silver creeks contribute large sediment loads to the valley floor, and Panoche Creek also contains elevated levels of selenium.

For many years, portions of the Tulare Lake region have experienced significant drainage problems. The need for proper drainage of agricultural return flows has long been recognized by federal and State agencies. Planning for drainage facilities to serve the San Joaquin Valley began in the mid-1950s. The poorly drained area is concentrated along the western side of the San...
Joaquin Valley from Kern County north into the San Joaquin River Hydrologic Region. Although the San Joaquin Valley has some of the most productive agricultural lands in the world, much of the west side of the valley is plagued by poor subsurface drainage that adversely effects crop productivity. Between 1977 and 1991, the area affected by saline shallow groundwater on the west side doubled to about 750,000 acres. At present, a substantial portion of the valley, about 2.5 million acres, is threatened by saline shallow groundwater resulting from the lack of proper drainage. In addition, drainage water is sometimes contaminated with naturally occurring, but elevated, levels of selenium, boron, and other toxic trace elements that threaten the water quality, environment, and fish and wildlife. Water planners had originally envisioned a master surface water drain to remove this poor quality water, but that proposal was never implemented. The U.S. Bureau of Reclamation has an obligation to provide agricultural drainage service to farm lands served by the CVP on the west side of the valley. To convey this sometimes contaminated drainwater more directly to the San Joaquin River and away from the sensitive San Luis National Wildlife Refuge Complex, a portion of the San Luis Drain was reopened in September 1996 as part of the Grassland Bypass Project. The San Luis Drain was modified to allow drainage through six miles of Mud Slough, a natural waterway that passes through the San Luis National Wildlife Refuge Complex and a section of the North Grassland Wildlife Area. Monitoring the quality of San Joaquin Valley agricultural drainage water began in 1959 as a cooperative agreement between the DWR and the University of California. In 1984, the San Joaquin Valley Drainage Program was established as a joint federal and State effort to investigate drainage and drainage-related problems and identify possible solutions. In September 1990 the San Joaquin Valley Drainage Program summarized its findings and presented a plan to manage drainage problems in a report titled “A Management Plan For Agricultural Subsurface Drainage and Related Problems in the Westside San Joaquin Valley.” In December 1991 several federal and State agencies signed a memorandum of understanding and released an implementation strategy titled “The San Joaquin Valley Drainage Implementation Program.” The purpose of the 1991 MOU and its strategy document was to coordinate various programs in implementing the 1990 recommendations.

In 1997 member agencies of the San Joaquin Valley Drainage Implementation Program and the University of California initiated a plan to review and evaluate the 1990 Plan and update its recommendations. Eventually, the San Joaquin Valley Drainage Authority, which includes districts in the Grassland, Westlands, and Tulare subareas, was formed to develop a long-term solution for drainage problems in the valley, which could include out-of-valley disposal. Studies continue in pursuit of cost-effective ways to dispose of the drainage water.

In 2002 the U.S. Bureau of Reclamation released a new San Luis report, which declared that an “in-Valley” solution to the drainage problem on the valley’s west side should be implemented. The proposed alternative contains features that include a drainwater collection system, regional drainwater reuse facilities, selenium treatment, reverse osmosis treatment for the Northerly Area, and evaporation ponds for disposal of accumulated salts. Also in 2002 the Westlands Water District and the United States reached a settlement agreement regarding the drainage of lands that the federal government was legally obligated to provide to west side farmers. Under this agreement the federal government would buy the poorest drained agricultural lands from farmers and then remove those lands from agricultural production. As a result of this agreement, the number of acres requiring drainage service in the San Luis Unit will initially be reduced by retiring about 33,000 acres, part of a long-term plan that may eventually retire up to 200,000 acres.

**Drought and Flood Planning**

*From Flood Mgt. Document Provided*
Add to Drought and Flood Planning *(Note: drought text will be “by others”)*

- Regional Flood Plans or Flood Planning Agencies
  - **Subject:** Tulare County FCD (TFCD), Fresno Metro FCD (FMFCD), Kern County Water Agency
  - **Source:** LGS, (DWR 1980).
- FloodSAFE regional flood management plans.
  - **Source:** Reference to SS
- Multi-county projects.
  - **Source:** LGS, (DWR 1980).

**Looking to the Future**

[Develop tribal content: Mention if something pending in tribal water rights. Tribal water rights that have not been quantified could be the sleeping giant throughout the western states. As tribes look to the future of their communities, their own economic survival may be played out in water rights proceedings. Some may simply buy from wholesale or retail water agencies.]

[Below from Previous Bulletin; need to add/subtract ?????]

Major water agencies and counties within the Tulare Lake region have been proactive for many years in all facets of water use and supply planning (see Box 8-1 Ongoing Planning Activities). The efficiency of water diversions from local rivers and streams is continually being optimized to meet agricultural and urban purposes. In addition, when it became apparent that the groundwater supply was not sustainable for meeting all future water demands, water agencies worked with the CVP and SWP to find ways to improve delivery capabilities. The predominantly agricultural economy is now adapting to share water resources with the rapidly growing urban economy. New projects have been identified as necessary to better manage the local water supplies, as well as to adhere to more stringent water quality standards and environmental regulations.

**Future Scenarios**

**Climate Change**

[how much detail; could be repetitive among some regions]  
[Text to be added by flood team]

- **Subject:** Corps Precipitation Studies
- **Source:** DFM Hydrology Staff (Tom Christiansen), reference to SS, (USACE 2001).

**Response Strategies**

[Text to be added by flood team]

- **Subject:** Studies to be developed
- **Source:** DFM Staff, Text (“Flood Hazards”, “Challenges”), Author.
Implementation Next Steps

[Text to be added by flood team]

- Steps to improve any aspect of flood management in the region.

Source: DFM Staff, Text (“Flood Hazards”, “Challenges”, and “Response Strategies”), Author.

Water Portfolios from 2002–2005

PLACEHOLDER Table 8-2 Percentage of acreage of each crop category by irrigation method used, Kern County

PLACEHOLDER Figure 8-xx Percentage of sprinkler irrigation by crop, 1984, 1998, 2006

PLACEHOLDER Figure 8-xx Percentage of surface irrigation by crop, 1984, 1998, 2006

PLACEHOLDER Figure 8-xx Percentage of micro irrigation by crop, 1984, 1998, 2006

Detailed information about actual water supplies and water uses (called “water portfolios”) for water years 1998, 2000, and 2001 is presented in tables 8-3 and 8-4 and figures 8-4 and 8-5.

Selected References

Water Quality

2002 California 305(b) Report on Water Quality, State Water Resources Control Board


Strategic Plan, State Water Resources Control Board, Regional Water Quality Control Boards, November 15, 2001

Water Quality Control Plan, Regional Water Quality Control Boards

Watershed Management Initiative Chapter, Regional Water Quality Control Boards

Flood Management


