2.0 INTRODUCTION

The San Joaquin River Watershed Unit of the Central Valley Regional Water Quality Control Board (Central Valley Water Board) initiated a water quality monitoring program in October of 2000 as part of California Assembly Bill AB 982 (Chapter 495, Statutes of 1999). AB 982 focuses State Water Resources Control Board (SWRCB) efforts on developing a comprehensive ambient surface water quality monitoring program known as the Surface Water Ambient Monitoring Program (SWAMP).

At the Central Valley Regional Board, SWAMP is attempting to answer the following overarching question and related sub-questions.

Short-term:

- --What is/are the status and trends of ambient water quality in streams and rivers in the Sacramento River, San Joaquin River, and Tulare Lake Basins?
- --Are there spatial and temporal trends in water quality?
- --What is the location and extent of various levels of water quality?
- --Is there evidence of beneficial use impairment?

Long-term:

- --Is water quality getting better or worse?
- --Are Board programs (regulatory/non-regulatory) and management actions effective?

From 2000-2005, the SWAMP for the San Joaquin River (SJR) Basin was built upon a monitoring framework developed as part of the agricultural subsurface drainage management program that focuses on selenium, salt and boron and has evolved since 1985 (Chilcott, 1998 and Steensen, 1998). This framework contained 3-tiers. The first tier was a selection of sites along the main stem of the river, downstream of major inflows. The second tier was a series of sites representing inflows from specific sub-watersheds into the main stem of the river (drainage basin inflows component). These first two tiers consisted of long term trend sites where monitoring was conducted weekly to monthly, depending on site and constituent.

The final tier, the Intensive Basin Monitoring Program (IBP), was a more detailed, yearlong survey of the water quality within each of six sub-basins once every 5-years, funding permitting. Each sub-basin consists of water bodies with similar hydrologies, geologies, management issues, land use and land cover. The sixth basin, the Sacramento – San Joaquin Delta, was not included as part of the rotation due to the extensive monitoring and modeling already conducted by other agencies.

During the rotation, sampling sites were selected based on flow pattern, land use in subareas, coordination with other monitoring efforts, and local stakeholder input, and then monitored twice a month for 1-year. Constituent selection was based on: historic information; data gathered as part of the Drainage Basin Inflows component; stakeholder response to a monitoring survey; and available funding. At a minimum, each site was analyzed for standard field measurements (specific conductivity, pH, temperature, turbidity, and dissolved oxygen) as well as total Coliform and E. coli. Monthly photo documentation was also conducted at each site.

This study focuses on data collected from the Eastside Basin between January 2003 and April 2004. The Eastside Basin consists of the Stanislaus, Tuolumne, and Merced River Watersheds and the Farmington and Valley Floor Drainage Areas. Prior to initial water quality sampling, over 200 state, federal, and local agencies, as well as known watershed groups were surveyed to identify current monitoring efforts and local concerns (Appendix E). Sampling sites were selected to complement monitoring already occurring in the watershed, such as flow and precipitation gauges maintained by the California Department of Water Resources and US Geological Survey, and targeted water quality monitoring conducted by USGS and Modesto Irrigation District (detailed in Appendix D). Local concerns were focused on watershed characterization, flood control, agricultural and rural/urban development impacts**.** The final sampling design incorporated the initial survey findings.

Initial funding supported monitoring twice a month for the constituents listed above, between January 2003 and April 2004. Additional funding allowed limited total organic carbon, total suspended solids, acute toxicity, partial minerals and trace element monitoring at selected sites during part of the study period. Data gathered over the 16-month period provides information on the spatial and seasonal trends in water quality and preliminary indications on potential beneficial use impairments. Key beneficial uses evaluated and the indicators utilized are listed below.

Drinking Water	(Salt/Specific Conductivity, Minerals, Total Organic Carbon, Trace Elements, ***E. coli***)
Aquatic Life	(pH, Temperature, Dissolved Oxygen, Turbidity, Toxicity, Trace Elements)
Irrigation Supply	(Salt/Specific Conductivity)
Recreation	(***E. coli)***

Details for overall SWAMP monitoring objectives and indicators, as well as data for expanded sub-basin monitoring and the selenium control program, can be found on the Central Valley Regional Water Quality Control Board SWAMP website at:
www.waterboards.ca.gov/centralvalley/programs/agunit/swamp/index.html

Since 2003, all data collected as part of the San Joaquin River SWAMP effort, which met quality assurance requirements, has been posted annually at the above website.

Final determination of beneficial use impairment is made during the Clean Water Act 303(d)/305(b) assessment and listing process[1] where data collected from this survey is combined with other available information to provide a more complete evaluation of beneficial use protection. The proposed 2008 303(d)/305(b) Integrated Report includes data collected from this study and can be viewed at
http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/index.shtml.

[1] Section 305(b) of the federal Clean Water Act requires states to submit a report on the State's water quality to the US Environmental Protection Agency every two years. The Report provides water quality information to the general public and serves as the basis for US EPA's National Water Quality Inventory Report to Congress.

3. 0 STUDY AREA

This report evaluates water quality in the Eastside Basin, one of six sub-basins draining into the San Joaquin River (SJR). More details on the overall hydrology of the SJR Basin and details of the Eastside Basin follow.

3.1 San Joaquin River Hydrology

The San Joaquin River (SJR) is the principal drainage artery of the San Joaquin Valley. The basin covers 17,720 square miles (Basin Plan, 2002) and yields an average annual surface runoff of about 1.6 million-acre feet. The SJR basin drains the portion of the Central Valley south of the Sacramento-San Joaquin Delta and north of the Tulare Lake Basin.

The river flows westward from the Sierra Nevada and turns sharply north at Mendota Pool near the town of Mendota. Most of the SJR flow is diverted into the Friant-Kern Canal and exported into the Tulare Lake Basin for irrigation, leaving the river channel upstream of the Mendota Pool dry except during periods of wet weather flow and major snow melt. The river continues past Mendota Pool to form a broad flood plain as it turns northward, for a distance of approximately 50-miles until the river is narrowed by the constrictions of the Merced River and Orestimba Creek alluvial fans.

Flows from the east side of the river basin to the San Joaquin River are dominated by discharges from the Merced, Tuolumne, and Stanislaus Rivers, which primarily carry snowmelt from the Sierra Nevada. Flows from the west side of the river basin are dominated by agricultural return flows since west side streams are ephemeral and their downstream channels are used to transport agricultural return flows to the main river channel. Poorer quality (higher salinity) water is imported from the Delta for irrigation along the west side of the river to replace water lost through diversion of the upper SJR flows.

The principal streams in the basin are the San Joaquin River and its larger tributaries: the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers which all drain the east side of the basin. Major land use along the San Joaquin Valley floor is agricultural, with over 2.1 million irrigated acres, representing 22% of the irrigated acreage in California. Urban growth is rapidly converting historical agricultural lands leading to an increased potential for storm water and urban impacts to local waterways. Timber activities, grazing, abandoned mines, rural communities, and recreation can impact upper watershed areas.

3.2 San Joaquin River Sub-basins

The SJR Basin can be broken into six sub-basins of similar hydrology, land use, and management (Figure 1).

1. The **Northeast Basin** consists of the Cosumnes, Mokelumne, and Calaveras River Watersheds, providing a combined drainage of 4,360 square miles.

2. The **Eastside Basin** contains the three largest SJR tributaries, in terms of flow: the Merced, Stanislaus, and Tuolumne Rivers, along with the Farmington Drainage basin and the lower Valley floor, both of which drain directly to the SJR. The Eastside Basin is approximately 6,091 square miles.

3. The **South East Basin** is approximately 4,338 square miles and reaches from the headwaters of the SJR north to the watershed divide between Bear Creek and the Merced River in Merced County.

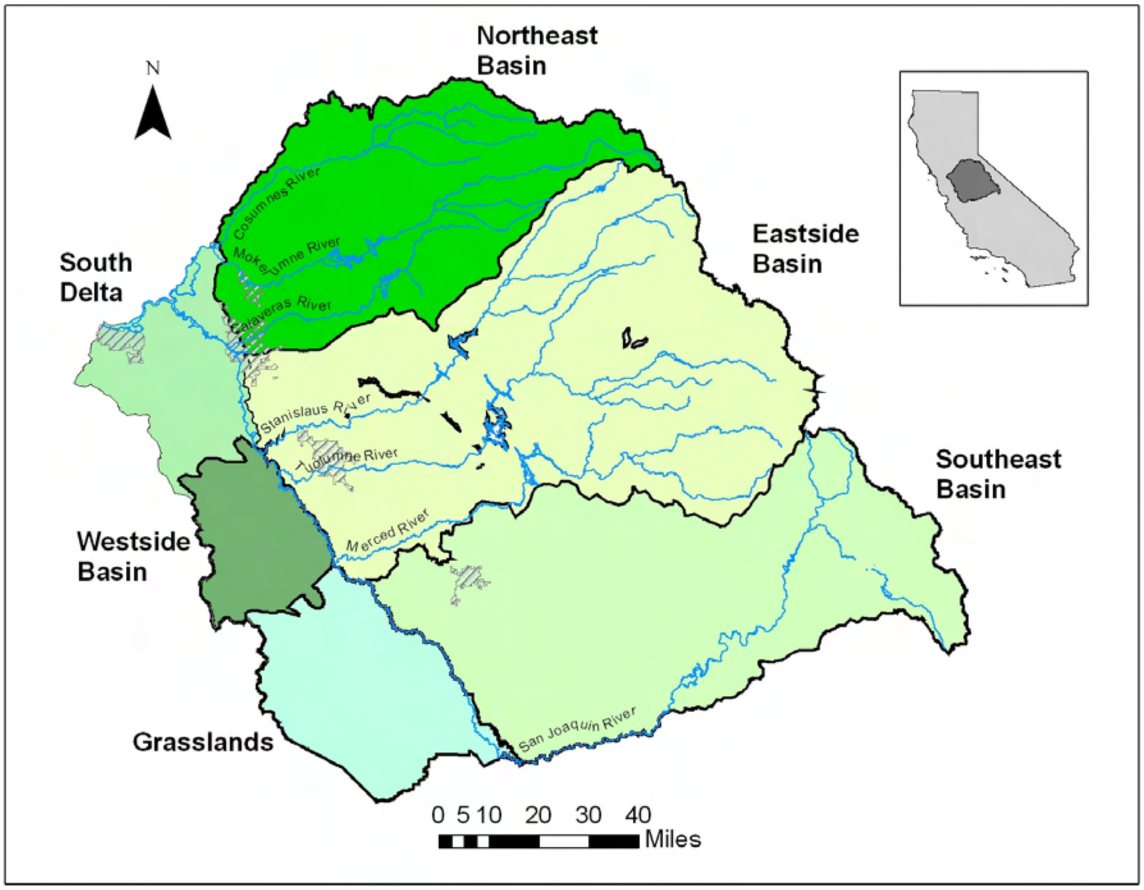
4. The **Westside Basin**, encompasses the watersheds of the creeks draining the eastern slope of the coast range from the Orestimba watershed in the south to the Lone Tree Creek in the north. The basin is approximately 670 square miles, contributing 6 percent of the total SJR flow.

5. The **Grasslands Basin** is a valley floor sub-basin of the San Joaquin River Basin, south of the Orestimba watershed, covering an area of approximately 1360 square miles. The basin lies on the west side of the SJR in portions of Merced County.

6. The **South Delta Basin** covers approximately 677 square miles and includes creeks on the northwest side of the SJR, as well as the southern portion of the Sacramento-San Joaquin Delta waterways down toward the confluence of the SJR and the Sacramento River. Waters inside the Delta boundaries are tidal influenced and typically higher in salinity than other surface water throughout the SJR Basin.

This report focuses on the Eastside basin. More detailed information on the other basins can be found at:
http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_studies/swamp/index.html
and in a companion report for the Northeast Basin, **San Joaquin River Basin Rotational Sub-basin Monitoring, Phase I: Northeast Basin** (Graham, 2009).

Figure 1 San Joaquin River Watershed Sub-basins



3.3 Eastside Basin

The **Eastside Basin** is made up of the Stanislaus, Tuolumne, and Merced River Watersheds and Farmington and Valley Floor Drainage Areas. The six areas are responsible for the drainage of 6,091 square miles.

Counties included in the Eastside Basin include Stanislaus, Tuolumne, San Joaquin, the northeast corner of Merced, and the northwest corner of Mariposa counties. This basin generally lies east of the SJR, west of the Crest of the Sierra Nevada, north of the Bear Creek Watershed, and south of the Calaveras River Watershed. Communities within the area include Hilmar, Delhi, Livingston, Oakdale, Turlock, and Modesto. Major reservoirs include New Melones Lake, Don Pedro Lake, Lake McClure, Woodward Reservoir, Modesto Reservoir, and Turlock Lake.

Figures 3 and 4 (in section 4.0 Sampling Program) provide close up maps of the Eastside Basin and sampling site locations.

The ***Stanislaus River*** originates within the Stanislaus National Forest within Tuolumne County (Tri-Dam Project, 1999) and eventually drains into the San Joaquin River. The Stanislaus River watershed drains an area of about 1,100 square miles. Snowmelt contributes the largest portion of the flows in the river. The average annual unimpaired basin runoff is about 1,200 thousand acre-feet. The highest monthly flows occur in May and June. The river provides habitat for

Chinook salmon and steelhead trout, threatened fish species protected under the Endangered Species Act of 1973 (Stanislaus River Restoration Plan). The main water diversion point on the river is Goodwin Dam. Along the lower Stanislaus River, there is mostly riparian forest and agricultural land as well as commercial gravel mining. Communities along the river include Sonora, Knight's Ferry, Oakdale, and Ripon, with populations in unincorporated areas ranging from less than 1000 people to an estimated 15,260 in Ripon by 2009 (DOF, 2009a).

The ***Tuolumne River*** originates from Mount Lyell within the easternmost region of Yosemite National Park (TRPT, 2002). In 1923, construction was completed on the O'Shaughnessy Dam in the Hetch Hetchy Valley, creating Hetch Hetchy Reservoir, which has a capacity of 360,000 acre feet. It is owned by the City and County of San Francisco, and has a primary purpose of supplying drinking water to the San Francisco Bay Area, where it provides 85 percent of San Francisco's total water needs. Water is transported from the reservoir by the Hetch Hetchy Aqueduct.

The remaining river flows downstream through the Stanislaus National Forest and into Don Pedro Reservoir. Below the reservoir, flows in the lower Tuolumne are controlled primarily by the operation of New Don Pedro Dam, constructed by the combined efforts of Modesto Irrigation District (MID), Turlock Irrigation District (TID), and the City and County of San Francisco, and La Grange Dam, constructed by MID and TID. The dams allow water to be diverted to the Modesto Main Canal to the north and the Turlock Main Canal to the south downstream of New Don Pedro Dam and La Grange Dam. The Tuolumne River drains about 1,540 square miles and has an average annual unimpaired runoff of about 1.8 million-acre feet. Many oak trees and riparian forests are found along the Tuolumne River. Communities along the River include Empire, La Grange, Waterford, and Modesto with populations in unincorporated areas ranging from less than 1000 people to an estimated 210,088 in Modesto by 2009 (DOF, 2009a). On September 28, 1984, the Tuolumne River, from the source to the Don Pedro Reservoir was granted Wild and Scenic designation, which placed limitations on uses for the 83 miles of river that was covered.

The ***Merced River***, originating in Mariposa County within eastern Yosemite National Park, drains about 1,273 square miles east of San Joaquin River producing an average unimpaired runoff of about 1 million acre-feet (EA Engineering, 1999). The river flows through the western slopes of the Sierra Nevada, which is characterized by forests, high relief terrain and steep granite slopes. Downstream of these designations, the river enters the Sierra Nevada Foothills, which are dominated by oak chaparral woodlands, unforested basins, alluvial fans and plateaus and then the river feeds into Lake McClure. The region is arid and dry and creeks and streams frequently dry up during summer and fall.

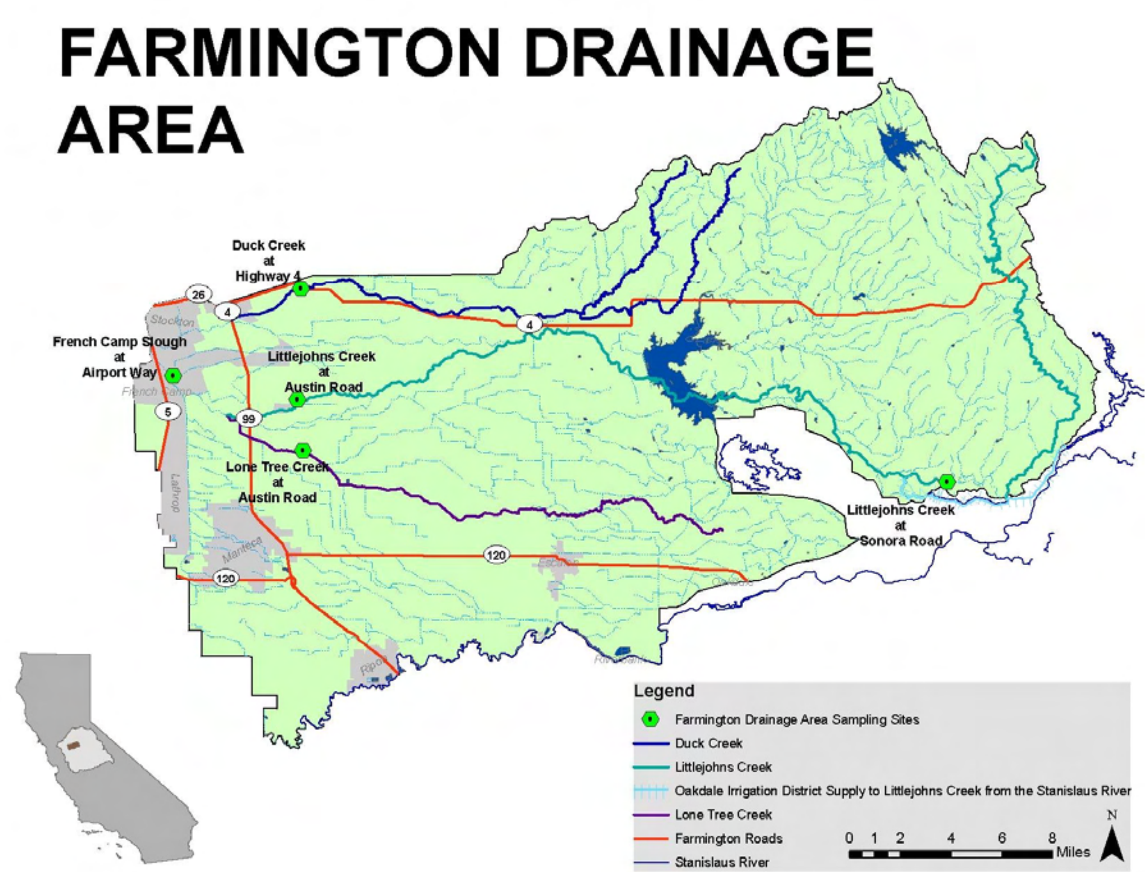
Starting at the bottom of Lake McClure, the Merced River is modified by dams, flow regulators, flow diversion, gravel mining, levee construction and land use conversion. The New Exchequer Dam, owned and operated by Merced Irrigation District (MeID), forms Lake McClure and regulates releases to the lower Merced River. Downstream of Merced Falls, the MeID diversion dam diverts flows from the Merced River into the MeID Main Canal to supply the city of Merced and surrounding areas. Most of the flow is then discharged to the Southeast Basin, eventually discharging directly to the San Joaquin River. Additionally, storm water runoff from the City of Atwater and towns of Livingston and Winton is discharged to the MeID's Livingston Canal and conveyed to the Merced River. As the river enters the central valley it flows for approximately 50 river miles, through agricultural and urban area until its confluence with the lower San Joaquin at the northern-most point of the San Luis National Wildlife Refuge.

Communities along the River include Merced Falls, Snelling, Coulterville, Cressey, and Livingston, with populations in unincorporated areas ranging from less than 1000 people to 13,940 in Livingston in 2009 (DOF, 2009a). On October 23, 1992, the Merced River, from the main stem's source in Yosemite National Park to a point 300 feet upstream of the confluence with

Bear Creek, and the south fork from its source to the confluence with the main stem, was granted Wild and Scenic designation.

The ***Farmington Drainage Area*** drains an area of 124 square miles between the Calaveras River and Stanislaus River Watersheds. The three main drainage arteries are Duck Creek, Littlejohns Creek, and Lone Tree Creek. Between these creeks, flows also travel through the supply and drainage systems of the South San Joaquin Irrigation District (SSJID) and Oakdale Irrigation District (OID). Figure 2 Farmington Drainage Area is provided to as visual representation of descriptions for the major arteries of this sub-basin.

Figure 2 Farmington Drainage Area



As a result of the Water Resources Development Act of 1996 (US Congress, 1996), the Farmington Groundwater Recharge Program (Farmington, 2009) was launched in 2003. This program includes the Mormon Slough Bypass and levees on Lone Tree Creek, Littlejohns Creek, Mormon Slough, the Calaveras River, and Bear Creek. The Duck Creek channel has been modified to increase its capacity (DWR, 2009). The recharge area boundaries are the Mokelumne River to the north, Highway 99 to the west, Lone Tree Road to the south, and Jack Tone Road to the east.

Duck Creek is the northern most creek, draining approximately 11,000 irrigated acres. The Creek originates near the San Joaquin – Stanislaus County Border, and flows through agriculturally dominated (predominantly field crops and irrigated pasture) areas until it joins French Camp

Slough, west of Highway 5, before draining into the San Joaquin River. Flow at this site was generally limited to May through September.

Littlejohns Creek is a natural ephemeral stream that originates in the Sierra Nevada Foothills, near Copperopolis, and flows in a westerly direction through the Farmington Drainage Basin. From March through November, irrigation supply flows from the Stanislaus River are diverted to the Littlejohns Creek channel at Goodwin Dam. These supply flows are carried 1.5 miles in the natural channel before the Creek is diverted into the OID North Main Canal for agricultural irrigation. Downstream of the OID North Main Canal, the channel receives a mixture of agricultural supply and drainage as it travels to the Farmington Flood Control Basin.

Since the 1930's, excess storm runoff from the upper reaches of Littlejohns Creek has been contained in the Farmington Flood Control Basin by the Farmington Dam. The earthen dam was built strictly for flood control by the U.S. Army Corps of Engineers (USACE). In 1994, Stockton East Water District (SEWD) constructed a diversion structure immediately downstream of the dam to divert water into the Lower Farmington Canal and Rock Creek, which can supply water to portions of the SEWD and Central San Joaquin Water Conservation District service areas.

Downstream of the Farmington Dam, runoff continues down the lower Littlejohns Creek channel for approximately four months of the year. Flows from Littlejohns Creek are partially diverted to Duck Creek just east of Escalon Bellota Road, and then to Lone Tree Creek just west of Escalon Bellota Road. The rest of the flow continues downstream, and eventually merges with Lone Tree Creek, just west of Highway 99, to form French Camp Slough.

Crops grown in this watershed include field crops, orchards, grains, and vineyards as well as irrigated pasture. (Johnson, 2008) Year-round stock watering rights exist along the lower reach of the Littlejohns Creek channel.

Lone Tree Creek is a 20-mile ephemeral channel originating south of Woodward Reservoir. Portions of the channel have been reconstructed to facilitate water supply and drainage. This stream carries natural runoff for four months of the year in a westerly direction until its confluence with French Camp Slough, which ultimately discharges into the San Joaquin River. Between March and November, flows in the creek are dominated by agricultural return flow beginning south of Woodward and continuing to French Camp Slough. Water is recaptured for irrigation as it moves downstream. The main agricultural land uses consist of deciduous nuts, field crops, irrigated pastures, and dairies. (Johnson, 2008)

The ***Valley Floor Drainage Area*** is the drainage area primarily located between each of the major river drainages (Stanislaus, Tuolumne, and Merced Rivers) and primarily drains to the SJR through multiple channels, with two channels draining to the Stanislaus River. The drainage area actually consists of three inter-basin areas. The northern most of the three areas is the area between the Stanislaus and Tuolumne River drainages, the middle area is between the Tuolumne and Merced River drainages, and the southern most area is between the Merced River and Bear Creek drainage basins. These areas are made up of all land east of the San Joaquin River that is not included in the Stanislaus, Tuolumne, or Merced watersheds; south of the Stanislaus River, west of Tuolumne and Mariposa counties, and north of the Bear Creek drainage area.

In large part, area flows are dominated by the supply and drainage systems of the local irrigation districts:

- The Modesto Irrigation District (MID) covers the area between the Stanislaus and Tuolumne rivers;
- The Turlock Irrigation District (TID) covers the area between the Tuolumne and Merced rivers;
- The Merced Irrigation District (MeID) covers the area south of the Merced River

The Oakdale Irrigation District (OID) covers the area east of MID, between the Stanislaus River and Dry Creek.

For this study, sites were generally chosen that drained directly to the San Joaquin River. Supply water for the districts primarily comes from the Tuolumne River with groundwater providing a secondary source. The laterals provide supply water to the district and may receive some recycled drainage. Discharge from the laterals is dominated by operational spill. Drainage from the area can include irrigated agriculture surface and subsurface drainage, urban, storm runoff, and runoff from land used for grazing and confined animal facilities.

The MID drainage system lies between the lower reaches of the Stanislaus and Tuolumne Rivers and contains 211 miles of canals and laterals and serves/drains 59,000 acres of irrigated farmland. The MID main canal originates at La Grange Dam and travels through Waterford with a branch to the Modesto Reservoir. The canal then enters the Modesto area and branches into a system of laterals that flow westerly through Modesto, and then out through the agriculturally dominated western outskirts of Modesto. The laterals and canals eventually empty into the Stanislaus, Tuolumne, and San Joaquin Rivers.

With very few exceptions, the Modesto Irrigation District does not permit on-farm irrigation return flows to be discharged into its canals. However, the district has entered into a number of agreements with local public agencies to accept storm water runoff and irrigation water for transport through the canals to adjacent rivers and streams. The majority of the urban drains that discharge into MID canals are located along Lateral 3, Lateral 6, and Lateral 7. Lateral 6 drains to the Stanislaus River near the western end of Kiernan Avenue or is diverted into Lateral 7. Both Lateral 3 and Lateral 7 enter the Main Drain at the western end of Gates Road and flow into the Stanislaus River. In MID's Water Management Plan (1999), MID reported that there were no on-farm subsurface drainage tiles in the district area and that farm tailwater is generally contained on the farm. The preferred method of watering crops is through either a drip or sprinkler system. During dry years, irrigation wells are used to supplement river water diversions.

The TID drainage system, which primarily delivers irrigation supply and may carry some agricultural drainage, lies between the lower reaches of the Tuolumne and Merced River watersheds. The TID contains 250 miles of canals and laterals (of which 80% are concrete lined) as well as 1800 miles of improvement district ditches and pipelines. TID serves/drains 149,500 acres of irrigated acreage. The TID's Main Canal, originates at La Grange Dam and carries municipal supply for 1.6 miles to the community of La Grange. Flows in this stretch of the Upper Main Canal consist entirely of high quality Tuolumne River water. The canal continues past La Grange to the Turlock Lake reservoir. From there, the Main Canal continues its westerly course towards Hickman. The Highline Canal branches off the Main Canal approximately 3 miles east of Hickman and serves the far eastern and southern portions of the District. At Hickman, the Main Canal is divided into the Ceres Main Canal and the Turlock Main Canal. From these two main canals stems a system of laterals, which flow in a westerly direction. These laterals drain into spills on the western edge of the TID.

Prior to 1982, there was no organized on-farm tile drain activity. In 1983, the groundwater in the TID was at its highest level in many years and many high-groundwater problem areas surfaced. Therefore, the TID began the formation of subsurface (tile) drainage improvement districts to resolve high groundwater problems in specific areas. Drainage and rented wells are used to lower ground water levels and supplement the surface water supply. Water pumped from drainage and rented wells either discharges directly into the canal, into a pipeline that flows back to the canal, or into a pipeline for irrigation use. The canals and drains are open waterways that receive water from a variety of sources. In addition to irrigation flows, the canal system downstream of Turlock Lake is used to transport municipal and agricultural storm water, agricultural drainage water, municipal dry weather flows, releases from irrigation pipelines, flush water from potable water systems and drip/micro irrigation systems, and some irrigation field runoff. Water in the drains consists of outflows from the canal system, direct discharges from roadway runoff, irrigation field runoff, groundwater seepage, tile drainage, and other flows. The Harding Drain, one of the main collector drains within the TID, is also used to transport tertiary treated wastewater from the City of Turlock's wastewater treatment plant to the SJR.

During the District's irrigation season, mid-March through October, storm water and drainage water flows are blended with irrigation water and used as much as possible for irrigation, with the remainder flowing to the river system. During the non-irrigation season, all of the flows that find their way to the canal/drain system flow to the river. However, for brief periods during the non-irrigation season, at the request of local growers, the canal can be reconfigured to collect these flows where it can be used for irrigation. These types of uses are on an as-needed basis and are subject to a variety to constraints including storm water operational requirements and canal maintenance needs. (URS, 2005)

4.0 SAMPLING PROGRAM

4.1 Program Objectives

In keeping with the overall Central Valley Regional Board SWAMP goals of being able to answer water quality questions related to spatial and temporal trends as well as whether or not there is evidence of beneficial use impairment, the following objectives were adopted for this effort.

1. Determine Spatial and Temporal Trends
    a. Spatial includes the evaluation of the major rivers moving progressively downstream of major inflows as well as comparisons between sub-watersheds
    b. Temporal includes seasonal variations
2. Evaluation of Beneficial Use Protection
    a. Using selected indicators to determine whether there is evidence of impairment

In addition, the rotational component of this effort allows the data collected during this round of sampling to serve as a baseline to evaluate changes in water quality during future rotations.

4.2 Program Design

In order to provide information on spatial variations, sampling locations were chosen in an effort to provide integrator sites at the lower end of sub watersheds as well as some targeted sites to represent specific land use and expressed stakeholder concerns (e.g. development in foothill small rural communities). Temporal trends were evaluated by sampling twice a month for a full year in an attempt to better evaluate differences between storm runoff, snowmelt, irrigation, and dry seasons.

Potential impacts to beneficial uses were evaluated by first identifying for each site the applicable Basin Plan (CVRWQCB, 2006) potential and existing beneficial uses, and whether the uses are based on the reach being specifically designated in the Basin Plan or if the reach is tributary to a designated reach (Appendix C). Indicators were chosen for four broad beneficial uses: drinking water; aquatic life; recreation (swimming); and irrigation. The choice of indicators (listed below) came from an evaluation of USEPA EPIC indicators (USEPA, 2003), water quality objectives and goals, and the fact that many of the indicators monitored as part of the SJR SWAMP efforts support high priority region-wide program assessments as listed in the 2005 Triennial Review of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins.

Drinking Water	(Salt/Specific Conductivity, Total Organic Carbon, Trace Elements, ***E. coli***)
Aquatic Life	(Toxicity, Temperature, Dissolved Oxygen, Trace Elements, pH)
Recreation	(***E. coli***)
Irrigation Supply	(Salt/Specific Conductivity)

Regional and statewide programs utilizing SJR SWAMP monitoring data include: Total Maximum Daily Load (TMDL) Program; Drinking Water Policy; Development of Water Quality Objectives for Bacteria Indicators; Salinity and Boron TMDL; Central Valley Salinity Policy Development; Erosion/Sediment guidelines; and SJR Dissolved Oxygen TMDL.

In order to maximize limited resources and facilitate information exchange, local stakeholders involved in monitoring in this area were contacted. These entities included University of California, Davis (UC Davis), United States Geological Survey (USGS), and various municipalities and utility companies. These and other agencies, as well as known stakeholder groups, such as the Tuolumne River Preservation Trust and Merced River Stakeholder Group, were contacted during the developmental stage of the program to determine existing and historic sampling locations, available information, and local community concern. Information gathered was combined with land use data, hydrologic characteristics and available resources to determine final site locations, constituents of concern, and sampling frequency. Mailings and contact lists can be found in Appendix E.

During this study, grab samples were collected twice a month between January 2003 and April 2004. Field measurements included dissolved oxygen (DO), specific conductivity (SC), pH, temperature, and turbidity. In addition, samples were collected twice a month for in-house total coliform and E. coli analyses. Photo documentation was conducted monthly. Other analyses conducted and frequencies were dependent on land use, other monitoring efforts and availability of funding. These additional analyses included total suspended solids (TSS); total organic carbon (TOC); partial minerals, including chloride, sulfate, hardness, calcium, and magnesium; water column toxicity; and total trace elements (TE), including arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, and zinc.

Dependent on the site and constituent of interest, monitoring was conducted twice per month (biweekly), quarterly, or on an annual basis for a 12-month period. However, some sites were replaced with others during the course of the rotation due to access constraints. In order to obtain a full 12 months of data for each site, monitoring in this basin was extended three months from December 2003 to March 2004. Table 1 lists the monitoring sites and sampling frequencies associated with the constituents monitored for each site, as well as the reasons for any needed changes in location.

4.3 Sampling Sites

Each site was assigned a site code and a site name. The site code begins with either the first three letters of the county in which the site is located (e.g., CAL represents Calaveras County), or the first letters of each word in the county name, plus ‘C’ for county (e.g., SJC represents San Joaquin County). The three numbers in the site code are arbitrarily chosen, but unique to each site in that county.

Site locations are depicted in Figures 2 and 3, with site codes matching those listed in Table 1. Figure 3 shows location of all monitoring sites included in this study. Sites that were discontinued are displayed with hollowed circles, while sites that were kept until the end of the study are shown with red filled circles. Three areas (northern Valley Floor, Dry Creek confluence with the Tuolumne River and Woods Creek) had several sites that were within a three-mile radius and details were difficult to identify in Figure 3. Figure 4 contains close ups of these three areas.

Six sites included in this sampling effort are also long-term SWAMP sites (French Camp Slough at Airport, Lone Tree Creek at Austin Road, Harding Drain, Stanislaus River at Caswell State Park, Tuolumne River at Shiloh, and Merced River at Hatfield Park), and represent discharge from the Eastside Basin just upstream of the main stem of the SJR. Long-term monitoring sites provide information for comparison of water quality data during the different water year types and help determine appropriate upstream constituents to monitor during the rotations into the different drainage basins.

The sites monitored within the East Side Basin are described in Appendix A, and arranged by watershed. Appendix A includes specific sampling location, summary of land-use, available water quality information, and monthly photograph documentation over the course of the study for each site. Details for the water body represented by each site has primarily been obtained from the Inland Surface Waters Agenda Item Report to the CVRWQCB (1993), followed by reconnaissance and ground truthing.

Table 1 Location and Duration of Eastside Basin Study Sites, January 2003 - April 2004

SITE CODE	SITE LOCATION	DATES MONITORED	APPROX ELEVATION (feet)	RIVER MILE FROM CONFLUENCE WITH SJR	COMMENTS	WATER COLUMN ANALYSES											
						SC	pH	Temp	DO	Turb	Bacti	*Partial Minerals*	*Trace Elements*	*TSS*	*TOC*	*Acute Toxicity*	*Sediment Analyses: TOX/Size*
Farmington Drainage Area																	
STC212	Littlejohns Creek @ Sonora Rd.	2/18/03 - 3/17/04	239	45.3	Background site for Basin	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
SJC201	Duck Creek @ Hwy 4	1/21/03 - 1/7/04	47	9.2	~6.8 RM Upstream from confluence with French Camp Slough Dry: 1 Apr - 6 May/7 Oct - 17 Nov	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
SJC213	Littlejohns Creek @ Austin Road	3/5/03 - 3/17/04	35	9.6	~5.6 RM upstream from SJC504	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
SJC503	Lone Tree Creek @ Austin Rd.	1/21/03 - 4/28/04	40	10	~6.58 RM Upstream from SJC504	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		A
SJC504	French Camp Slough @ Airport	1/21/03 - 4/28/04	22	3.2	Upstream of confluence with SJR	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		A
Valley Floor Drainage Area																	
STC203	MID Lateral 6/8 @ Dunn Rd.	1/23/03 - 1/6/04	50	1.5	~1.7 RM upstream from confluence with Stanislaus River	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC202	Main Drain Inlet to Miller Lake	1/23/03 - 2/4/04	30	2.2	<1 RM upstream of inflow to Miller Lake Replaced by STC211 due to flow pattern	BM	BM	BM	BM	BM	BM						
STC211	MID Main Drain @ Shoemake Road	2/19/03 - 3/17/04	30	4.2	~3 RM Upstream from Miller Lake	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC204	MID Lateral 3/4 @ Paradise Rd.	1/23/03 - 1/6/04	45	1.7	Mixed supply/drain water which discharges to SJR	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC208	TID Lower Lateral 2 @ Grayson	1/22/003 - 1/6/04	47	0.6	Mixed supply/drain water which discharges to SJR	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC501	TID Harding Drain	1/14/03 - 1/8/04	50	2.4	Drainage just upstream of discharge to SJR	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP	B	
MER201	TID Lat 6&7 Drain @ Central Ave.	1/22/03 - 4/17/03	67	4.8	Replaced by TID Lat 7 due to site access	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
MER203	TID Lateral 7 @ Central Ave.	5/22/03 - 1/20/04	67	5.2	Mixed supply/drain water upstream discharge to SJR	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
Stanislaus River Watershed																	
CAL201	Stanislaus River @ Camp Nine Road	2/18/03 - 2/18/03	1300	90	~9.3 RM upstream from TUO201 Site was removed due to safety concerns	BM	BM	BM	BM	BM	BM						
TUO201	Stanislaus River @ Parrot's Ferry	1/21/03 - 2/4/03	1250	81	<1 RM upstream of New Melones Reservoir Site was removed due to representativeness	BM	BM	BM	BM	BM	BM						
STC201	Stanislaus River @ Knight's Ferry	1/21/03 - 1/7/04	200	54.1	~45.4 RM upstream from STC514 ~3.7 RM downstream from Goodwin Dam	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC514	Stanislaus River @Caswell	1/23/03 - 4/28/04	45	9.1	Upstream of confluence with SJR	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP	B	
Tuolumne River Watershed																	
TUO208	Woods Creek @ Mother Lode Fairgrounds	3/19/03 - 3/17/04	1750	84.5	~1.42 RM upstream from TUO202 Upstream of residential construction	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
TUO205	Woods Creek @ Hwy 108	2/18/03 - 3/6/03	1600	83.2	<1 RM upstream from TUO202 Replaced by TUO208 to coincide with Tuolumne County water quality sampling	BM	BM	BM	BM	BM	BM						
TUO202	Woods Creek @ Mill Villa Dr	1/21/03 –	1530	82.9	Just downstream of residential construction	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		

Table 1 continued:

SITE CODE	SITE LOCATION	DATES MONITORED	APPROX ELEVATION (feet)	RIVER MILE FROM CONFLUENCE WITH SJR	COMMENTS		WATER COLUMN ANALYSES: SC	pH	Temp	DO	Turb	Bacti	*Partial Minerals*	*Trace Elements*	*TSS*	*TOC*	*Acute Toxicity*	***Sediment Analyses: TOX/Size***
		3/17/04			(stakeholder concern)													
TUO207	Sullivan Creek @ Algerine Road	2/18/03 - 3/17/04	1300	79.0	Tributary to Don Pedro Reservoir		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
TUO209	Curtis Creek @ Algerine Road	5/20/03 - 3/17/04	1325	79.0	Tributary to Don Pedro Reservoir		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
TUO203	Tuolumne River @ Wards Ferry	1/21/03 - 1/21/03	816	77.9	Tributary to Don Pedro Reservoir		BM	BM	BM	BM	BM	BM						
TUO204	Tuolumne River @ Jacksonville/River Rd.	1/21/03 - 2/4/03	800	72.9	Within Don Pedro Reservoir Site was removed due to representativeness		BM	BM	BM	BM	BM	BM						
STC210	Tuolumne River @ Old LaGrange Bridge	1/21/03 - 1/7/04	258	51.4	~1.9 RM downstream from La Grange Dam		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC205	Tuolumne River @ Mancini Park	1/23/03 - 5/6/03	90	17.6	Upstream site for Dry Creek inflow Special Study	Replaced STC216 due to site access	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC216	Tuolumne River @ Legion Park	5/21/03 - 3/17/04	90	17.6			BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC206	Dry Creek @ La Loma Road	1/23/03 - 3/17/04	85	18.7	~1.5 RM upstream of confluence with Tuolumne River		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC207	Tuolumne River @ 9th Street Modesto	1/23/03 - 4/16/03	80	16.5	Downstream site for Dry Creek inflow Special Study (stakeholder concern)	Replaced by STC215 due to safety concerns	BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC214	Tuolumne River @ 7th Street Modesto	3/5/03 - 4/2/03	80	16.3			BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC215	Tuolumne River @ Audie Peeples	5/6/03 - 3/17/04	55	12.9			BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
STC513	Tuolumne River @ Shiloh	1/22/03 - 4/29/04	37	3.7	Upstream of confluence with SJR		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP	B	
Merced River Watershed																		
MAR202	Merced River @ Briceburg	2/18/03 - 4/1/03	800	93.2	Replaced by MAR203 due to representativeness		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
MAR203	Merced River @ Bagby Recreation Area	4/15/03 - 1/7/04	816	81.4	Inflow to McClure Reservoir		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
MAR201	Merced River @ Hwy 49	1/21/03 - 2/5/03	816	79.4	Replaced by MAR202 due to site access		BM	BM	BM	BM	BM	BM						
MER209	Merced River @ Merced Falls	1/21/03 - 1/7/04	300	51.8	~3.3 RM downstream from McSwain Reservoir		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
MER202	Merced R. @ Hwy 99	1/22/03 - 1/6/04	100	20.8	Midpoint lower Merced River		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP		
MER546	Merced River Hatfield Park (River Road)	1/22/03 - 4/29/04	65	1.2	Upstream of confluence with SJR		BM	BM	BM	BM	BM	BM	MP	MP	BMP	BMP	B	

MP = Monthly part of the study (specific dates can be found in Appendix Section II, D)
BMP = 2x/Month part of the study (specific dates can be found in Appendix Section II,D)
M = Monthly
Partial Minerals = boron, calcium, magnesium, chloride, sulfate, hardness
Acute Toxicity = 48 hour % survival, ***Ceriodaphnia***; 96 hour % survival, ***Pimephales***

A = Annual
B = 2x/Year
BM = 2x/Month
RM = River Mile
Trace Elements = copper, cadmium, zinc, mercury, arsenic, chromium, lead, nickel

Twining Laboratories
Sierra Foothill Laboratories
Dept. of Fish and Game Laboratories

Figure 3 Intensive Basin Monitoring Program - Phase II: Eastside Basin, January 2003 - April 2004

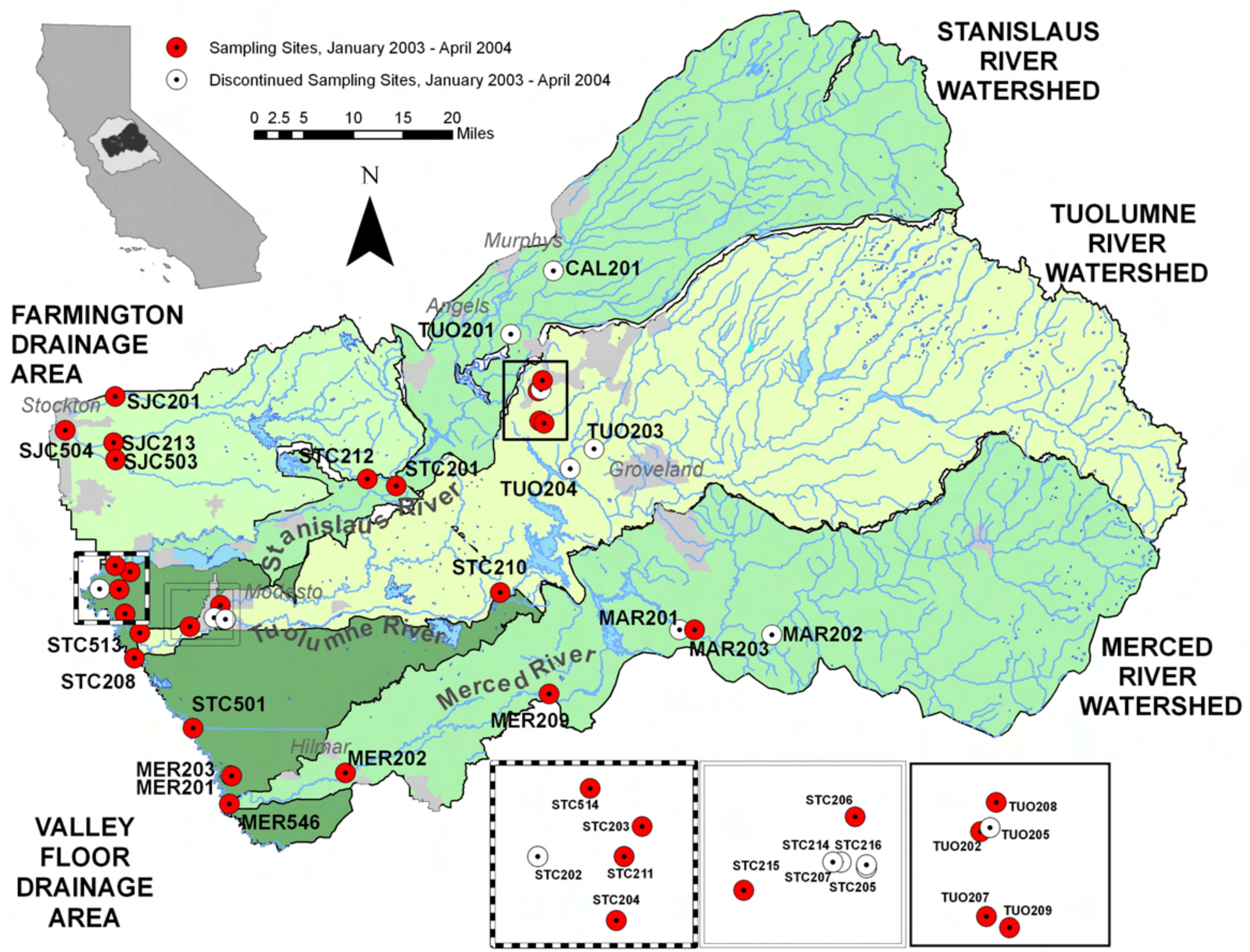
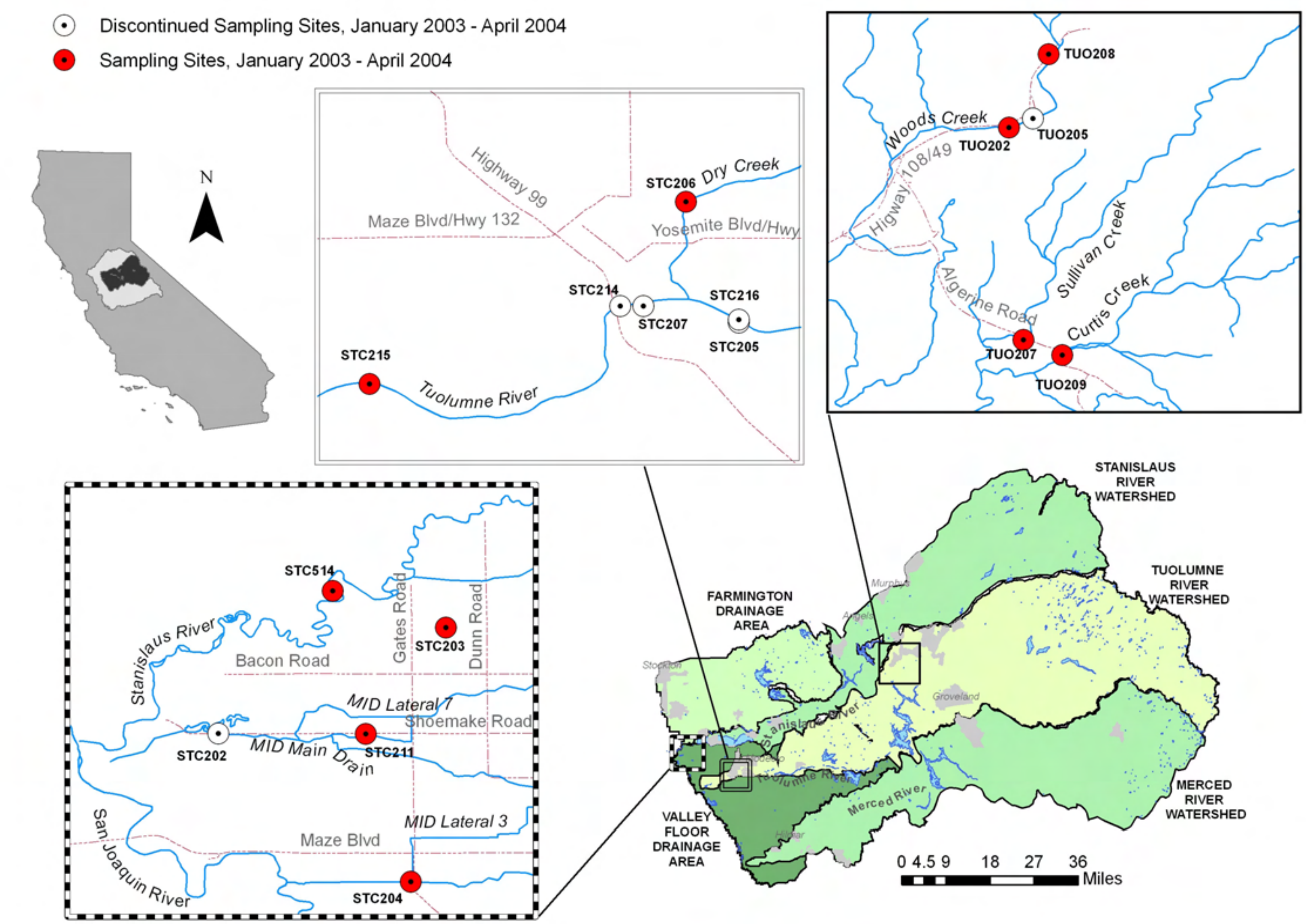


Figure 4 Intensive Basin Monitoring Program - Phase II: Sampling Site Close-ups, Valley Floor, Dry Creek, and Upper Tuolumne Watershed



4.4 Sampling Procedures

Collection and analysis of all water samples occurred in compliance with the related Quality Assurance Project Plan (Graham 2001), which was based on the Agricultural Subsurface Drainage Program Procedures Manual (CVRWQCB 1996). The SWAMP QA team reviewed the procedures manual after the monitoring in this study was conducted, and found it to meet SWAMP data quality objectives. All samples were collected as grab samples within 6 feet of the bank. In general, sample bottles were triple rinsed with sample water before the actual sample was collected. The exception was TOC, which was collected in a triple rinsed stainless steel cup, and then poured into an amber glass container that was pre-acidified with sulfuric acid (H_2SO_4). All samples were kept at 4°C during transport.

Analytical laboratories included Twining Laboratories in Fresno (partial minerals, trace elements, and total suspended solids in March), Sierra Foothill Laboratories in Jackson (total suspended solids, total organic carbon, and 3 species acute toxicity).

Field measurements included temperature, pH, turbidity, dissolved oxygen (DO), and specific conductivity (SC), and were collected using Yellow Springs Instruments (YSI) Sonde Model 6920 and Logger Model 650 MDS. Methods identified in Table 2 are consistent with the SJR Procedures Manual, 2007.

Samples collected for total coliform and ***E. coli*** were analyzed using the IDEXX® Colilert-18 method (Analytical methods 9223B in STANDARD METHODS, EDITION 20). Results using the Colilert method are reported in terms of Most Probably Number (MPN). Analysis for total coliform and ***E. coli*** were conducted in the Central Valley Regional Water Quality Control Board laboratory.

Partial mineral analysis included boron, calcium, magnesium, chloride, sulfate and hardness.

The following constituents were included in the trace element series analysis: total chromium, copper, nickel, lead, zinc, mercury, cadmium, and arsenic.

4.5 Quality Assurance and Quality Control

The Contract Manager maintained Quality Assurance (QA) and Quality Control (QC) logs for constituents analyzed by outside labs. The QA/QC logs for bacteria analysis are found in the CVRWQCB laboratory where samples are analyzed.

Transport contamination was evaluated by submitting a travel blank on a monthly basis for most constituents, and on each run for bacteria monitoring. For most constituents, the travel blank consisted of a sample of deionized water that was collected at the CVRWQCB laboratory. For bacteria monitoring, the travel blanks consisted of Type II water and were prepared by the Department of Plant Sciences, University of California Davis. Type II water is autoclaved, double deionized water.

The contracted laboratory provided travel blanks for toxicity analysis.

Consistency in sample collection and analysis was maintained by utilizing the project QAPP (Graham, 2001). Analytical methods used in this program are identified in Table 2.

Analytical precision and accuracy were evaluated using blind split and duplicate samples. Blind split or duplicate samples were collected at a 10% frequency for each sampling event. Duplicate samples were collected in two separate containers. Split samples were collected in a container double the normal sample volume and then homogenized and split into two equal amounts for submittal to the analyzing laboratory. Toxicity samples were collected as duplicates, but then composited and split at the contracting laboratory.

Potential contamination from the reagent grade nitric acid used to control pH was evaluated by submitting a deionized water matrix preserved with 1 ml of acid per 500 ml of sample, to the contract laboratories at monthly intervals to be analyzed for the trace elements of concern. All reported recoveries for these acid check samples were below the analytical reporting limit.

Only data from sample sets whose blind QA/QC met specifications outlined in Table 2 have been included in this report. All results for toxicity to algae (***S. capricornutum***) were significantly different from the laboratory control, and therefore were not used.These specifications are consistent with the QAPP for this program. (Graham, 2001).

Field Equipment and Analytical Methods

The CVRWQCB San Joaquin River Watershed Unit practices a standard quality assurance procedure with all its sampling programs that includes calibration of sampling equipment prior, during, and after each sampling run. Calibration procedures can be found in the Ag Procedures Manual (CVRWQCB 1996). Analytical methods utilized are listed in Table 2.

Bacteria Analysis

Results for total coliforms and E. coli were recorded as Most Probable Number (MPN) per 100 ml of sample water and were detectable between 1 to 2420 MPN. Results above and below the method detection limit (MDL) were recorded as >2420 and <1, respectively.

Replicate bacteria samples were initially collected and analyzed at a 10 percent frequency (1-replicate per 10-samples) in an effort to evaluate analytical precision. However, a review of sampling methodologies indicated that replicate bacteria samples provided information on inherent stream variability rather than analytical precision. The IDEXX methodology does not require duplicates or replicates and reports a 95% Confidence Interval for precision. Therefore, all data collected during this study has been reported, and variability in replicate samples noted.

Table 2 Parameters, Detection Levels, Holding Times, and Acceptable Analytical Recoveries

Constituent	Laboratory	Units	Method	MDL	Recovery	Holding Time	Container	Complete-ness	Dup	Split
Minerals										
Boron	Twining	mg/L	SM 200.7	0	85-115%	6 mos[A]	500 mL/1L P	95%		X
Calcium	Twining	mg/L	SM 200.7	0	85-115%	6 mos[A]	500 mL/1L P	95%		X
Magnesium	Twining	mg/L	SM 200.7	0	85-115%	6 mos[A]	500 mL/1L P	95%		X
Chloride	Twining	mg/L	SM 300.0	2	85-115%	28 Days	500 mL/1L P	95%		X
Sulfate	Twining	mg/L	SM 300.0	2	85-115%	28 Days	500 mL/1L P	95%		X
Hardness	Twining	mg/L	SM 200.1	1.0	80 - 120%	7 days	500 mL/1L P	95%		X
Trace Elements										
Copper	Twining	ug/L	SM 200.7	1.0	80-120%	6 mos[A]	500 mL/1L P	95%		X
Chromium	Twining	ug/L	SM 200.7	1.0	80-120%	6 mos[A]	500 mL/1L P	95%		X
Lead	Twining	ug/L	SM 200.7	5.0	70-130%	6 mos[A]	500 mL/1L P	95%		X
Nickel	Twining	ug/L	SM 200.7	5.0	70-130%	6 mos[A]	500 mL/1L P	95%		X
Zinc	Twining	ug/L	SM 200.7	2.0	60-140%	6 mos[A]	500 mL/1L P	95%		X
Arsenic	Twining	ug/L	SM 200.9	4.0	65-135%	6 mos[A]	500 mL/1L P	95%		X
Cadmium	Twining	ug/L	SM 200.9	0.1	70-130%	6 mos[A]	500 mL/1L P	95%		X
Mercury	Twining	ug/L	SM 245.1	0.2	70-130%	6 mos[A]	500 mL/1L P	95%		X
Total Suspended Solids (TSS)	Twining	mg/L	SM 209C	10.0	80-120%	7 days	500 ml P	95%		X
	Sierra Foothill	mg/L	SM2540D	1	80 - 120%	7 days	1 L P	95%		X
Total Organic Carbon (TOC)	Twining	mg/L	EPA 415.1	1.0	80- 120%	28 days	40 mL amber glass	95%		X
Freshwater Toxicity										
48h % Survival, ***Ceriodaphnia***	Sierra Foothill	% Survival	EPA 600/4-90/027F		Sig. Diff., or 20%	36 Hr	1L amber glass	95%	X	
96h % Survival, ***Pimephales***, non-renewal	Sierra Foothill	% Survival	EPA 600/4-90/027F		Sig. Diff., or 20%	36 Hr	1L amber glass	95%	X	
96h % Growth, ***S. capricornutum***	Sierra Foothill	Cell Count (million/ml)	EPA 600/4-91/002		Sig. Diff., or 20%	36 Hr	1L amber glass	95%	X	
YSI - Field Measurements[B]										
pH	CVRWQCB	pH	150.1	0.01	+/- 0.2	on site	in situ	95%		
Specific Conductance	CVRWQCB	uS/cm	120.1	0.001 to 0.1 mS/cm (range dependent)	+/- 0.5% of reading + 0.001 mS/cm	on site	in situ	95%		
Temperature	CVRWQCB	-C	temp	0.01	+/-0.15	on site	in situ	95%		
Dissolved Oxygen	CVRWQCB	mg/L	360.1	0.01	+/-0.5	on site	in situ	95%		
Turbidity	CVRWQCB	NTU	Comparable to EPA180.1	0.1	+/-2% of reading or 0.3 NTU, whichever is greater	on site	in situ	95%		
Colilert 18										
Total coliform	CVRWQCB	MPN	SM9223B	1/100 ml	95% CI	24 Hr	100 ml I	95%	X	
E. Coli	CVRWQCB	MPN	SM9223B	1/100 ml	95% CI	24 Hr	100 ml I	95%	X	

A = When preserved to a pH <2 using nitric acid within 24 hours of sample collection
B = A YSI 6600 and a 600XLM Instrument is used to determine field SC, pH, Temp, DO, Turb; the instrument was calibrated at the beginning and end of each sampling run against standard solutions. Instrument makes readings at 4 second intervals. Data was recorded after readings stabilized

CI=Confidence Interval
P=Polyethylene
I = Idexx Factory sterilized, nonfluorescent Polystyrene

5.0 PRECIPITATION AND FLOW: JANUARY 2003 – APRIL 2004

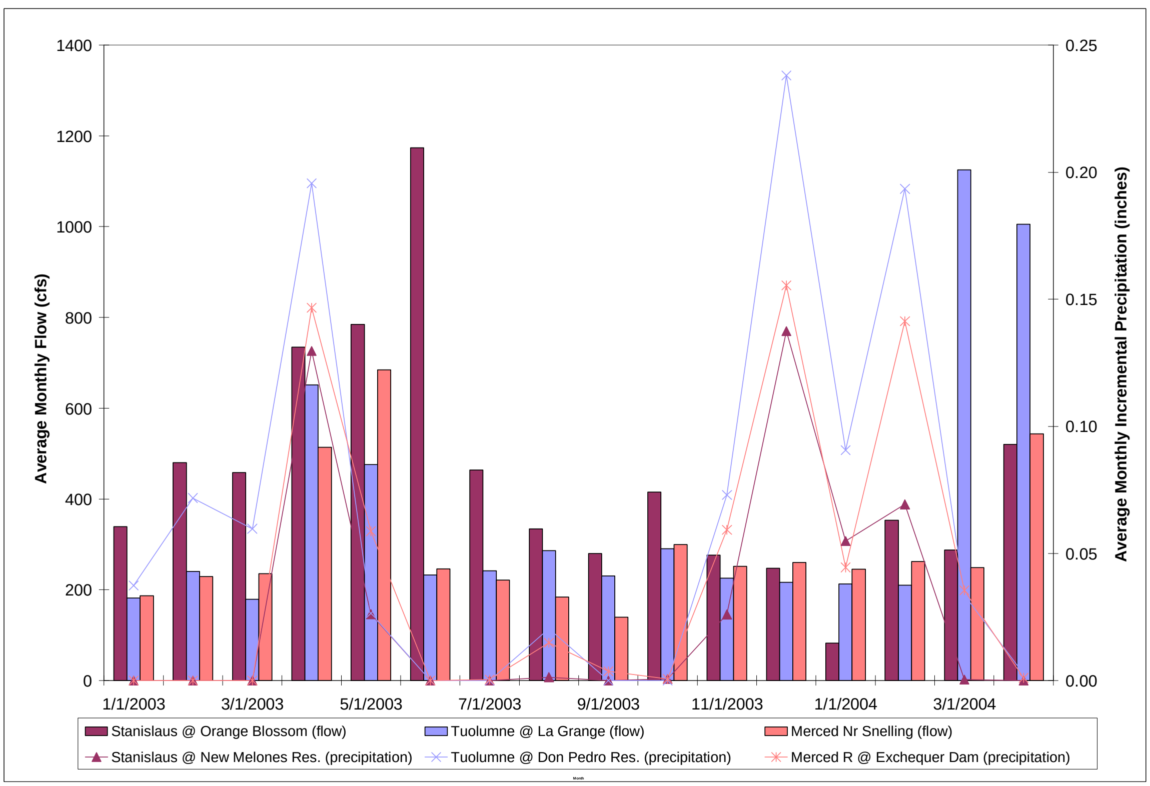
The San Joaquin River Index, as described in the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB, 1995) is used to classify the water year type in the river basin based on runoff. The 60-20-20 Index includes five classifications: wet, above normal, below normal, dry and critical, based on millions of acre-feet of unimpaired annual flow.

A Water Year (WY) begins 1 October and ends 31 September of the following year. Because of the timing of this study, January 2003 – April 2004, portions of both WYs 2003 and 2004 are represented. The classification determination for January – September 2003 was below normal and the classification for October 2003 – March 2004 was dry.

Data from the California Data Exchange Center was used to create Figures 5 through 8. Flow data was recorded at Stanislaus River @ Orange Blossom, Tuolumne River @ La Grange, and Merced River near Snelling. Incremental precipitation data came from stations at Stanislaus River @ Don Pedro Reservoir, Tuolumne River @ New Melones Dam, and Merced River @ Exchequer Dam.

Figure 5 shows average monthly measured flow compared to average monthly incremental precipitation for each of the major rivers contained within the Eastside Basin. Highest precipitation was seen in December 2003, with storm events also occurring at the beginning of 2004 and into spring.

Figure 5 Monthly Average Flow vs. Precipitation: Eastside Basin, January 2003 - April 2004



Through the San Joaquin River Agreement (SJRA), flows from April to May are managed by the Vernalis Adaptive Management Program (VAMP). Through VAMP, spring flow increases occur in the Stanislaus, Tuolumne, and Merced Rivers.

The VAMP is a twelve year study to gather scientific information on salmon and smolt survival, based on the relative effects of flows in the lower San Joaquin River and State Water Project-Central Valley Project, and Delta export pumping. VAMP flows provide a balance between existing flow, target flow, and delta export. The initial VAMP forecast is made no later than February 10, using 50% and 90% probability of exceedance runoff forecasts and demand conditions. Thereafter, VAMP flows provide a 31-day pulse flow in the San Joaquin River near Vernalis from April through May.

Parties to the SJRA include the Department of Water Resources, Department of Fish and Game, US Bureau of Reclamation, US Fish and Wildlife Service, Modesto Irrgation District, Tuolumne Irrigation District, Merced Irrigation District, South San Joaquin Irrigation District, Oakdale Irrigation District, San Joaquin Exchange Contractors, Friant Water Utility District, and the City and County of San Francisco.

Figures 6 through 8 relate sampling events to both high and low flow events, as well as precipitation in the Stanislaus, Tuolumne, and Merced Rivers, respectively. Precipitation and flow patterns create two distinct seasons, high flow and precipitation November through May, and low flow and low precipitation June through October. The impact of the highly managed flow regime (including VAMP) is most noticeable in the spring of 2004, when flows in the downstream river channels remained steady, even after a series of significant rainfall events, but increased dramatically during later reservoir releases.

Structuring the sampling schedule at twice a month allowed data to be captured during both significant rainfall and as well as high flow events.

Figure 6 Stanislaus Flow vs. Precipitation: Eastside Basin, January 2003 - April 2004

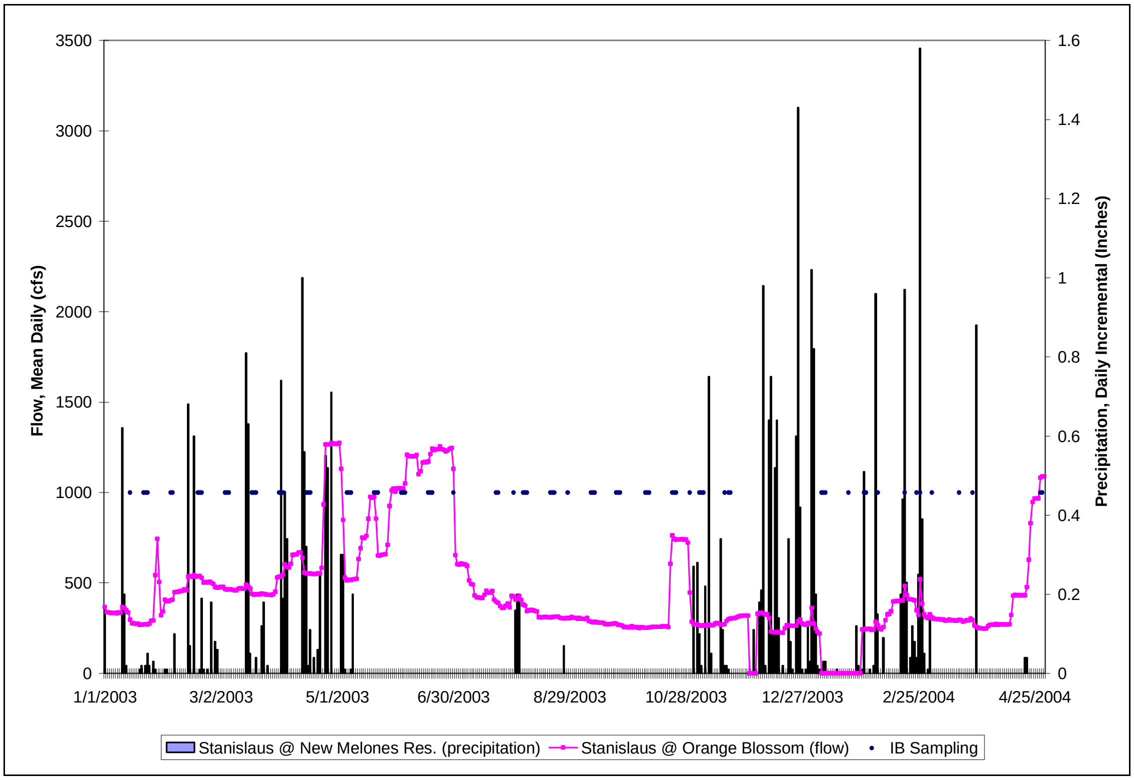


Figure 7 Tuolumne Flow vs. Precipitation: Eastside Basin, January 2003 - April 2004

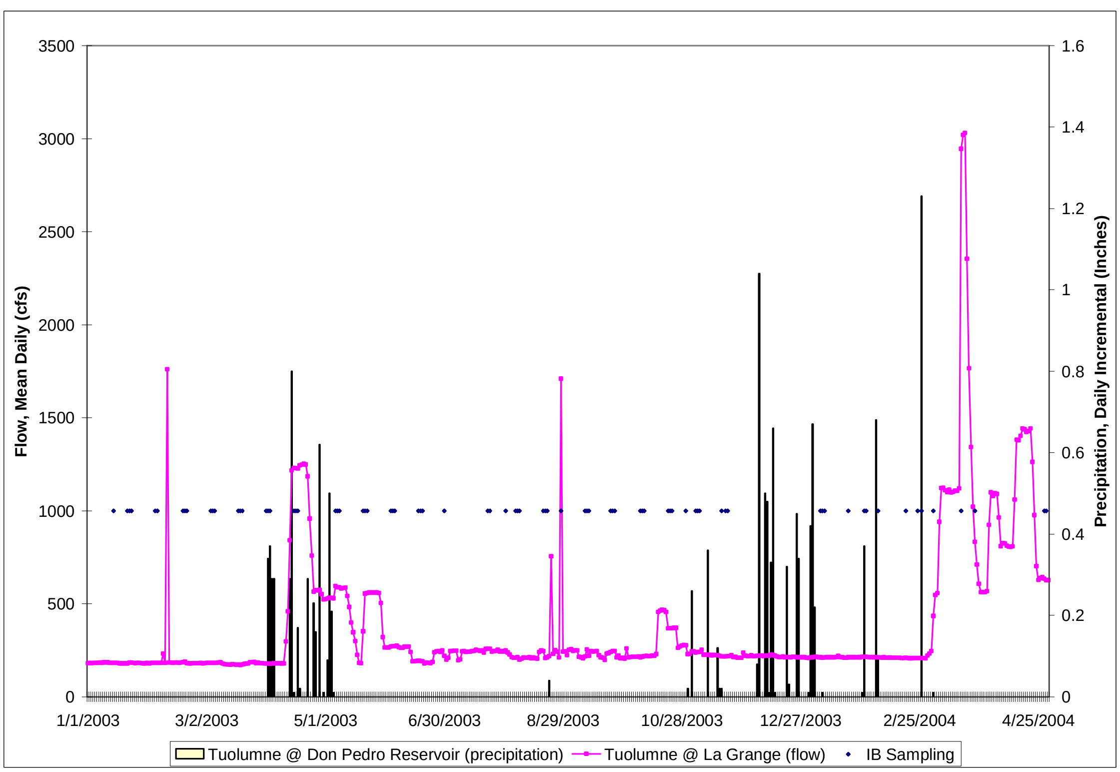
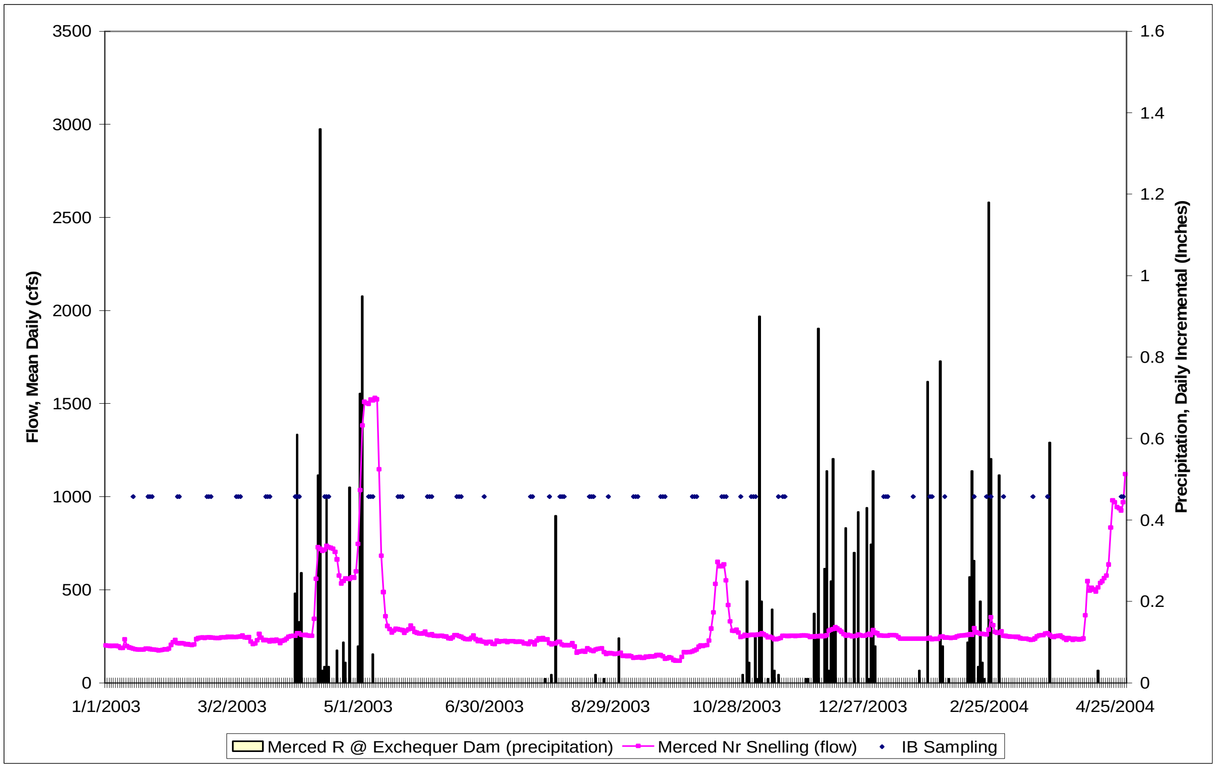


Figure 8 Merced Flow vs. Precipitation: Eastside Basin, January 2003 - April 2004



6.0 BENEFICIAL USES AND APPLICABLE WATER QUALITY OBJECTIVES AND GOALS

One component of Region 5's SWAMP efforts is to evaluate ambient water quality and to determine whether there is any indication that beneficial uses are being impacted. Information gathered during this study allowed analysis of a broad spectrum of water bodies at key integrator sites in order to determine existing quality at the site itself and allow some inference of the water quality within identified sub-basins. Potential beneficial uses applicable to each site monitored were identified using designated listing from the Sacramento/San Joaquin Water Quality Control Plan (Basin Plan) (CVRWQCB, 2002). To evaluate potential impact, indicators were chosen for four broad beneficial uses: drinking water (salt, TOC, trace elements, bacteria); aquatic life (pH, temperature, dissolved oxygen, turbidity, and water column toxicity); irrigation water supply (salt); and recreation (bacteria). Not all of the indicators could be monitored throughout the entire study period, due to funding limitations, but at least one indicator for each beneficial use evaluated was included throughout the study.

The following two sections highlight: 1) the beneficial uses that apply to each of the water bodies sampled; and 2) the objectives and goals that were utilized when evaluating results to determine whether there was any indication that water quality was not meeting a specific beneficial use.

6.1 Applicable Beneficial Uses

In the SJR Basin, all natural water bodies have potential municipal and industrial supply designated through the statewide Sources of Drinking Water Policy (State Water Resources Control Board Resolution No. 88-63). Other specific beneficial uses have been designated to individual water bodies as well as the San Joaquin River/Sacramento-San Joaquin Delta—to which the entire SJR Basin drains. The beneficial uses of any specifically identified water body generally apply to its tributary streams.

The applicable beneficial uses for each sampling site have been summarized in Table 3, under the general headings of Drinking Water, Recreation Use, Irrigation Supply and Aquatic Life. Table 3 indicates whether the use has been specifically designated or is being applied as a tributary. In cases where specific beneficial uses have not been designated for a particular water body, the Water Quality Control Plan for the Sacramento river and San Joaquin River Basins allows the use for the "tributary rule", which applies beneficial uses of downstream water bodies to those not specifically designated. While the Regional Board generally does not use the tributary rule to determine beneficial uses for constructed agricultural drains and other non-stream tributaries, as noted in Board resolution R5-2005-0137 (October 2005), those beneficial uses were noted in the Eastside Report to provide a consistent framework to assess potential water quality impacts. In the case of the constructed facilities, those impacts would more likely be to downstream water bodies.

Appendix C3 provides more detail on the subcategories of use that have been specifically designated in the Sacramento-San Joaquin Basin Plan.

Table 3 Applicable Beneficial Uses for Water Bodies in the Eastside Basin

		APPLICABLE BENEFICIAL USES											
		DRINKING WATER	AQUATIC LIFE						IRRIGATION SUPPLY	RECREATION			
			Fresh-water		Migra-tion		Spawn-ing			REC-1		REC-2	
Site Description	Site ID	Municipal and Domestic Supply	Warm	Cold	Warm	Cold	Warm	Cold		Contact	Canoeing / Rafting	Other Noncontact	Designated (D) / Tributary (T)
FARMINGTON DRAINAGE AREA													
Littlejohns Creek at Sonora Road	STC212	E	E	E	E	E	E		E	E	E	E	T
Duck Creek at Highway 4	SJC201	E	E	E	E	E	E		E	E	E	E	T
Littlejohns Creek at Austin Road	SJC213	E	E	E	E	E	E		E	E	E	E	T
Lone Tree Creek at Austin Road	SJC503	E	E	E	E	E	E		E	E	E	E	T
French Camp Sl at Airport Wy	SJC504	E	E	E	E	E	E		E	E	E	E	T
VALLEY FLOOR DRAINAGE TO SAN JOAQUIN RIVER													
MID Lateral 6/8 at Dunn Road	STC203	Exempt	E		E	E	E		E	E	E	E	T
MID Main Drain Inlet to Miller Lake	STC202	Exempt	E		E	E	E		E	E		E	T
MID Main Drain at Shoemake Road	STC211	Exempt	E		E	E	E		E	E		E	T
MID Lateral 3/4 at Paradise Road	STC204	Exempt	E		E	E	E		E	E	E	E	T
TID Lower Lateral 2 at Grayson Road	STC208	Exempt	E		E	E	E		E	E	E	E	T
TID Harding Drain at Carpenter Road	STC501	Exempt	E		E	E	E		E	E	E	E	T
TID Lateral 6/7 at Central Avenue	MER201	Exempt	E		E	E	E		E	E	E	E	T
TID Lateral 7 at Central Avenue	MER203	Exempt	E		E	E	E		E	E	E	E	T
STANISLAUS WATERSHED													
Stanislaus River at Camp Nine Road	CAL201	E	E	E					E	E	E	E	D
Stanislaus River at Parrott's Ferry	TUO201	E	E	E					E	E	E	E	D
Stanislaus River at Knight's Ferry	STC201	P	E	E		E	E	E	E	E	E	E	D
Stanislaus River at Caswell State Park	STC514	P	E	E		E	E	E	E	E	E	E	D
TUOLUMNE WATERSHED													
Woods Creek at Mother lode	TUO208	E	E	E					E	E	E	E	T
Woods Creek at Highway 108	TUO205	E	E	E					E	E	E	E	T
Woods Creek at Mill Villa Drive	TUO202	E	E	E					E	E	E	E	T
Sullivan Creek at	TUO207	E	E	E					E	E	E	E	T

Table 3 continued:

APPLICABLE BENEFICIAL USES													
		DRINKING WATER	AQUATIC LIFE						IRRIGATION SUPPLY	RECREATION			
			Fresh-water		Migra-tion		Spawn-ing			REC-1		REC-2	
Site Description	Site ID	Municipal and Domestic Supply	Warm	Cold	Warm	Cold	Warm	Cold		Contact	Canoeing / Rafting	Other Noncontact	Designated (D) / Tributary (T)
Algerine Road													
Curtis Creek at Algerine Road	TUO209	E	E	E					E	E	E	E	T
Tuolumne River at Ward's Ferry	TUO203	E	E	E					E	E	E	E	D
Tuolumne River at Jacksonville Road	TUO204	P	E	E					E	E	E	E	D
Tuolumne River at Old La Grange	STC210	P	E	E		E	E	E	E	E	E	E	D
Tuolumne River at Mancini Park	STC205	P	E	E		E	E	E	E	E	E	E	D
Tuolumne River at Legion Park	STC216	P	E	E		E	E	E	E	E	E	E	D
Dry Creek at La Loma Road	STC206	P	E	E		E	E	E	E	E	E	E	T
Tuolumne River at 9th Street Bridge	STC207	P	E	E		E	E	E	E	E	E	E	D
Tuolumne River at 7th Street Bridge	STC214	P	E	E		E	E	E	E	E	E	E	D
Tuolumne River at Audie Peeples	STC215	P	E	E		E	E	E	E	E	E	E	D
Tuolumne River at Shiloh	STC513	P	E	E		E	E	E	E	E	E	E	D
MERCED WATERSHED													
Merced River at Briceburg	MAR202	P	E	E					E	E	E	E	D
Merced River at Bagby	MAR203	P	E	E					E	E	E	E	D
Merced River at Highway 49	MAR201	P	E	E					E	E	E	E	D
Merced River at Merced Falls	MER209	E	E	E	E	E	E	E	E	E	E	E	D
Merced River at Highway 99	MER202	E	E	E	E	E	E	E	E	E	E	E	D
Merced River at River Road	MER546	E	E	E	E	E	E	E	E	E	E	E	D
E = Existing P = Potential													

6.2 Applicable Water Quality Objectives and Goals

Water quality information collected during this study was evaluated using water quality objectives adopted in the Sacramento River and San Joaquin River Basin Plan (CVRWQCB, 2002), a compilation of water quality goals identified by state and federal agencies (Marshack, 2003), and targets developed by the Bay-Delta Authority (a joint State and Federal agency) to protect fish passage (temperatures not to exceed 20-degrees Celsius) and drinking water (total organic carbon to remain below 3.0-mg/L). The Basin Plan objectives are enforceable criteria that are linked to protecting designated beneficial uses such as domestic, municipal, agricultural and industrial supply, recreation, and preservation and enhancement of fish, wildlife and other aquatic resources. These objectives are both numeric and narrative and may be specific to certain reaches of various water bodies or apply to entire basins.

The water quality goals are scientifically defensible, numeric criteria developed by diverse agencies to protect specific uses, primarily aquatic life, drinking water, and irrigation supply. In many cases, the goals are national guidelines. These goals may be used to determine compliance with some of the narrative Basin Plan objectives (e.g. toxicity).

Both the objectives and the goals apply to the indicators used to evaluate beneficial use protection. A summary of the general groups of indicators that can be utilized to evaluate a beneficial use and the most limiting use (e.g. if the objective/goal is met for that use than it would be met for the remaining uses) is listed in Table 4.

Appendix C1 lists the applicable Basin Plan objectives for this study and the targets from the Bay-Delta Authority. For turbidity, pH, temperature, and total suspended sediment, the listed objectives refer to changes impacting “normal” and “natural” conditions. For this study, natural conditions have been assumed to be conditions at the furthest upstream sampling location or upstream of a specific discharge. Appendix C2 shows the applicable goals sorted by generalized beneficial uses.

Table 4: Indicator and Beneficial Uses

INDICATOR(S)	SJR-BENEFICIAL USE(S)			
	Drinking Water	Aquatic Life	Irrig. Water Supply	Rec. Use
Water Column Analyses				
Specific Conductance	x	x	x	
pH	x	x	x	
Temperature		x		
Dissolved Oxygen		x		
Turbidity	x	x	x	
Minerals		x	x	
Trace Elements (Total)	x	x	x	f
Total Suspended Solids	x	x	x	x
Total Organic Carbon	x	x	x	
Bacteria	x		x	x
Toxicity				
P. promelas - 96 hr	x	x	x	x
C. dubnia - 48 hr	x	x	x	x
S. capricornutum - acute	x	x	x	x

f = Major recreational use concern is in fish consumption

Minerals: B, Cl, H2SO4, Ca, Mg, Hardness

Trace Elements: As, Cd, Cr, Cu, Pb, Ni, Zn, Hg

(shaded) = Most limiting beneficial use(s). For reference of actual numerical values of WQ objectives, see Appendices C1 and C2