San Joaquin Valley Drainage Authority
ERP-02D-P63

Site Description and Map

Task 10: Installation of a New Monitoring Station for the San Joaquin River

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Objectives

Identify and describe the location of a water quality monitoring station on the San Joaquin River that will yield representative constituent concentrations entering the Deep Water Ship Channel (DWSC) that originate upstream of the City of Stockton wastewater effluent outfall.

Site Selection

The Department of Water Resources maintains a continuous water quality station that continuously monitors dissolved oxygen and chlorophyll *a* at Mossdale Crossing, approximately 16 river miles above the Port of Stockton. These data are not representative of the water quality entering the DWSC. Often the concentration of chlorophyll *a* is half that measured at Mossdale. *A* new continuous station will be installed closer to Stockton, CA to better monitor water quality parameters entering the DWSC from the San Joaquin River above Stockton, especially those constituents associated with algae and its growth. However, the City of Stockton discharges treated wastewater effluent 1.3 miles upstream of the DWSC. Thus, it is desired to locate the new monitoring station outside of the influence of this outfall. These criteria require that the station be located as close to the DWSC as possible, yet still upstream of the Stockton outfall. The location of the outfall, City of Stockton, the DWSC, and the proposed reach for the water quality station are shown in Figure 1.

Tidal flows in the San Joaquin River transport Stockton wastewater effluent upstream during flood tides. Tidal flows typically range from 2000 to 3000 cfs and are usually greater than the net river flow. Tidal excursion above the effluent outfall was recently measured during a tracer study to evaluate the performance of the Port of Stockton aerator. Figure 2 presents the extent of dye transport above aeration facility, located at the confluence of the San Joaquin River and the DWSC. As shown in Figure 2, the rhodamine WT profile measured at the end of two flood tides indicates that the upstream movement on September 1 and 2 was approximately 15,000 to 17,000 ft above the aerator. The net river flow during the tracer investigation was approximately 540 cfs.

Tidal excursion upstream of the DWSC is a function of the net river flow and tidal phases. On occasion, management of water resources in the Delta and upstream reservoirs can reverse the net flow of the San Joaquin River at Stockton. A net flow reversal was observed as recently as August, 2004. To evaluate the influence of net flow on the upstream tidal excursion, a series of calculations were performed with flow data measured by the USGS at the Garwood Bridge station. Figure 3 exhibits the calculated movement of a parcel of dye released from the aerator at 16:15 on September 1, 2004 at low slack tide. Neglecting

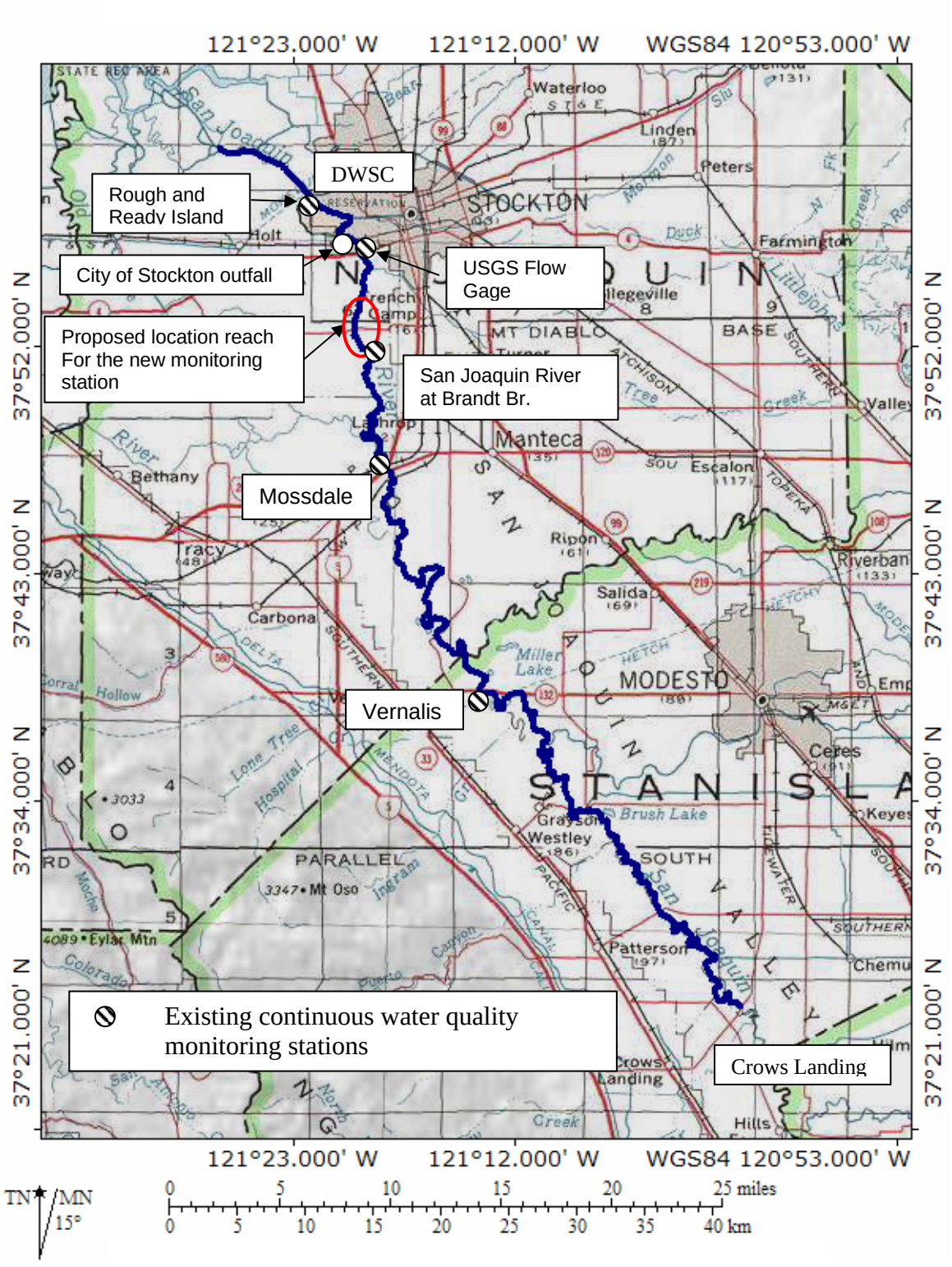

Figure 1: The San Joaquin River near Stockton, CA and the reach for the proposed water quality monitoring station.

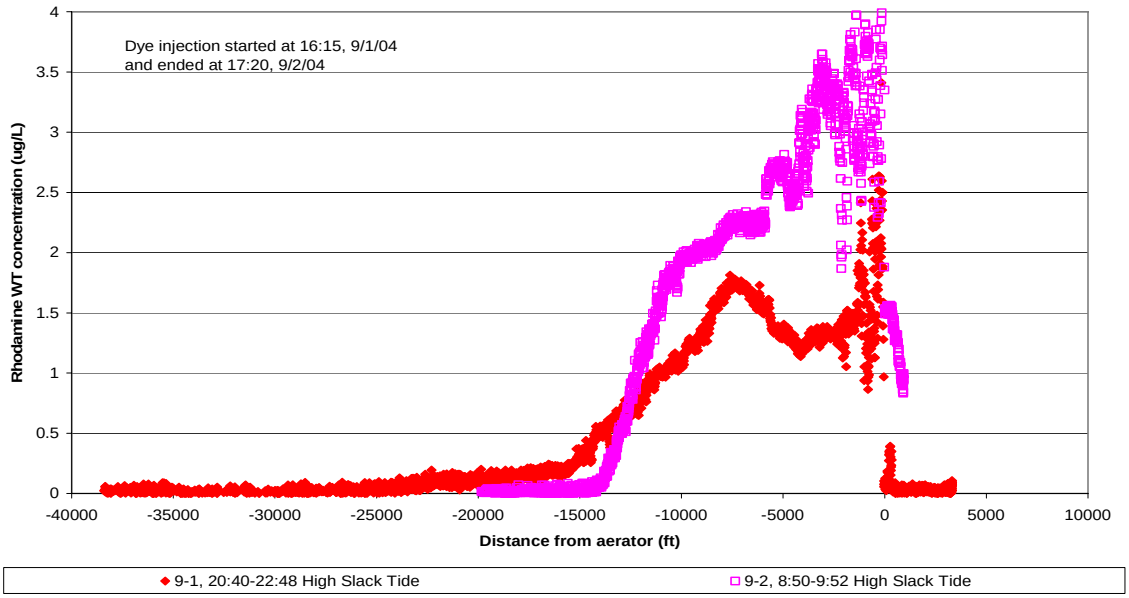

Figure 2: Excursion of rhodamine WT tracer above the DWSC measured on September 1 and 2, 2004.

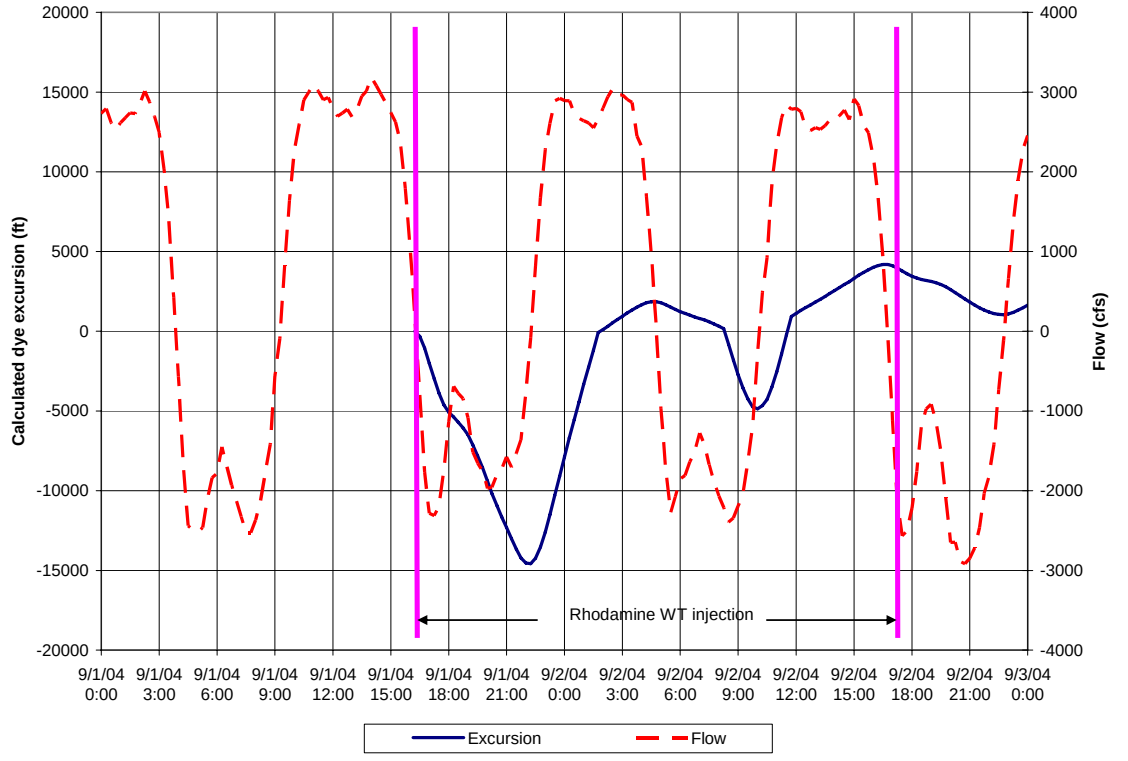

Figure 3: Calculated rhodamine WT excursion during the tracer injection of September 1 and 2, 2004 at the Port of Stockton aeration facility.

dispersion, this estimate indicates that the tracer moved upstream approximately 15,000 ft during the first flood tide on September 1 at approximately 22:15. This estimate of the tidal excursion is in good agreement with the tracer measurements shown earlier in Figure 2.

Additional tide excursion calculations were also performed for other days in 2004 under different net flows and tidal conditions. The results of these estimates are summarized in Table 1. Plots of the tidal excursion for each of these dates are presented in the Appendix.

Dates	25-hr tidal day net river flow (cfs)	Upstream excursion (ft)	Upstream movement (mi)
July 14 and 15, 2004	116	33,000	6.2
June 1 and 2, 2004	299	27,000	5.1
June 25 and 26, 2004	617	20,000	3.8
Sept 1 and 2, 2004	540	17,000	3.2

Table 1: Maximum upstream tidal excursion for selected dates and net river flows.

The upstream excursion was calculated for three different net flow conditions to better estimate the influence of net flow on the extent of upstream tidal transport. Ideally the new station should always be above the influence of the Stockton wastewater outfall. However, this is not possible at extremely low flows or during flow reversal of the San Joaquin River. The results of the calculations shown in Table 1 indicate that the upstream excursion exceeds approximately 5 miles for net average flows of about 300 cfs. At net flows of 100 cfs, the excursion increases upstream an addition mile for the tidal conditions of July 14 and 15. Tidal phases, such as spring and neap tides, will also influence the extent of upstream excursion. These effects were not explored in detail here, but will be directly assessed during the temporary deployment of multiparameter sondes in 2005.

During 2003 water year, the net average flow measured at the USGS Garwood Bridge gage was less than 500 cfs, more than 50 percent of the time. Since an upstream tidal excursion of approximately 3.5 miles is associated with net flows of approximately 500 cfs, these data suggests that the proposed station should be located at least about 3.5 miles above the City of Stockton wastewater outfall if the measurements are not to be impacted by the effluent on most days. The site of the Stockton Brick Company (SBC) is adjacent to the river at this location. Ammonia measurements of water samples collected from the San Joaquin River at SBC during 2003 and 2004 have been consistently below a detection limit of 0.2 mg-N/L (Litton, unpublished data). These data suggest that this location may be sufficiently upstream to remain out of the influence of the high ammonia

concentrations in the treated effluent discharged at the Stockton outfall. However, since these measurements were performed intermittently they do not reflect a comprehensive record of water quality at SBC, and a continuous record is needed to establish the permanent station location.

The cumulative distribution of flow in the San Joaquin River at Garwood for the 2003 water year are shown in Figure 4. The average daily net flow at the Garwood Bridge was less than 100 cfs approximately 10 percent of the time, which may be characteristic of seasons with below average precipitation. At this low flow, the previous excursion calculations indicate that the station would need to be located greater than 6.5 miles above the outfall to remain out of the influence of the Stockton effluent 90 percent of the time. This distance probably represents the upper extreme for locating the water quality monitoring station since this point is midway between Mossdale and the DWSC. This upper location is also near the DWR water quality monitoring station at Brandt Bridge. The Brandt Bridge station measures stage, electrical conductivity, and water temperature.

These estimates of tidal excursion are approximate, but probably bracket the most probable river segment for the new station. It is recommended that the station be installed on a temporary basis to first consider dispersion effects and a wider range of flow and tidal conditions on excursion. This would be accomplished by installing one or more multiparameter, internal logging sondes within the proposed reach and manually downloading the data during weekly maintenance visits. The average net flows at Garwood have ranged from 726 to over 6800 cfs since January 1, 2005 due to above average precipitation during the 2004 water year. At these high flow rates, monitoring at the Stockton Brick Company (SBC) site would not be influenced by the Stockton effluent discharge. It is recommended to temporarily install a multiparameter sonde at SBC and monitor the data as flows subside later this summer or fall. If flows become low enough for the wastewater to influence water quality, the station would be moved progressively upstream. In this manner the excursion calculations provided earlier could be refined, and the effects of dispersion more carefully considered in the locating the new water quality monitoring station. A second sonde installed at the DWR Brandt Bridge station would remain fixed throughout 2005 and until April, 2006.

The proposed reach for the new water quality station is delineated in Figure 5. It will extend from approximately 4.5 to 8 miles above the DWSC. Within this reach eight water diversion pump platforms, bridges or stations exist that can be used to temporarily mount instrumentation during 2005 and 2006. These locations are also shown in Figure 5 and their coordinate positions are listed in Table 2. Verbal permission to use these structures on a temporary basis has been obtained and written documentation has been requested.

Location No.	Name	SJR mi	UTM E	UTM N
1	Stockton Brick Co. (SBC)	44.7	647.0459	4195.5196
2	River diversion/pump station	45.5	646.9109	4194.7051
3	River diversion/pump station	46.6	646.7095	4193.5099
4	Howard Road Bridge	46.8	646.7079	4193.2715
5	River diversion/pump station	47.1	646.9213	4192.6519
6	River diversion/pump station	47.4	647.3788	4191.9219
7	River diversion/pump station	47.5	647.5143	4191.8892
8	DWR Brandt Bridge station	48.2	647.8691	4191.0835

Table 2: Locations of structures that may be used for temporary mounting of water quality instrumentation.

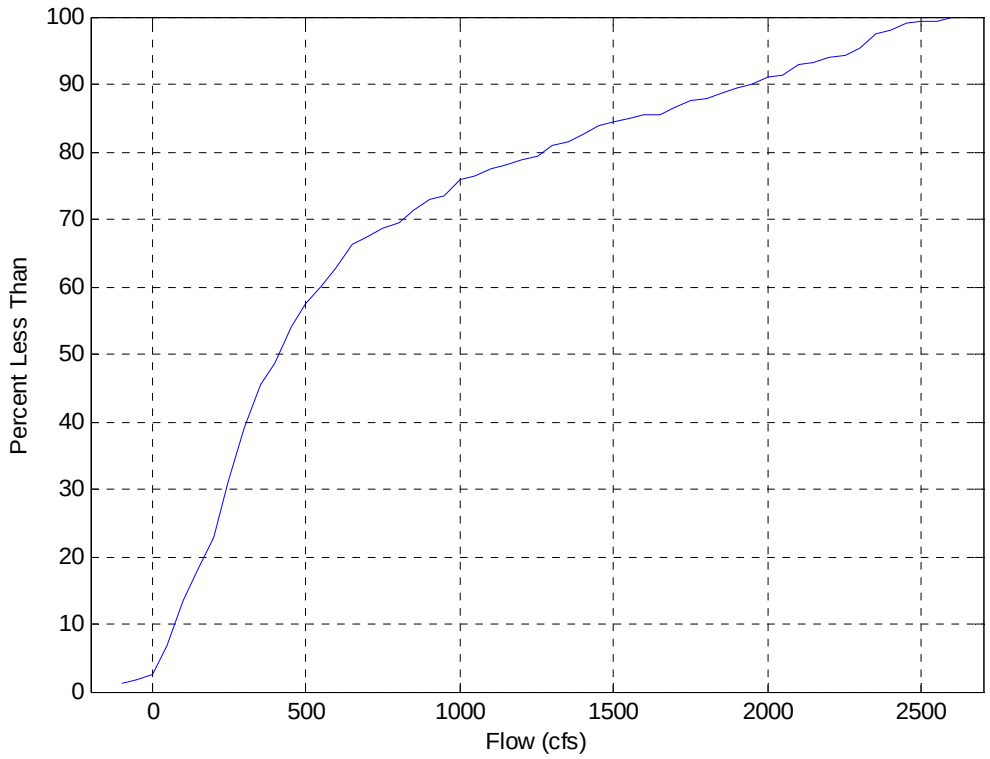

Figure 4: Cumulative distribution of observed flows for the 2003 water year.

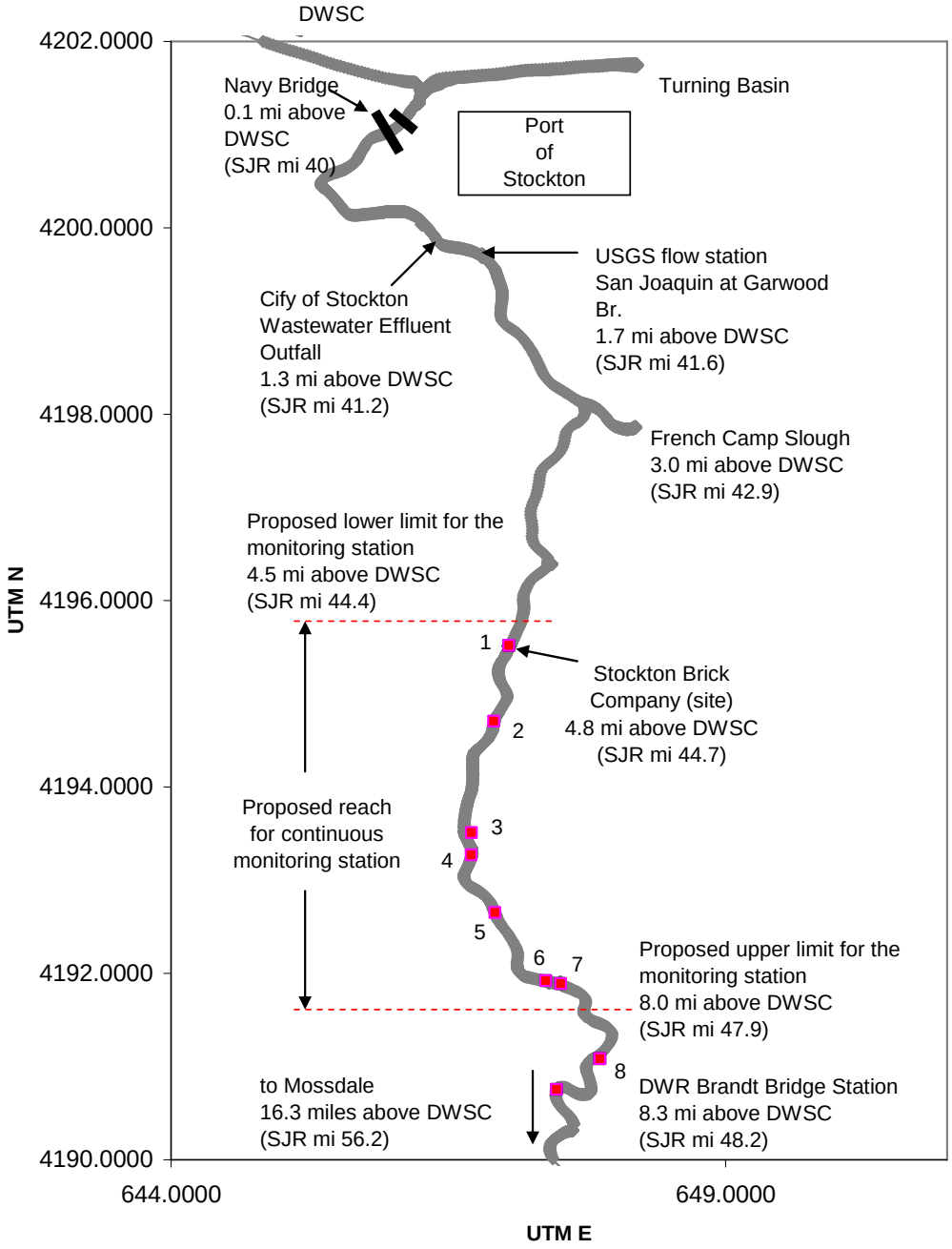

Figure 5: Proposed reach for the new continuous monitoring station location. Sites 1 through 7 are structures that offer piers for temporary instrumentation installation. Site 8 is the DWR Brandt Bridge Station.

Description of the Station

A river reach extending from approximately 3.5 to 7 miles above the Stockton outfall is proposed for the new monitoring station location as previously shown in Figure 5. Deployment of temporary instrumentation is proposed for 2005 to refine the position for the permanent installation. If the 2004 water year yields data over a wide range of flows, a permanent location will be identified and the station will be installed in 2006.

A listing of possible temporary measurement locations within the proposed monitoring station reach was listed in Table 2. Figure 6 presents the bathymetry of the San Joaquin River for the proposed monitoring reach. In this river segment, water depths range from about 10 to 20 feet along the centerline. Mixing in this region is sufficient to yield uniform lateral and vertical water quality profiles, except during brief periods between tidal flow reversals. Tidally induced velocities often exceed 1 ft/s.

In the proposed reach, the San Joaquin River is highly channelized with steep levee banks armored with rock, brick and concrete debris as shown in Figure 7 at the Stockton Brick Company site. The smoke stack of the former Stockton Brick Company is seen in the background of the photograph. Aerial photographs of the proposed monitoring station reach are presented in Figures 8 and 9. As shown in these photographs the adjacent properties consist of agriculture lands irrigated with water from the San Joaquin River. Above the DWSC there are numerous water diversions and tailwater return outfalls that support agricultural activities along the San Joaquin River.

A multiparameter sonde will be installed to one of the piers supporting the water diversion pump station located near the Stockton Brick Company site after the owner's permission is obtained. A photograph of the pump station is shown in Figure 10. The water depth at the outside piers was approximately 9 feet on February 4, 2005 when the net river flow was 1867 cfs. Disturbance of sediments during the operation of the diversion pump is not anticipated due to the relative depths of the intake and river, but this will be carefully evaluated during the first week of monitoring. A second sonde will also be installed at the DWR Brandt Bridge site to collect data at the extremes of the proposed range. A photograph of the station is shown in Figure 11.

Two Hydrolab DX5S sondes will be used to continuously monitor water quality within the proposed monitoring station reach during 2005 and 2006. Water stage, temperature, dissolved oxygen, electrical conductivity, pH, fluorescence (chlorophyll *a*), and turbidity will be recorded at 15 minute intervals. The data will be downloaded and maintained on a weekly basis. Manufacture defects in the internal software of the sondes has resulted in an equipment recall. The sonde have been returned to the manufacture, but are expected back by mid-September.

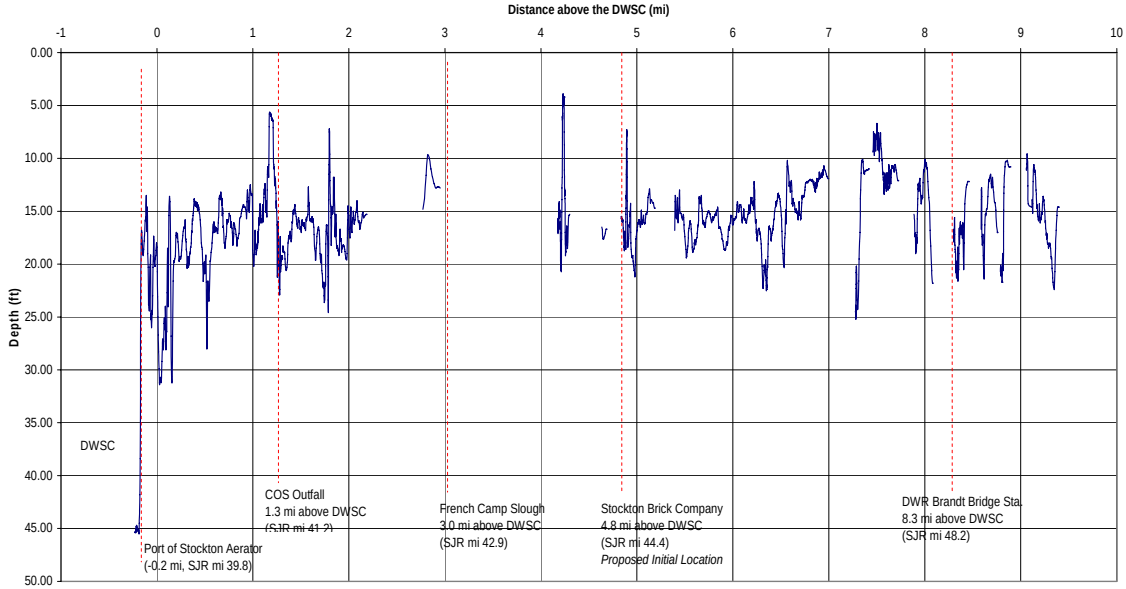

Figure 6: Bathymetry of the San Joaquin River above the DWSC.

Figure 7: The San Joaquin River at the Stockton Brick Company Site.

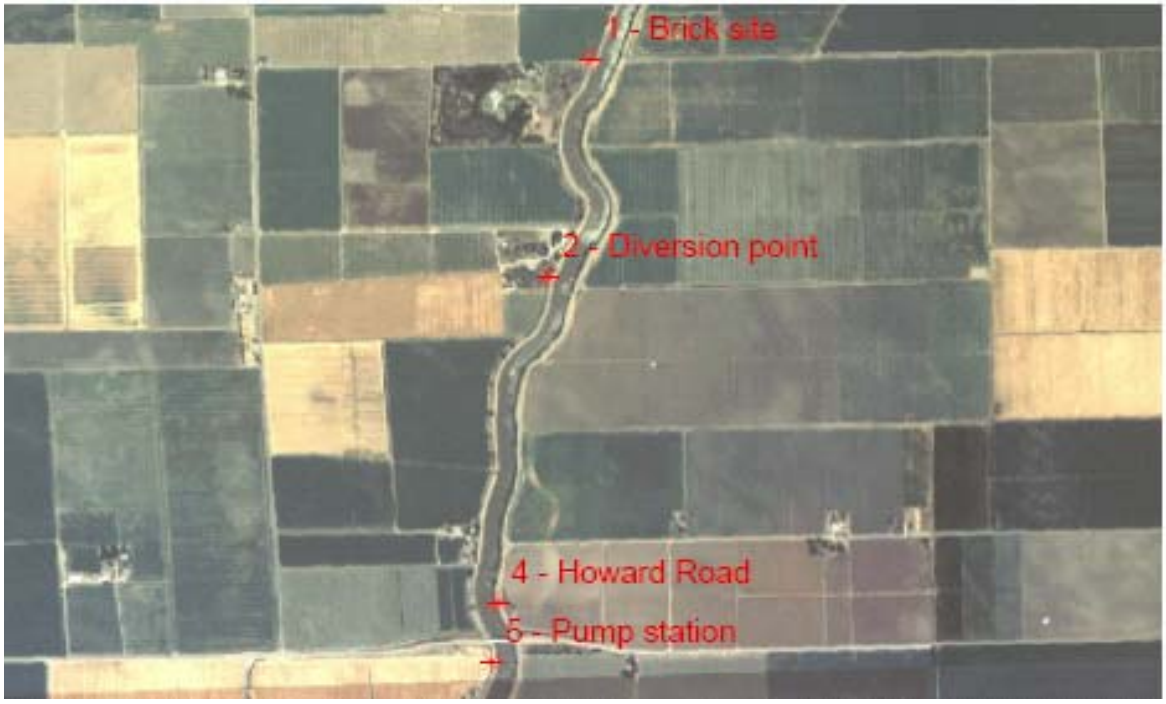

Figure 8: An aerial photograph of the proposed monitoring station reach from SJR mi 44.7 to SJR mi 47. Locations of selected temporary monitoring sites are also presented.

Figure 9: An aerial photograph of the proposed monitoring station reach from SJR mi 47 to SJR mi 47.9 . Locations of selected temporary monitoring sites are also presented.

Figure 10: The water diversion pump at the Stockton Brick Company.

Figure 11: The DWR Brandt Bridge Station

Conclusions

A reach of the San Joaquin River extending from river mile 44.7 to 48.2 has been identified for the installation of a water quality monitoring station for quantifying inputs to the Stockton DWSC. Existing structures have been identified for the attachment of self-logging water quality sondes at these two locations to evaluate for which of these sites is best for a permanent station. The evaluation will be conducted during the fall, winter, and early spring of 2005-06. Verbal permission has been obtained from the property owners of these structures and written agreements are forthcoming. Software bugs in the data acquisition programs of the water quality sondes has delayed temporary deployment. The sondes were recalled by the manufacturer and are expected to be returned by mid September. It is anticipated that the two water quality sondes will be deployed by late September,2005 within the study reach. The results of the station site evaluation will be presented to the TWG in April, 2006 with a recommendation for the permanent station location.

Appendix

Plots of tidal excursion estimates

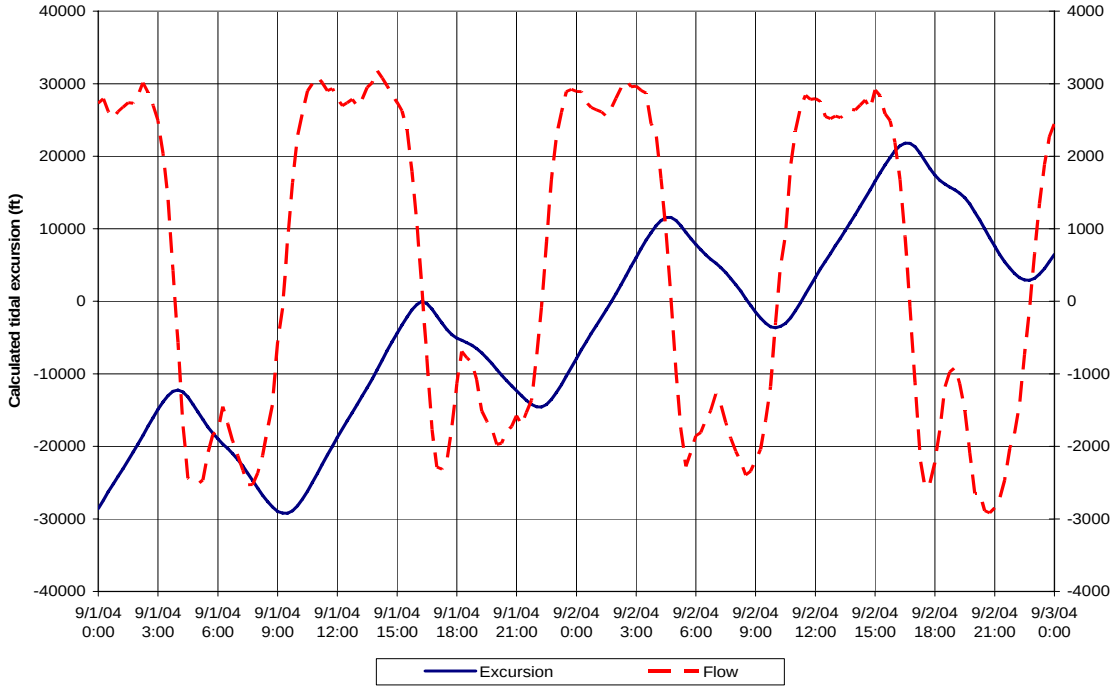

Figure A1: Estimated tidal excursion in the San Joaquin River above the DWSC for Sept 1 and 2, 2004.

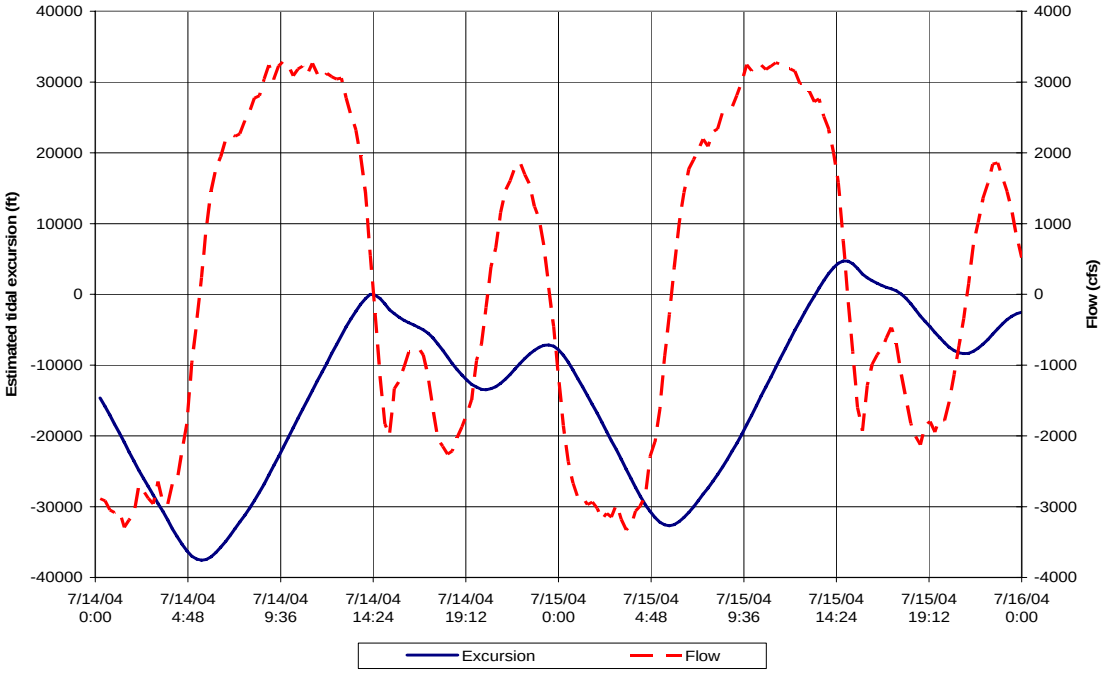

Figure A2: Calculated tidal excursion for July 14 and 15, 2004 based on measured flow at the Garwood Bridge gage. The average net flow for the 25-hr tidal day starting at 14:15 on July 14 was 116 cfs.

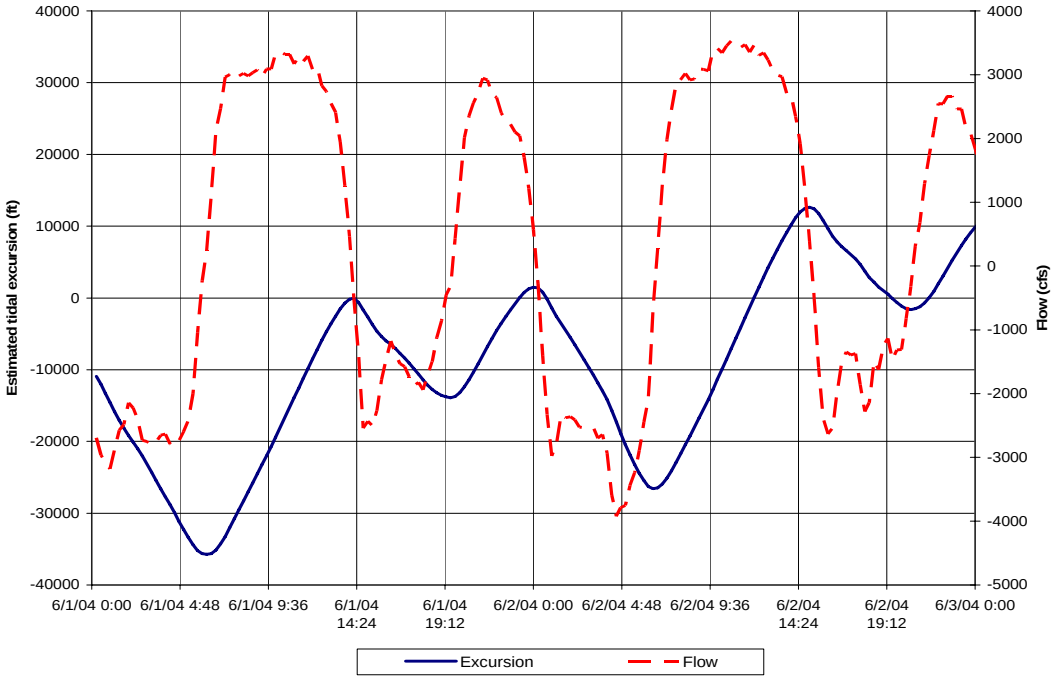

Figure A3: Calculated tidal excursion for June 1 and 2, 2004 based on measured flow at the Garwood Bridge gage. The average net flow for the 25-hr tidal day beginning at 14:15 on June 1 was 299 cfs.

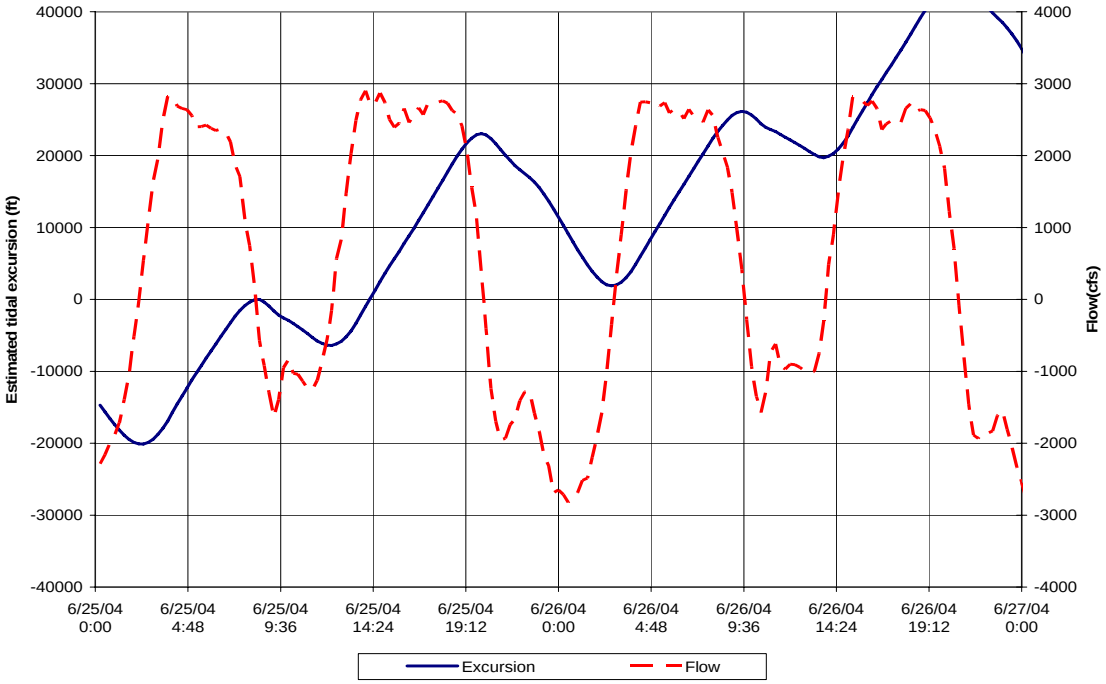

Figure A4: Calculated tidal excursion for June 25 and 26, 2004 based on measured flow at the Garwood Bridge gage. The average net flow for the 25-hr tidal day starting at 8:30 on June 25 was 617 cfs.