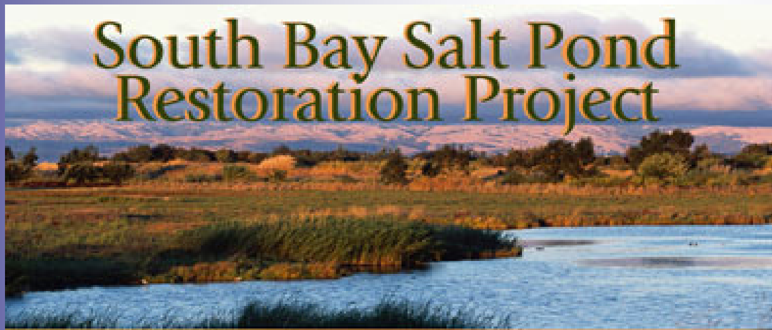
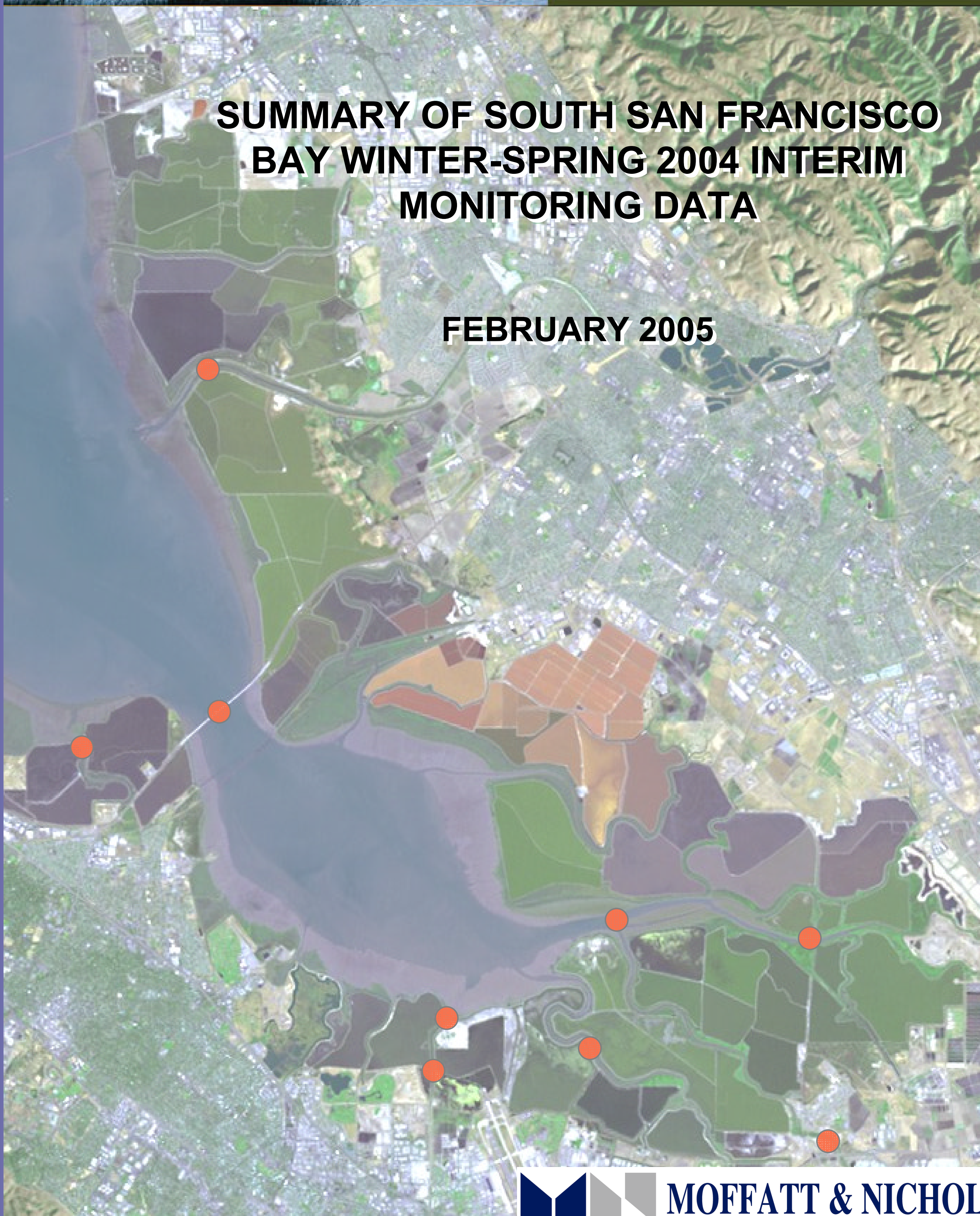


A San Francisco Bay project provided by the California Department of Fish & Game, Coastal Conservancy and U.S. Fish & Wildlife Service

SUMMARY OF SOUTH SAN FRANCISCO BAY WINTER-SPRING 2004 INTERIM MONITORING DATA

FEBRUARY 2005



MOFFATT & NICHOL

SUMMARY OF SOUTH SAN FRANCISCO BAY WINTER-SPRING 2004 INTERIM MONITORING DATA

SOUTH BAY SALT POND RESTORATION PROJECT

Prepared For :

CALIFORNIA STATE COASTAL CONSERVANCY
1330 Broadway, Ste 1100
Oakland, CA 94612

Prepared By :

MOFFATT & NICHOL
2001 North Main Street, Ste 360
Walnut Creek, CA 94596

&

ENVIRONMENTAL DATA SOLUTIONS
1010 B Street, Suite 425
San Rafael, CA 94901

February 2005
M&N Job 5196-05

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

1.1 Background

The goal of the South Bay Salt Ponds Restoration Project is to restore and enhance a mosaic of wetlands, while maintaining many of the ponds as managed ponds. The potential restoration area includes the recently acquired salt ponds which consist of about 7,500 acres of existing ponds in the southern part of the South Bay, 4,800 acres of ponds along the East Bay shoreline, and about 1,500 acres along the West Bay shoreline.

Work described in this report was conducted for the California State Coastal Conservancy (CCC), as part of the initial planning phase of the restoration project. The objective of this short-term data collection was to obtain hydrologic and suspended sediment data for the 2004 winter season, such that it would aid others in characterizing existing conditions and in formulating alternatives. It is very likely that this data collection will continue into the future, under the EIR/S contract.

Combinations of water level, conductivity and temperature data were monitored at nine distinct locations (total of 11 data recorders) in the Far South Bay. USGS-measured data for one additional station was also obtained.

1.2 Purpose

Information collected during this monitoring effort can help characterize important physical and chemical processes during a period associated with runoff. Details of tidal and water quality variation through much of the Far South Bay are not well understood, and this data will serve to better understand these processes. Capturing a winter runoff period is particularly important in terms of determining the impacts of large rainfall-runoff on salinity in sloughs and in the South Bay. High flow periods are also important in terms of observing water surface elevations during coinciding high flows and high tides for flood management purposes.

This monitoring effort will also provide input to the planning process, particularly in understanding Baseline Conditions and in formulating alternatives. An important element of the Restoration Project is predictive numerical modeling, which will provide assistance in designing the restoration alternatives and analyzing the impacts of the alternatives. Field measurements are generally used to provide model boundary conditions, as well as to compare with modeling results for calibration and for verification purposes. Data collected in this effort can assist in developing screening-level models of the entire Far South Bay as well as in developing near-field models encompassing smaller portions of the system.

1.3 Scope Of Work

This report presents the data acquisition methodology, results, and brief observations from the monitoring effort. It also describes the locations and data types investigated, methods used to collect the data, and quality assurance procedures followed. Time series plots of hydrodynamic and water quality measurements for each location are presented, and significant findings are provided. General conclusions and recommendations for future studies are also presented.

Results of the following specific tasks are presented :

1. Data collection methodology ;
2. Summary of data collected ;
3. General observations of monitoring data ;
4. Conclusions and recommendations

The rationale for implementing this data collection effort, specific locations selected for monitoring, and a detailed scope of work is provided in Appendix A.

2. METHODOLGY

2.1 Locations

Instrument stations were set up at nine locations in the Far South San Francisco Bay (Figure 1). Seven locations had instruments mounted within weighted mooring platforms, and two locations had top and bottom mounted instruments attached to high-strength cables. Table 2-1 lists the locations and type of instruments placed at each location. Details of instrument locations and mountings are outlined in this section. The gage locations are presented alphabetically, rather than any geographic order.

Table 2-1
Locations and Types of Instrument Platforms

Station	Type
Channel Marker 17 (USGS-obtained data)	Conductivity / Temp
Alviso Slough	Conductivity / Temp / Water Level
Coyote Hills Slough	Conductivity / Temp / Water Level
Dumbarton Bridge – Top and Bottom	Conductivity / Temp / Water Level
Guadalupe Slough	Water Level
Power Tower – Top and Bottom	Conductivity / Temp / Water Level
Railroad Bridge	Conductivity / Temp / Water Level
Ravenswood Slough	Water Level
Stevens Creek – Mouth	Water Level
Stevens Creek - Upstream	Water Level

2.1.1 Alviso Slough

EDS mounted a Conductivity, Temperature and Depth sensor (CTD) within a weighted mooring approximately two ft above the channel thalweg in the upstream reach of Alviso Slough in the town of Alviso. The mooring was anchored to a 30 ft chain (drag chain) that was attached to a pile at the channel edge

2.1.2 Coyote Hills Slough

A CTD was mounted within a mooring two feet above the channel bottom approximately 1000 ft. upstream of the mouth of Coyote Hills Slough. As with Alviso Slough, this mooring also had a drag chain attached which was shackled to a small pile at the channel edge. It should be noted that this channel is also referred to as the Alameda County Flood Control Channel.

2.1.3 Dumbarton Bridge

A top and bottom CTD were mounted on a single-weighted cable which was suspended from the bridge pier fender located on the eastern side of the shipping channel of the Dumbarton Bridge. The top CTD was mounted at an elevation of -16.4 ft NGVD, 31.90 feet above the channel bottom. The bottom CTD was located at approximately -44.0 ft NGVD, 4 feet above the channel bottom. EDS applied for and received an encroachment permit from Caltrans to mount the aforementioned weighted cable from the pier fender.

2.1.4 *Guadalupe Slough*

A tide gage was mounted within a mooring two feet above the channel bottom 2.75 miles landward of the mouth of Guadalupe Slough. As with Alviso Slough, this mooring also had a drag chain attached which was shackled to a small pile at the channel edge. This platform did not monitor conductivity.

2.1.5 *Power Tower – Coyote Creek and Alviso Slough Confluence*

A top and bottom CTD were mounted on a single-weighted cable (same configuration as the Dumbarton Bridge platform) which was suspended from a concrete power tower footing that is located at the confluence of Alviso Slough and Coyote Creek. As with the Dumbarton Bridge, EDS applied for and received am encroachment permit from Pacific Gas and Electric.
Water depth in this area is approximately fifteen feet deep at MHHW resulting in the top CTD mounted at -5.70 ft NGVD, approximately 8 feet above the channel bottom. The bottom CTD was mounted at -13.70 ft NGVD, approximately 1 ft off the channel bottom.

2.1.6 *Railroad Bridge*

A CTD gage was located approximately 45 feet off the railroad bridge which crosses Coyote Creek east of the Mud Slough confluence. The gage was mounted approximately 20 ft to the north of the channel thalweg – towards the NW railroad bridge abutment (Figure 1.0 and Table 1.0). The CTD gage was mounted in the same fashion as the other channel bottom moorings: two feet off of the channel bottom within a weighted mooring.

2.1.7 *Ravenswood Slough*

A tide gage was mounted within a mooring two feet above the channel bottom 0.61 miles upstream of the mouth of Ravenswood Slough. As with Alviso Slough, this mooring also had a drag chain attached which was shackled to a large pile at the channel edge. This platform did not contain a conductivity sensor.

2.1.8 *Stevens Creek - Mouth and Upstream*

Two tide gages were deployed within Stevens Creek: at the mouth to South San Francisco Bay and 0.60 miles upstream. Each gage was deployed in the same fashion as the other mooring-mounted stations, within a weighted mooring approximately two ft above the channel thalweg.

2.1.9 *Channel Cross Section Surveys*

Cross section surveys were also performed for at least 2 locations within each slough where data were monitored. The location of cross section surveys and the surveys themselves are presented in Appendix B.

2.2 Instrumentation and deployment

Water level, conductivity and temperature data were collected using submersible, non-vented pressure / conductivity sensors designed and manufactured by *Coastal Leasing Inc* of Cambridge, Massachusetts *(MacroTide* series). Each sensor has a pressure transducer port, a temperature sensor and an electrodeless, ceramic conductivity sensor (on CTD sensors only) mounted on the top of the unit. The sensors are self-contained in that the data logger is built directly into the unit. Each data logger was programmed to turn on and excite each sensor every 12 minutes and take readings at 2 hertz for 30 seconds. These 30-second “bursts” were then averaged and stored into memory with a date and time stamp (Pacific Standard Time).

Non-vented pressure transducers measure absolute pressure (water column pressure + atmospheric pressure) by converting the deformation of a pressure diaphragm to a millivolt reading. The millivolt reading is then converted to an absolute pressure reading reported in PSIA (Pounds Per Square Inch Absolute).

When the data loggers are downloaded, a comma-delimited file containing a temperature, pressure, conductivity (CTD only), and time and date stamp is produced. Data post-processing includes the subtraction of concurrent atmospheric pressure values from each absolute pressure reading. A separate, atmospheric pressure time series was acquired from the National Weather Service database (http://www.ncdc.noaa.gov), which maintains a piezoelectric barometer at Moffett Field (station id# 74509).

These ten-minute NWS observations were subtracted from each PSIA reading during the conversion from PSIA to depth. Depth of water above the pressure port was calculated using:

$$D=(P-A)*K$$

where:

D = depth, in meters
P = total pressure, from Macro Tide, in PSIA
A = atmospheric pressure
K = pressure-to-depth conversion factor, which is a function of temperature and conductivity

The conversion from pressure to depth can be derived from the density of water as follows:

K = 0.703242 m/psi * 1/Rho (T) (relative V as a function of temp.)* 1/Rho(S) (relative volume as a function of salinity)

The ceramic conductivity sensor measures the resistivity of a small electric current through water, a measurement known as conductivity. Conductivity (millisiemens/cm) is directly related to salinity (reported in Practical Salinity Units) using the following conversion

$$R(S,T,P)= \frac{C(S, T, P)}{C(35\%15^{o}C,0)}$$

where:

C(S,T,P) = conductivity at salinity (S, %), Temp (T, ^{o}C) and Pressure (P, PSIA)

Bottom-mounted moorings consisted of a one-foot long, six inch diameter PVC, horizontally-bolted to the top of a 100 pound cement block. The sensor was placed within the protective PVC housing. The mooring block was tapered toward the top and wide at the bottom to ensure stability. To keep the mooring from sinking into soft sediment, four, three-foot long thin wood “feet” were attached to the bottom of the mooring block (see Figure 2).

Each mooring was attached to a 30 – 40 foot drag chain that was attached to either an existing pile or to a steel pipe that was driven into the adjacent shoreline.

At the Dumbarton Bridge site, EDS mounted a 3/16th inch high-tension stainless steel cable to a permanent shackle which was located at the top of the concrete bridge pier fender. Before the cable was lowered, a 150 pound weight was attached to the end of the cable to ensure the cable remained taught during the deployment. This weight was then lowered until it rested on the channel bottom (55 ft below Mean Higher-High water), the cable was then pulled tight and shackled to the aforementioned fender mount. The small diameter cable was utilized in an effort to minimize hydraulic forces acting on the cable during ebb and flood tidal flows.

Each CTD was placed within a weighted six inch diameter PVC tube that was attached around the weighted cable and lowered to the proper depth. Each CTD housing had a separate nylon rope attached to it and the fender shackle, to facilitate raising and lowering the instruments to the proper depths during maintenance visits (see Figure 3).

The collected water surface elevation (WSE) data may be used to calibrate numerical computer models, thus requiring accurate relative elevations of each time series. To ensure all of the WSE time series are in a relative datum (for example, feet NGVD), surveying of the actual water surface (concurrent with a scheduled sensor reading) before and after each instrument reconnaissance was integral to this data collection effort.

During the initial deployment of each station, EDS field personnel installed a temporary benchmark (TBM) at each instrument location. The TBMs consisted of either a physical point driven into the adjacent shoreline (usually a 4 ft galvanized pipe) or a horizontal line etched into a pile or bridge pier.

Before each mooring was recovered during a site visit, the distance (and time) between the water surface and TBM was recorded concurrently with a sensor reading. This distance was either surveyed using optical survey equipment, or simply measured using a tape measure (where the TBM was an etch on a pile of bridge pier). This protocol was also repeated after the deployment of each instrument. To ensure proper clock synchronization, each data logger clock was synchronized (during each site visit) with the hydrographer’s watch.

To covert from feet of water above the pressure transducer (units after PSIA conversion) to the project datum (ft NGVD), conversions between NGVD (at the TBMs) and depth were derived from the survey data. Each instrument deployment “data block” (data collected between each deployment and recovery) had a separate conversion factor since the instrument was moved and relocated to a slightly different vertical position during each site visit.

All TBMs were surveyed into feet NGVD utilizing benchmarks which were set by Tom Tucker, a licensed land surveyor with Tucker and Associates. EDS field personnel performed optical level-line loops between the Tucker primary benchmarks and each instrument TBM (feet NGVD).

2.3 Quality Assurance

EDS utilized numerous quality assurance protocols to ensure an accurate and representative dataset. A field deployment plan and the QA protocol followed by EDS is provided in Appendix C. These protocols were followed during each step of the monitoring effort; from instrument check-out and programming, to data reduction.

Before a detailed field plan was constructed, field personnel conducted a site visit to choose specific locations for each sensor platform. This initial reconnaissance was used to help develop mooring designs specific to each site. These design changes included integrating large feet into the mooring so they would not sink over time (project managers found that ~30% of the sites contained soft sediment), as well as cutting very large holes into the PVC housing to ensure proper flushing of sediment that would otherwise foul the pressure ports.

Field project managers also noted very high water velocities at the Dumbarton Bridge during spring ebb and floods; this resulted in the use of small-diameter, high-strength, stainless steel cabling. High flows in certain channels (upstream Alviso) resulted in constructing heavier mooring blocks.

Each *MacroTide* sensor was constructed and calibrated specifically for the water depths encountered at each site. Each sensor was subjected to a variety of lab bench tests before EDS received delivery of the instruments.

Instrument deployments and recoveries involved sensor checks on the following constituents:

- An open-air pressure reading was taken every time the sensor was recovered to ensure accuracy against atmospheric pressure reading taken by the NWS.
- The conversion (before instrument recovery) between sensor reading and readings in the project datum was checked against the conversion derived from the previous post-deployment readings. Post deployment and pre-recovery conversions need to be the same; differences in conversions are indicative of either the sensor physically moving or experiencing transducer drift during that particular deployment.
- Instruments inspected for physical damage or corrosion.
- Ensuring o-rings are not cracked and are properly lubricated
- Checking battery power and remaining memory space.
- Cleaning the instrument of any bio fouling or sediment accumulation.
- Checking mooring position and integrity after each storm event.

State of the art ceramic conductivity sensors experience almost no drift – unlike older technology, electrode-based conductivity sensors. Still, each conductivity sensor was calibrated prior to deployment using three known conductivity standard solutions representing low, medium and high conductivities. Separate salinity readings were taken at each CTD during most site visits using a hand-held refractometer as another check against instrument drift

The sensors were also inspected for bio fouling during each site visit and cleaned if necessary. Bio fouling was a non-issue during the winter deployment.

Bathymetric surveys were accomplished using a survey vessel outfitted with a *Hydrotrac* single-beam depth sounder integrated with a *SatLoc* DGPS satellite receiver. Data strings from the GPS and fathometer were combined in real-time through the use of *Hypack Max* survey software. Horizontal control was achieved through the use of the DGPS satellite receiver. The receiver collected horizontal control data in geographical coordinates (Latitude and Longitude) every 0.10 second. The horizontal coordinate transformation between geographical coordinates and state plane was accomplished through the use of Corpscon - version 5.11.08 (USACOE, Topographic Engineering Center, Alexandria VA, 9/1997).

Multiple steps in the data reduction process incorporated quality assurance protocols which monitored data integrity as processing proceeded. The first step was to compare open air pressure sensors readings (which were recorded during each instrument visit) with the atmospheric data. Most sensors matched within 0.03 PSI of the reported atmospheric data. This average difference was applied to the raw sensor pressure data before conversion to depth.

Conversions between the sensor reading in depth and concurrent water surface elevation readings in ft NGVD (derived from post-deployment surveys and pre-removal and) were complied and compared for each instrument location. These conversion were checked to ensure that they were the same (+ / - 0.10 ft) during each individual instrument deployment. If a mooring moved position during a deployment (either by high storm flows or vandalism), this movement would show up as a large difference in the aforementioned conversion.

If there was a large difference in conversion factors, than the time series for that particular deployment period was scrutinized for anomalies in the depth readings. If a mooring did move (like it happened at Coyote Hills Slough and Stevens Creek), this movement is usually readily apparent in the time series. Post-deployment conversion factors were then applied to the time series before mooring movement, and pre-retrieval survey conversion factors were applied to the time series after mooring movement.

As a final check on data integrity, WSE time series were plotted against each and analyzed for proper relative elevations during flood, slack and ebb tide periods.

3. RESULTS AND OBSERVATIONS

This section presents results and observations of the data collection effort. Description of results includes overall deployment periods, gaps in the data sets, and time-series plots of the actual data. Supplemental data is also presented in this section, which were obtained to gain a better understanding of the South Bay and to compare against data collected by EDS. General observations are presented based on inspection of the data.

The data return rate for this monitoring effort was approximately 85%. Small gaps in data are present where the instruments were removed for cleaning; larger gaps where the sensors moved or otherwise required maintenance. There were also periods during which data needed correcting. Mooring subsidence into some channel bottoms resulted in the need to identify these periods where instrument calibration fell out of range. These gaps and corrections are described in the following sections.

Deployment periods for the nine monitoring locations (11 sensor platforms including top and bottom) are listed in Table 3-1. The periods of record generally spanned three months, from early February to the end of April in 2004.

Table 3-1
Dates of Coverage at Each Station

Location	Deployment Period
Alviso Slough	2/7/04 15:48 – 4/29/04 10:00
Coyote Hills Slough	2/7/04 11:24 – 4/29/04 6:00
Dumbarton-Top	2/6/04 13:12 – 4/1/04 14:10 & 4/5/04 14:36 – 4/29/04 8:00
Dumbarton - Bottom	2/6/04 13:12 – 4/1/04 14:10 & 4/5/04 14:36 – 4/29/04 8:00
Guadalupe Slough	2/6/04 14:48 – 4/29/04 9:12
Power Tower-Top	1/31/04 11:12 – 4/29/04 11:12
Power Tower-Bottom	1/31/04 11:12 – 4/29/04 11:12
Railroad	1/31/04 12:12 – 4/29/04 10:48
Ravenswood	1/24/04 14:12 – 4/29/04 6:36
Stevens Cr. - up	2/18/04 13:00 – 4/29/04 8:24
Stevens Cr. - down	1/24/04 16:12 – 4/29/04 8:48

3.1 Instrument Mooring Movement

Four of the eleven instrument platforms experienced movement due to either settling into the soft sediment (despite the application of large, wide mooring "feet") or episodic movement due to very high storm flows (such as the February 25, 2004 event). This movement manifests itself in the discrepancy between Post-Deployment Calibration coefficients (PDCC) and Pre-recovery Calibration Coefficients (PRCC) (Section 3.1.2)

Before a time-weighted linear interpolation can be applied to the raw data, the data were analyzed to see if the settling was episodic or gradual over the course of the deployment. In order to make this determination, data sets in question were filtered to extract the high tides.

These high water values were than compared to verified high tides recorded at the Redwood Creek acoustic tide gage (station ID# 9414523, http://co-ops.nos.noaa.gov). Differences between the collected high tides and the Redwood Creek high tides were plotted and filtered for trends. Supplemental data such as tide elevations at Redwood Creek are described in the section below.

3.2 Supplemental Data

To support data collected by EDS, supplemental data were obtained from various public agencies. These agencies include the USGS, National Weather Service (NWS), CA State Department of Water Resources (DWR) - Interagency Ecological Program (IEP), Santa Clara Valley Water District (SCVWD), and the National Ocean Services/National Oceanic and Atmospheric Administration (NOS/NOAA).

The purpose of gathering supplemental for the monitoring period was to characterize hydrologic and water quality conditions beyond the immediate study area, so that patterns in the monitoring data could be explained. For example, it is useful to know when high flows in the South Bay tributary sloughs occur so that their effect on water surface elevations (WSEs) and salinity can be identified. Supplemental data was also used to verify and correct data that was known to be in error. For instance, verified stage data at the Port of Redwood City was used to correct data from platforms that experienced settling or movement during high flows yet was still rectifiable.

Table 3-2 lists the location, data type, and agency information of each set of data. Periods of record of these data sets overlap those collected by EDS, generally extending from January to May 2004.

Table 3-2
Supplemental Data Gathered From Public Agencies.

Station location	Type	Agency & Data Program/Station
Moffett Field	Rainfall	NWS, Station 74509
Guadalupe River at Hwy 101	Flow	USGS, NWIS
Coyote Creek above Hwy 237	Flow	USGS, NWIS
Coyote Hills Slough (Alameda Creek at Union City)	Flow	USGS, NWIS
Net Delta Outlflow Index (NDOI)	Flow	DWR/IEP, DAYFLOW
Port of Redwood City	Tide/WSE	NOS/NOAS SFPORTS
USGS Marker 17	Salinity	USGS Larry Schemel

Rainfall data was collected from a NWS station at Moffett Field (Figure 4). Several moderate rainfall events impacted the monitoring area during the deployment period: February 2, February 18, February 25 and March 25, with the February 18 and February 25 storms being the most significant.

Rainfall events during the monitoring period are reflected in the stream flows of several local tributaries in the project vicinity. A time series plot comparing daily average flows in Coyote Hills Slough (Alameda Creek Flood Channel), Guadalupe River, and Coyote Creek is presented in Figure 5. This plot spans January 1 to May 1 in 2004. The rainfall events on 2/18 and 2/25 result in relatively large flow events on these dates. Daily average flow in Coyote Hills Slough for these two days were over 600 cfs, and flow in Guadalupe River on the 25^{th} exceeded 1,200 cfs. Smaller storm flows in these channels occurred on January 24, February 2, March 25, and April 19. Flows during these events were fairly small, all under 400 cfs.

Net Delta Outflow Index (NDOI) was also tracked during this period. The NDOI is overlaid with the local tributary flows in Figure 5. NDOI is an estimate of net freshwater flows from the Sacramento-San Joaquin River Delta past Chipps Island to San Francisco Bay. The index is calculated by DWR's DAYFLOW computer program as a mean daily flow and does not consider tidal fluxes. It is used here as a general barometer of hydrologic conditions in the San Francisco Bay-Delta system and as a way to compare the hydrologic regime during the interim data collection period to flow regimes during the recent several years. It is known that very large Delta outflows influence hydrodynamics and water quality of the Far South Bay such that tracking this parameter can be helpful in explaining variations in data.

From Figure 5, the NDOI hydrograph coincides with hydrographs of the other tributaries but with a 3 to 5 day lag in the NDOI. This seems a reasonable result as it is expected that rainfall runoff reaches the Far South Bay earlier via local tributaries than it does being routed through tributaries of the Delta and eventually the Delta itself. During the collection period NDOI peaked at approximately 160,000 cfs at the end of February.

General hydrologic conditions of the winter and early spring of 2004 are compared with those of several recent years. Coyote Hills Slough and the NDOI were used as surrogates for this comparison (Figure 6). Flow data from October 1998 to April 2004, capturing 5 other water year periods, were evaluated. At Coyote Hills Slough, flows during this data effort were fairly low compared to recent years. Maximum mean daily flow for 2004 was on the order of 600 to 700 cfs, while flows in other water years frequently exceeded 2,000 cfs. (water years 1999, 2000, 2002, and 2003). The largest flow in the slough during these years occurred in water year 2003 on 12/16/2002 when the peak reached almost 6,000 cfs.

In contrast, Delta outflows during the monitoring period in 2004 were large compared to recent years (Figure 6). In 2004 the peak in NDOI reached 160,000 cfs which was only exceeded in recent years by flows in January 2000 of approximately 180,000 cfs. In the winter of 1999, flows also reached approximately 160,000 cfs, but levels in other years rarely approached 100,000 cfs. While local Far South Bay tributary flows were moderate relative to the recent history, peak Delta outflows in 2004 could be characterized as above normal to high. Since it is known that large flushing events from the Delta via the North and Central Bay can have a significant impact on water quality of the Far South Bay, this is an important observation.

Tidal stage information at the Port of Redwood City (Redwood Creek) was also obtained as part of the supplemental data. This record of water surface elevations (WSE) was used by EDS to validate data inconsistencies at certain stations as noted in the Results section. A time series plot of hourly WSE at Redwood City over the monitoring period is shown in Figure 7.

Salinity data was also obtained from USGS to supplement the collected water quality data. USGS maintains a monitoring station at Channel Marker 17. Data at this location provides an additional point of comparison and a check of reasonableness of the monitored salinities. A time series of salinity levels at Marker 17 is shown in Figure 8.

3.3 Alviso Slough

The following subsections detail the results and observations of data collected at each station. Each subsection lists the instrument deployment and recovery dates, data gaps, and corrections made to the data. General observations are also provided with reference to the appropriate time series plots. Typically the observations and plots include descriptions of long term (monthly) trends and variations as well as shorter-term, intertidal variations.

The Alviso platform was located at the City of Alviso (Figure 1). The purpose of monitoring this location was to better understand the landward propagation of tidal stage and salinity in the slough. This slough receives upstream flow from the Guadalupe River, a major tributary to the Far South Bay. In Alviso Slough there were four CTD deployment and recovery blocks. These are shown below in Table 3-3.

Table 3-3
Alviso Slough Data Blocks

Data Block 1	Data Block 2	Data Block 3	Data Block 4
2/7/04 15:48 – 2/10/04 12:36	2/10/04 12:46- 3/6/04 15:00	3/6/04 15:36 – 4/1/04 13:00	4/1/04 13:36 – 4/29/04 9:00

Post deployment calibrations (PDC) and pre-recovery calibrations (PRC) for data block 3 differed by 0.25 ft, indicating that the mooring settled this distance.

Inspection of the time series plot of WSE at Alviso Slough (Figure 9) shows that higher high water levels in the slough vary between 3 and 5.5 ft NGVD depending on the phase of the moon. Lower low water levels vary between -1 to –4 ft NGVD, again depending on the phase of the moon. WSE is also influenced by rainfall runoff periods in Guadalupe River. This is evident by examining the last week of February when a storm pulse passed through the Guadalupe River (Figure 10). The rising and falling stage due to the storm flows is evident during the February 25 storm.

In general winter and early spring temperatures in 2004 at Alviso Slough varied from 11 to 24 deg. C (Figure 9). Values showed a gradual increase from the beginning of February to the end of April. This long-term variation appears to be weakly correlated with the spring-neap tide cycle. Short-term temperature variations at the slough are influenced by the semi-diurnal tide. Incoming flood tides typically coincide with cooler slough temperatures (Figure 10). However there are a few instances, particularly in April (not detailed in figures), when the incoming tide coincides with warmer recorded temperatures.

Base levels of conductivity are relatively low at this location (Figure 9). Conductivity levels vary around 1 mmho/cm. The general conversion of conductivity to salinity used by EDS (Instrumentation and Deployment Section) is not applicable for conductivities in this low range. As an alternative conversion, a simple, constant factor of 0.64 is suggested for conductivity levels less than 2 mmho/cm. This factor is an approximation of the general conversion for conductivity just greater than 2 mmho/cm, and this factor is generally accepted for conversions in the Delta where salinity is generally less than 0.5 PSU. Using this conversion, salinity levels in the slough are typically less than 1 PSU over the period of record.

Salinity fluctuations during the tidal cycle are generally small. Concentrations usually do not vary by more than 1 PSU. Exceptions to this occur when flows in the Guadalupe River are very low (approximately less than 30 cfs). Salinity levels seem to concentrate over several tidal periods and spike well above typical winter levels (Figure 10). This occurs when consecutive low flow days coincide with the spring tide. When the flood phase of the spring tide flushes salinity landward and flows are relatively low, levels approach 10 PSU in mid-February. This suggests that salinity levels during low flow periods may be significantly different than they are during wet seasons.

3.4 Coyote Hills Slough (Alameda Creek)

The station at Coyote Hills Slough, also known as Alameda Creek Flood Control Channel, was placed 1000 ft landward of the mouth of the slough. Instrument recovery blocks at the slough are shown in Table 3-4. Data were recovered in 5 periods during the monitoring effort.

Table 3-4
Coyote Hills Slough Data Blocks

Data Block 1	Data Block 2	Data Block 3	Data Block 4	Data Block 5
2/7/04 11:24 – 2/10/04 16:00	2/10/04 16:12 - 2/18/04 9:36	2/18/04 10:12 – 3/6/04 9:48	3/6/04 10:24 – 4/1/04 8:36	4/1/04 9:00 – 4/29/04 6:00

Calibration coefficients for the fourth and fifth data blocks differed by 0.47, and 0.26 feet respectively. The third data block contains data from the large 2/20/04 and 2/25/04 storms. These data have been rectified to the extent possible. Post 2/25/04 data within this block is suspect. Data from 2/19/04, 8:24 through 3/6/04, 10:24 shifts slowly downward during the course of the deployment. A linear interpolation was applied to this set with unsuccessful results.

Tidal stage during this period ranged from 3 to 5.5 ft NGVD (higher high tide) and –3 to –2.5 ft NGVD (lower low tide, Figure 11). Temperature in the slough varies generally from 7 to 18 degrees C when the creek is flowing, to as much as 27 deg. C when flows are low and possibly when the detention ponds are releasing. The temperature pattern shows a two week cyclical trend that strongly corresponds with the spring-neap cycle. Temperatures peak during the neap phase when relative tidal interchange is low, and they approach a relative minimum during the spring tide when water in the slough is more quickly flushed to the bay. Changes in temperature over this two week cycle approach 10 deg. C. The high rainfall runoff periods caused moderate changes in temperatures at this location. Temperatures in the slough decreased about 1 to 2 deg. C when the two February storm flows passed the station (Figure 12).

General salinity levels during the monitoring period showed large variations (Figure 11). Levels ranged from approximately 2 PSU to over 20 PSU. Typical levels centered between 10 to 15 PSU. These short term salinity variations probably corresponded with the tide: flood tide brings salinity into the slough, causing increases up to 10 PSU. During several of the storm periods during the monitoring effort, storm flows pushed freshwater seaward through the slough (Figure 12). As a result, there is a short-term depression in salinity that remains for approximately 1 day. This can be seen after the two larger storms in February.

There was also a distinct long-term change in salinity that occurred around February 25th that spanned tidal variations (Figure 11). Over this period salinity levels dropped from above 20 PSU to below 15 PSU, and they stayed at this level for an extended period of time. Salinity levels eventually increase just above 15 PSU at the end of the period of record, but they do not approach levels recorded in the beginning of the data set (20 PSU and above). Because levels stay depressed for an extended period of time, it is hypothesized this depression is caused by freshwater dilutions from flow coming down the watershed as well as from the Delta that are advected into the South Bay. Delta outflows approach 150,000 cfs less than a week before the beginning of the salinity depression. The timing and magnitude of high Delta outflows and the salinity depression may be an important observation of the effect of Delta outflows on the water quality of the Far South Bay.

3.5 Dumbarton Bridge – Top and Bottom

Tidal stage along with top and bottom salinity and temperature were recorded at the Dumbarton Bridge station. Table 3-5 displays data blocks defined by instrument recovery events. All PDC and PRC calibration coefficients remained unchanged for each data block. Therefore, no linear interpolations were applied to the time series. However, gaps in the data do exist due to maintenance requirements of the instrument platform.

Table 3-5
Dumbarton Bridge Top and Bottom Data Blocks.

Data Block 1	Data Block 2	Data Block 3	Data Block 4	Data Block 5
2/6/04 13:12 – 2/7/04 11:48	2/7/04 12:24- 2/18/04 11:36	2/18//04 10:24 – 3/6/04 11:36	3/6/04 12:12 – **4/1/04 14:24**	**4/5/04 14:36 –** 4/29/04 8:00

Routine instrument maintenance during the fourth site visit (4/1/04) revealed that the watertight o-ring seal in both sensors had failed, necessitating instrument removal and subsequent data gaps. Both sensors were replaced on 4/5/04 at 14:36. The 4/1/04 site visit also revealed that the main cable had loosened from the bottom anchor weight. This resulted in the sensors moving up in the water column during spring ebb tides. This movement manifested itself in pressure anomalies (starting on 3/25/04 4:24, indicating when the cable had come loose) within the time series during the following time periods:

1	3/25/04 4:24 – 7:48
2	3/26/04 4:48 – 8:00
3	3/27/04 5:36 – 9:00
4	3/28/04 7:00 – 9:19
5	3/29/04 9:00 – 11:24
6	3/30/04 9:48 – 12:24
7	3/31/04 10:24 – 13:24

The bottom conductivity and temperature sensor failed on the following dates (this data has been removed from the data set):

1	3/7/04 13:36 – 3/21/04 12:00
2	4/10/04 1:24 – 4/10/04 15:48
3	4/16/04 2:24 – 4/22/04 23:28

The tidal variation at the bridge over the period of record ranged from +3 to +5.5 ft NGVD (at higher high tides) to –2 to –5.5 ft (at lower low tides) as shown in Figure 13. Temperatures at this station varied over the period from approximately 12 to 23 deg. C. Top and bottom water temperatures sensors did not record large differences. This implies there was no persistent or strong temperature stratification during this period. Typical differences between top and bottom temperature were typically less than 1 deg. C. in February and March, and 1 to 2 deg. C during the end of March and in April.

It is interesting to note that bottom water temperatures were at times higher than those at the top (Figure 13). This "temperature inversion" occurred consistently from the end of March to the end of the monitoring period. This is in contrast to the beginning of the period when temperatures at the top of the column were higher than those at the bottom.

Also there is a consistent rise in temperature from the beginning of March to near the end of the month. The temperature rises from approximately 13 deg. C to 20 deg. C. during this time. This rise does not appear to coincide with the neap tide when the tidal exchange is relatively low.

General salinity levels ranged over the period from 12 to 23 PSU. Salinity stratification was generally on the order of 1 to 2 PSU between top and bottom sensors. It is not evident why salinity at the top of the water column is higher than at the bottom – the data were checked and re-checked to ensure that they were not being mis-labeled (top versus bottom). Comparing with Marker 17 data from the USGS, the upper sensor measurements at the bridge seem to coincide well with the lower sensor measurements at Marker 17. Possible explanations are that a flow reversal occurs near the bridge, causing lower salinity water to "upwell". A long-term depression of top and bottom salinity also was seen at this location between the end of February and early April. Salinity levels dropped from well above 20 PSU to approximately 16 PSU at the beginning of this depression. The long-term drop occurred on approximately February 28, approximately 2 or 3 days after a similar depression was recorded at Coyote Hills Slough. Again, this depression is thought to be a result of significant freshwater flows from the local watersheds and the Delta.

In general during this monitoring period, flood stages of the tide coincided with increases in salinity (Figure 14). The flood tide also corresponded with cooler water temperatures. Ranges of salinity fluctuations over the semi-diurnal tide cycle were typically on the order of 3 to 5 PSU throughout the collection period. Temperature ranges over this cycle were generally small, on the order of 1 to 2 deg. C. Greatest variation occurred towards the end of March when they varied up to 3 deg. C, a time when rainfall-runoff was largely absent.

3.6 Guadalupe Slough

A tidal gage was placed in Guadalupe Slough about three miles from the mouth of the slough. Table 3-6 displays the time period of each data block. All PDC and PRC calibration coefficients remained unchanged for each data block. Therefore, no linear interpolations were applied.

Table 3-6
Guadalupe Slough Data Blocks

Data Block 1	Data Block 2	Data Block 3
2/6/04 14:48 – 2/10/04 14:48	2/10/04 15:12 - 3/6/04 14:01	3/6//04 14:24 – 4/29/04 9:12

A tidal gage was placed in the slough to determine the extent of the tidal range during various flow conditions in the winter. Tidal stages during the monitoring period varied from 3 to 5.5 ft

NGVD (HH tide), and from just under –5 to –2 ft (LL tide) (Figure 15). Following the high rainfall runoff event on February 18, the LL tide did not drop below –1.0 ft NGVD when it should typically drop below -2.5 ft NGVD. Also, the HH tide exceeded 6.1 ft NGVD whereas it normally peaks around 5.5 ft.

Variations in WSEs over the tide at the slough were compared to those at Dumbarton Bridge in Figure 16. This two-week period at the end of February shows that high tides in the slough are approximately 0.3 to 0.6 ft higher than corresponding high tides at the bridge. Low tides during in the slough are either occasionally lower by about the same amount or similar to those at the Bridge. Note that during the period shown in Figure 16 some LL tides in the slough are slightly higher than corresponding tides at the bridge; these instances correspond to high flow events moving through the slough that do not allow WSEs to drop to normal LL tide levels.

3.7 Power Tower – Top and Bottom CTDs

The power tower was chosen as a monitoring site because of its location at the confluence of Coyote Creek and Alviso Slough (Guadalupe River). Measurements at this location reflect the combined flow and water quality of these two major tributaries. The region surrounding the tower is dynamic and complex due to the interaction of these two streams. The data generally reflect these dynamic and complex interactions.

Top and bottom salinity and temperature were recorded at the PG&E Power Tower. Data were collected in five blocks. Table 3-7 displays the time period for each block. The bottom CTD sensor did not come online until 2/18/04. Bottom salinity data were also sporadic during Block 5 when only a few measurements exist.

Table 3-7
Power Tower Data Blocks

Data Block 1	Data Block 2	Data Block 3	Data Block 4	Data Block 5
2/6/04 13:12 – 2/7/04 11:48	2/7/04 12:24 - 2/18/04 11:36	2/18//04 10:24 – 3/6/04 11:36	3/6/04 12:12 – 4/1/04 14:24	4/5/04 14:36 – 4/29/04 8:00

As shown in Figure 17 water surface elevation at the Power Tower ranged from approximately 3 to 5.5 ft NGVD at HH tide, and from–5.5 to –2 ft NGVD at LL tide. This range in spring tide reached a maximum variation on February 17 and 18 when higher high and lower low tide ranged from 6.0 to –5.5 ft.

The general range of temperatures over the monitoring period was 10 to 24 deg. C. Temperature stratification at the Power Tower was generally small. Differences in top and bottom temperatures were usually less than 1 deg. C. Even during large storm flow events in Coyote Creek and Alviso Slough temperature stratification was typically no greater than 1 deg. C.

Water temperatures at this location varied from approximately 12 deg. C. in the beginning of February to about 24 deg. C at the end of the monitoring period. There is a significant warming trend in the record from the beginning of March to the third week in March. During this time the temperature increases from 13 to 21 deg. C. Before this, temperatures are relatively constant at approximately 12 to 14 deg. C. The rise in temperatures in March may be a result of a lack of relatively cooler storm runoff from Far South Bay tributaries and the general warming during neap tide that occurs in the South Bay. Even after the neap period passes, the rising trend continues instead of cooling as is does at other locations (particularly Coyote Hills Slough) probably due to the poor flushing characteristics of the Far South Bay.

Top and bottom temperatures showed a reverse stratification, with cooler temperature closer to the water surface. The temperature difference was usually small, on the order of 1 deg. C. Although reverse temperature stratification can result in unstable vertical density gradients in the water column, this regime is possible particularly if salinity stratification is strong. Over the semi-diurnal cycle, cooler temperatures typically coincided with high tide while warmer temperatures were recorded during low tide (Figure 18).

General salinity concentrations over the collection period ranged from 2 to 20 PSU. The high rainfall runoff periods in February cause short term salinity to decreases 2 to 4 PSU. Concentrations rise back to their ambient levels after these storm flows within a 24 hours or less. The general pattern of salinity seems to be correlated to freshwater inflows from the Delta. The long term pattern of salinity drops from approximately 18 PSU around February 27 to 14 PSU and stays at roughly this level to the end of the period. Very high outflows from the Delta are recorded beginning February 21. Delta flows can be advected by the tide to the Far South Bay. If this is the cause of the depression in salinity, it appears to take almost 1 week. Complete dilution of salinity in to the Far South Bay appears to occur after approximately 2 weeks.

Short tem salinity at this location exhibits an unusual pattern (Figure 18), with surface concentration being higher during high water, and nearly equal to bottom concentration at low water. High tide causes surface salinity levels to be about 5 PSU higher than bottom salinity levels; differences are smaller during low tides (up to 2 PSU).

This dynamic pattern of salinity stratification may be due to the vertical variation of tidal exchange. If salinity of the general South Bay is higher than those of tributaries and if salinity at the top of the water column is higher during flood tide, this implies that tidal exchange in the slough is greater near the water surface than it is towards the bottom of the water column. Figure 18 also indicates that top salinity levels exhibit a much greater variation in concentration than that at the bottom.

3.8 Railroad Bridge (Coyote Creek)

A CTD station was placed in Coyote Creek at the Railroad Bridge. Table 3-8 shows the time period for each data block.

Table 3-8
Railroad Bridge

Data Block 1	Data Block 2	Data Block 3
1/31/04 12:12 – 2/10/04 13:24	2/10/04 14:24- 4/1/04 11:36	4/1//04 12:24 – 4/29/04 10:48

Calibration coefficients for the third deployment of the Railroad bridge sensor (data block 3) were off by 0.36 ft (see Section 3.1.2). This discrepancy in PDC and PRC coefficients is due to the mooring settling over the course of the deployment.

Mooring settling was determined to be fairly uniform over the course of the deployment; as a result, a time-dependant linear interpolation was applied to the dataset with satisfactory results (see Figures B-6).

Tidal variation ranges from approximately 3 to 5.5 ft NGVD (HH) and –5.5 to –2 (LL) ft NGVD, as shown in Figure 19. The WSE peaked at 6.3 ft NGVD on February 18, coinciding with the relatively large flow of 250 cfs in the creek.

Temperatures fluctuated over the monitoring period from 10 to 25 deg. C. Over the semi-diurnal tide, water temperatures varied 3 to 5 deg. C (Figure 20). Flood tides corresponded to cooler temperatures. During the transition to flooding tide, temperature would decrease gradually to a minimum coinciding with the peak of the high tide before gradually increasing again.

General salinity fluctuated from 2 to 20 PSU over the monitoring period. Levels also strongly varied with the tide; flood tides raised salinity levels and ebb tides coincided with drops in salinity. Salinity concentrations often ranged from 2 to 20 PSU through the tide cycle. During storm events, salinity levels decreased significantly, often approaching only 5 to 10 PSU as opposed to 20 PSU during non-storm flow periods.

3.9 Ravenswood Slough

A tidal stage station was deployed at Ravenswood Slough to assess the variation in tidal range between the main channel of the South Bay and this location. Table 3-9 displays the time period for each data block.

Table 3-9
Ravenswood Slough Tidal Stage Data Blocks

Data Block 1	Data Block 2	Data Block 3	Data Block 4
1/24/04 14:12 – 1/31/04 9:12	1/31/04 9:36- 2/18/04 10:36	2/18//04 11:24 – 3/6/04 10:48	3/6//04 11:12 – 4/29/04 6:36

Calibration coefficients for the second, third and fourth deployments of the Ravenswood Slough sensor (data blocks 2 - 4) were off by 0.77, 0.70 and 0.47 ft respectively (see Section 3.1.2). As stated in Section 3.3.5.1, these discrepancies in PDC and PRC coefficients are due to the mooring settling over the course of each of the deployments. The settling rate for data blocks 2 and 4 was gradual; thus enabling the interpolation to be a good fit. Data block 3 experienced gradual settling and slight episodic movement from the 2/25/04 storm.

General variation of the WSE at this location was 3 to 5.5 ft (HH) NGVD (Figure 21). The station was exposed at most tides because the slough was very shallow or dry during these times. Comparison of tidal range at this station and the stage at Dumbarton Bridge shows that high tide elevations in the slough are at times up to 0.3 ft higher than at the bridge, plotted in Figure 22. Typically, however, differences are on the order of 0.1 ft or less. Shifts in the phase of the tide are also small between these locations.

3.10 Stevens Creek Upstream and Downstream

Stations at the upstream and downstream sites in Stevens Creek included tidal stage measurements. Table 3-10 displays the time period for the upstream station data block.

Table 3-10
Stevens Creek Upstream Data Blocks.

Data Block 1	Data Block 2
2/18/04 13:12 – 3/6/04 12:48	3/6/04 13:12 - 4/29/04 8:24

The sensor was deployed on 1/24/04 and then visited on 2/7/04 for routine download and maintenance. This site visit revealed a malfunctioning pressure sensor element and thus no data. The instrument was removed, repaired and re-deployed on 2/18/04 at 13:12.

The stream flow from the 2/25/04 storm was strong enough to move the entire mooring approximately 30 meters downstream. The mooring was recovered and redeployed in the original position. Data from 2/25/04 4:00 to 2/25/04 18:00 has been removed from this data set; instrument movement was too vigorous during this period to establish a stable, reliable sensor datum.

Table 3-11 displays individual data block time periods for the downstream station deployment. All PDC and PRC calibration coefficients remained unchanged for the downstream data blocks. Therefore, no linear interpolations were applied.

Table 3-11
Stevens Creek Downstream Station Data Blocks

Data Block 1	Data Block 2
2/18/04 13:12 – 3/6/04 12:48	3/6/04 13:12 - 4/29/04 8:24

The downstream (seaward) gage was exposed to the atmospheric pressure at low stage levels, thus the apparent bottoming at 0.0 ft datum level (Figure 23). The rest of the sinusoid stage variations of the two stations tracked one another very closely.

Higher high tide ranged from 3 to 5.5 ft NGVD at both u/s and d/s stations. At the u/s station, lower low tide ranged from just under –0.5 ft to 0.0 ft NGVD. The d/s station data was often exposed at low tides such that the data record shows minimum elevations of 0 (exposure to atmospheric pressure).

Differences in WSE and in tidal phase, between upstream and downstream stations, are presented on Figure 24. Comparing these elevations with those at Dumbarton Bridge reveals that creek elevations are slighter higher than elevations at the bridge during high tides. Differences vary over the period from 0.1 to 0.6 ft. There is also a slight phase shift in the tidal signal with the bridge elevations leading creek elevations by approximately 15 minutes.

3.11 Tidal Stages

Tidal stages showing differences in tidal range and timing at various locations in the study area are presented in

Figure 25. Locations plotted include Coyote Hills Slough, Ravenswood Slough, Dumbarton Bridge, Stevens Creek, Power Tower, Guadalupe Slough, and Alviso Slough. The time selected is a 24 hour period on March 20, 2004 which is close to a spring tide associated with a new moon. This date was chosen because there are no significant runoff events in the creeks that might alter the tidal signal, and the tidal variation should be relatively large.

Results indicate that tides (WSE and phase) at Ravenswood, Coyote Hills and the Dumbarton are very similar. Locations in the Far South Bay lag the Bridge location by about 30 to 60 minutes. Amplification of tides in the Far South Bay is also evident from the figure. At noon the high tide at Coyote Hills Slough peaks at 4.2 ft NGVD while the peak at the Power Tower is approximately 5.2 ft NGVD. At Alviso Slough, the tide at this time reaches 5.34 ft NGVD.

3.12 Summary of Observations

Table 3-12 below summarizes conditions at the stations monitored for this study. The table lists ranges of HH and LL tides, and general ranges of temperature and salinity over the monitoring period. Also listed in the table are general changes in water quality due to storm events. Other general notes of interest are made for each station in the right column of the table.

Table 3-12
Summary Conditions During Monitoring Period

	Range in WSE ft NGVD		Range in Temp and Salinity		Effect of Storm Flows		
Location	**HH**	**LL**	**Temp., deg. C**	**Salinity, PSU**	**Temp., deg. C**	**Salinity, PSU**	**Notes**
Alviso Slough	3 to 5.5	-4 to -2.5	11 to 24	1 to 2	Decrease 1 to 2	Decrease 1	WSE influenced by storm flows in slough; Max. high tide stage generally occurs at this station. Salinity generally very low in winter. Salinity can approach 10 PSU during low flows.
Coyote Hills Slough	3 to 5.5	-3 to -2.5	7 to 27	10 to 15	Decrease 1 to 2	Decrease approx. 8	Storm flows result in more pronounced variation in salinity over tidal cycle. Salinity level drop at end of Feb may be due to Delta freshwater flushing
Dumbarton – Top/Bottom	3 to 5.5	-5.5 to -2	11 to 24	12 to 23	Negligible	Decrease 5	Storm periods resulted in smaller semi-diurnal variation of temperature. Long term drop in salinity may be due to Delta flushing.
Guadalupe Sl	3 to 5.5	-5.0 to -2	NA	NA	NA	NA	HH and LL tides can exceed those at DMB by approx. 0.3 ft.
Power Tower-Top	3 to 5.5	-5.5 to -2	10 to 27	2 to 20	Small	Short term ~1 day flush	Delta freshwater flows lower salinity approx 5 PSU from end of Feb through Apr. Higher tidal exchange at surface than bottom. Very dynamic conditions noted.
Power Tower-Bottom	-	-	-	-	-	-	Bottom values similar to those at top; Very sporadic values in April
Railroad Bridge (Coyote Creek)	3 to 5.5	-5.5 to -2	10 to 25	2 to 20	Small	Decrease up to 10	Large tidal variation in salinity and temperature at this location in winter.
Ravenswood	3 to 5.5	-0.5			NA		Signs of platform settling
Stevens Cr – d/s	3 to 5.5	NA	NA	NA	NA	NA	Elevations d/s typically higher than those u/s. Elevations in the creek generally higher than DMB by 0.1 to 0.6 ft. Approx. 15 minute lag in tidal stage at creek compared to DMB. Gage exposed at low tide.
Stevens Cr – u/s	3 to 5.5	-0.5 to 0	NA	NA	NA	NA	Elevations u/s higher than those d/s usually only during coinciding high creek flows and low tide.

4. CONCLUSIONS

The data collection effort was successful. Proper monitoring and instrumentation protocols were used and appropriate quality assurance measures were taken to produce a comprehensive dataset. Loss of data was minimized, and errors in records were rectified to the extent possible.

Data collected in this monitoring effort can serve many purposes. It captures previously undocumented details of hydrodynamic and water quality variation at key locations in the Far South Bay during a wet season (winter-spring of 2004). These data can be used to guide numerical model development and as a reference to guide additional monitoring efforts.

Based on observations of the data collected, the following recommendations for future work are suggested:

1. Variations in top and bottom salinity and in tidal stage at several key locations such as Dumbarton Bridge and Alviso Slough may be significantly different during the dry weather periods than during wet-weather period. Therefore, monitoring should include dry weather periods, the transition periods between dry and wet season, and additional wet weather periods.
2. Establishing additional *salinity* monitoring locations will assist in better understanding circulation and hydrological conditions in the Far South Bay. Recommendations for additional locations are:
    - Between the Power Tower location and the mouth of Artesian Slough, to understand the effects of freshwater flow on salinity (including discharges from the San Jose/Santa Clara Water Pollution Control Plant) ;
    - East mudflats (near the mouth of Mowry Slough) ;
    - West mudflats (near the mouth of San Francisquito Creek) ;
    - Concurrent measurements at San Mateo Bridge and Bay Bridge
3. Short-term real time measurements of *salinity* at several locations, to determine circulation characteristics, should be made concurrent with the static gage locations. This will also help significantly in developing and validating numerical models and other analytical tools.
4. Measurements of *suspended sediment* (using optical backscatterance sensors, and/or ADCPs) should also be made over the mudflats, and in waterways which contribute significant sediment to the Far South Bay (see memorandum in Appendix A).
5. Measurements of *wind wave characteristics* along the margins of the Far South Bay, to understand daily and seasonal variations in wind waves, which will help in understanding the variation in suspended sediment observations.
6. Measurements of *tidal flux* across Dumbarton Bridge which will help in estimating the tidal prism of the Far South Bay.

5. REFERENCES

Interagency Ecological Program (IEP) – Data Vaults, http://www.iep.ca.gov/data.html

National Weather Service, online data sets – http://www4.ncdc.noaa.gov

NOAA/NOS PORTS CO-OP online database, San Francisco Bay, Redwood City Port. http://www.co-ops.nos.noaa.gov/PORTS_Archives/PORTS_DataHist.html

Santa Clara Valley Water District, ALERT System Real-Time Data http://alert.valleywater.org/

U.S. Army Corps of Engineers, Corpscon Technical Documentation and Operating Instructions, Topographic Engineering Center, Alexandria, VA, September 1997.

USGS NWIS WaterData Website (streamflow), http://waterdata.usgs.gov/nwis

USGS Water Information on San Francisco Bay & Delta, various online links at http://sfbay.wr.usgs.gov/access/water.html

FIGURES

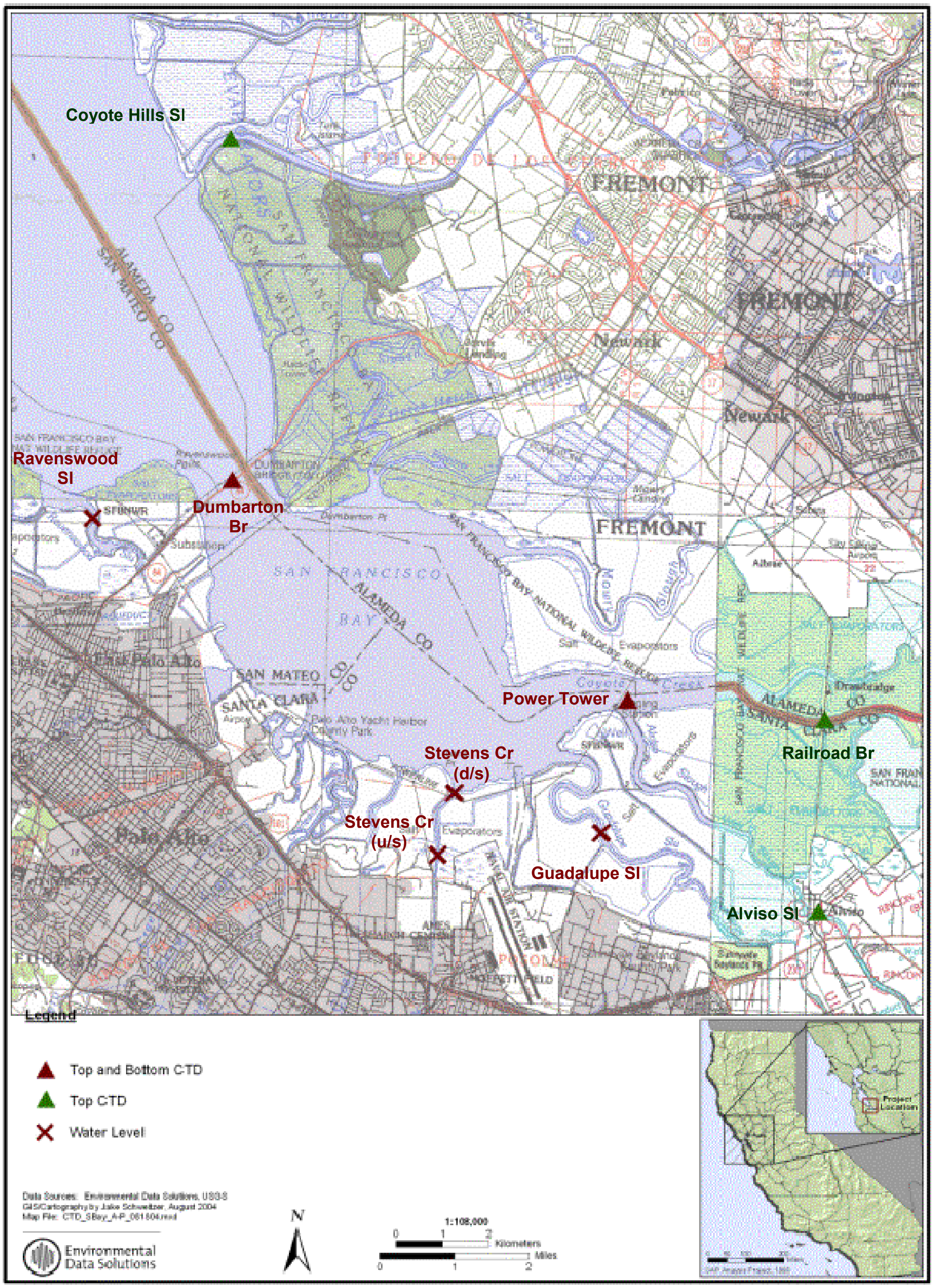


Figure 1
Instrument Locations in the Far South Bay

Figure 2
Bottom-Mounted Mooring.

Figure 3
Dumbarton Bridge Sensor Canisters After Retrieval.

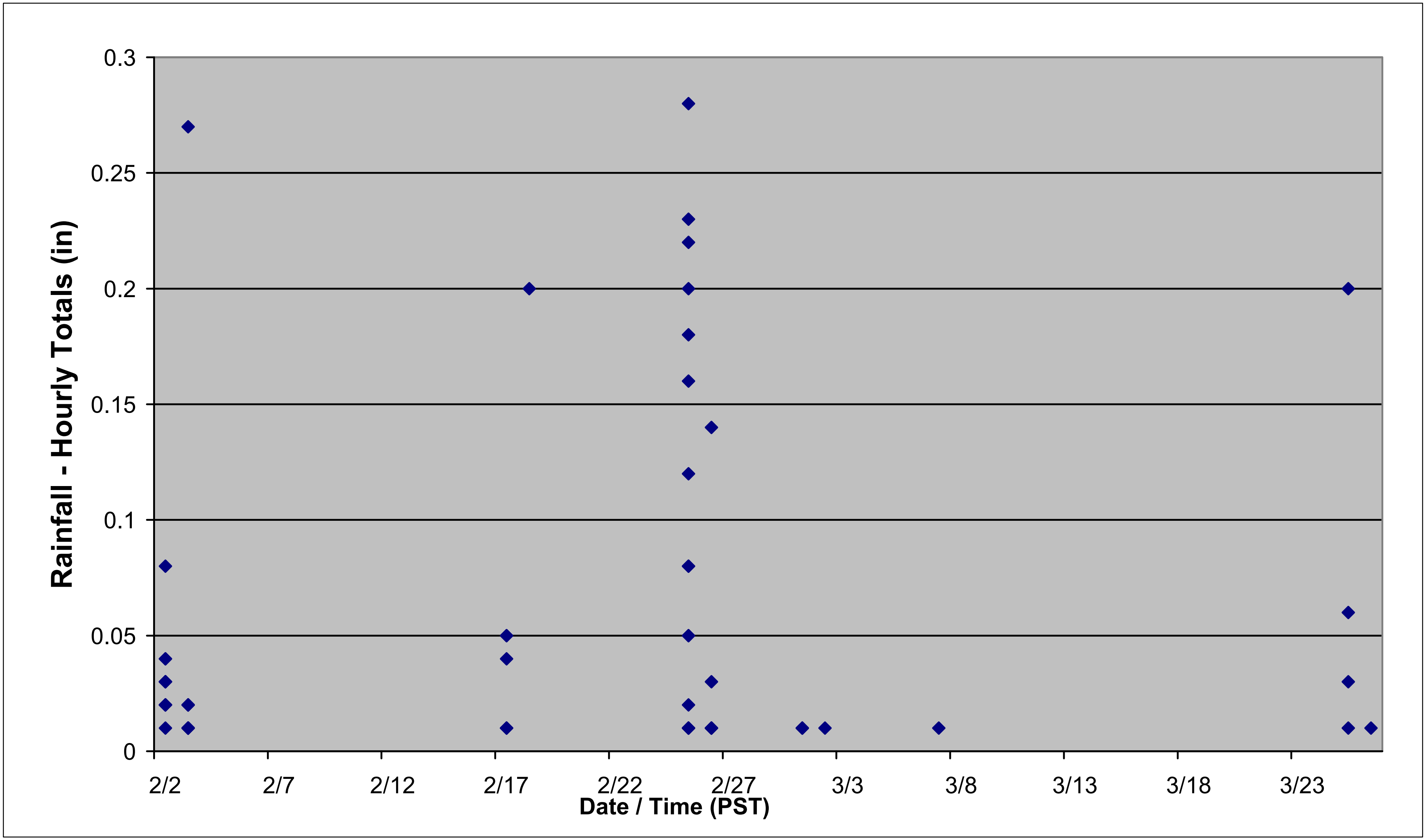


Figure 4
Hourly Rainfall Totals at Moffett Field (source NWS – Moffett Field Stn. #74509)

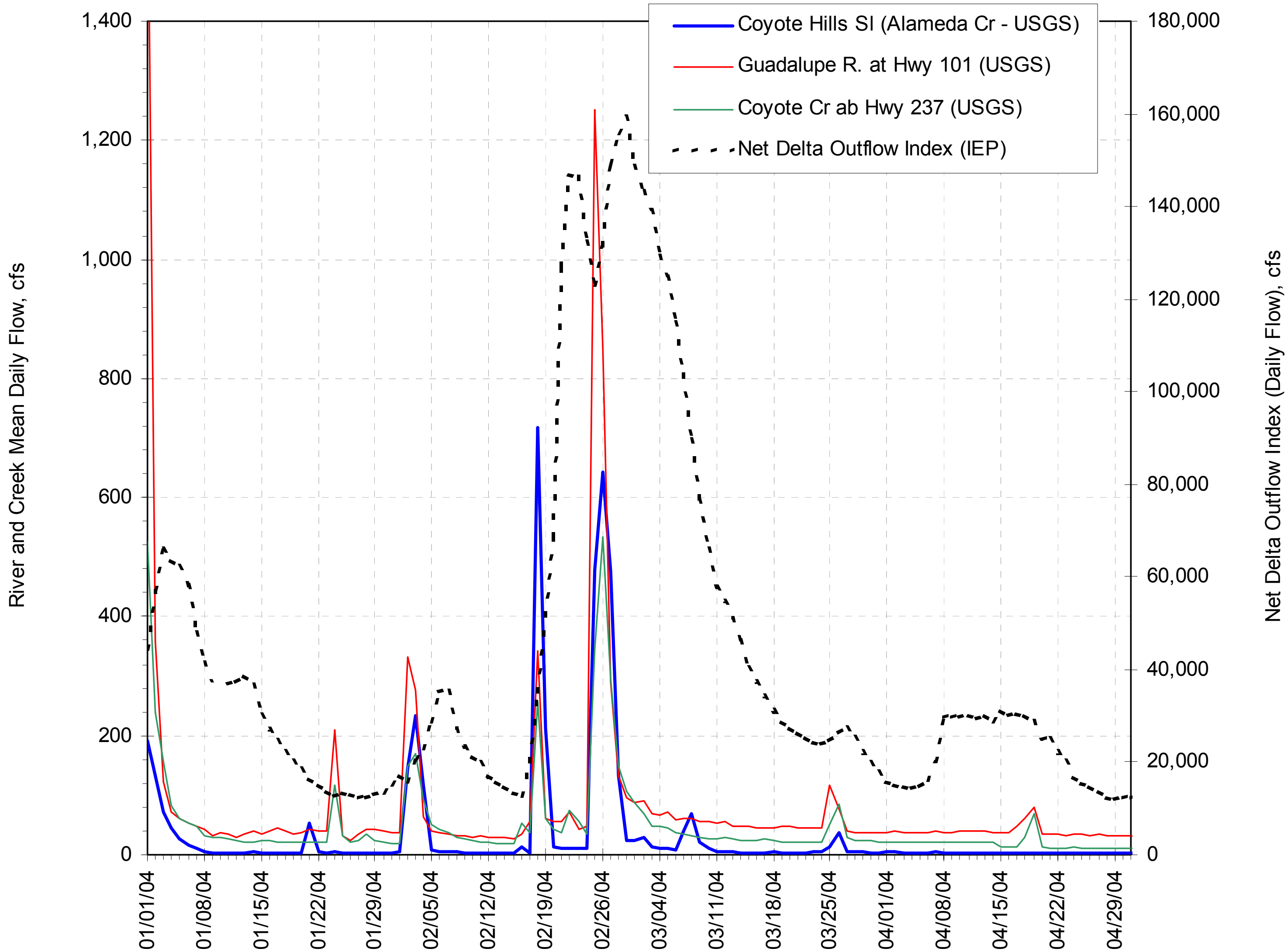


Figure 5
Time Series of Daily Stream Flows at Several Major South Bay Tributaries During the Monitoring Period.

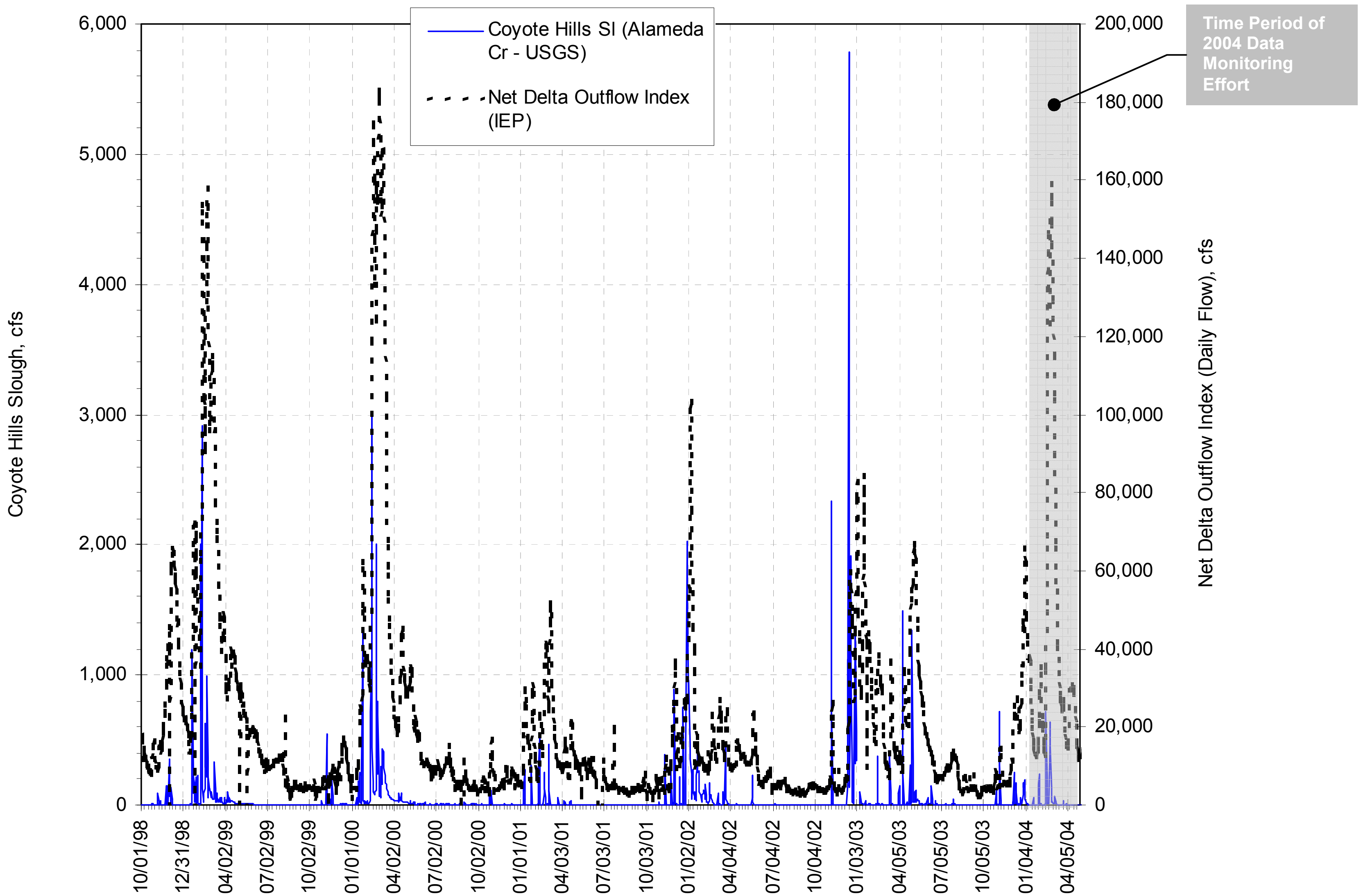


Figure 6
Recent History of Mean Daily Stream Flows at Coyote Hills Slough (Alameda Creek) and Delta Outflows (NDOI).

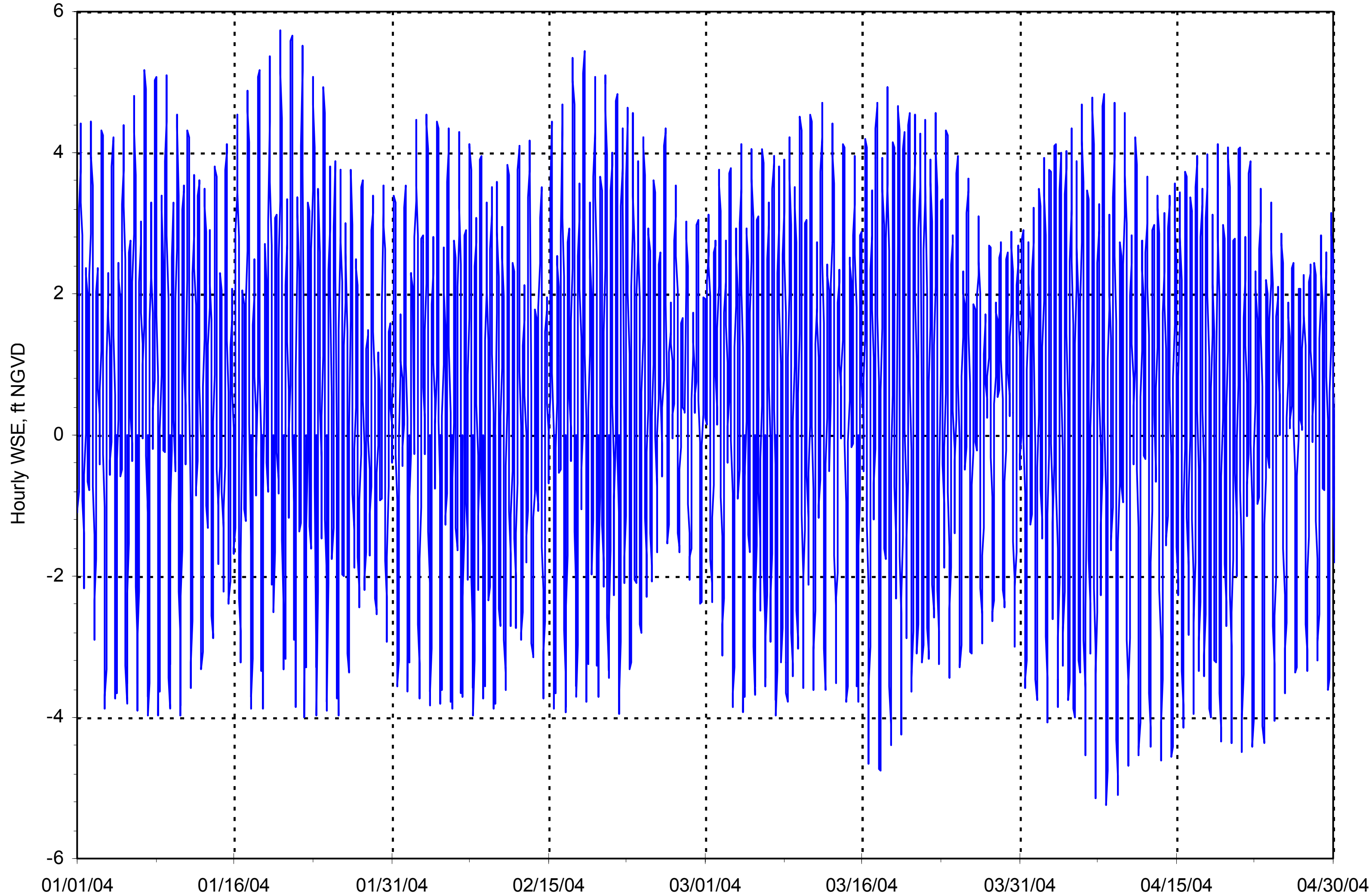


Figure 7
Hourly Water Surface Elevation at Port of Redwood City (Redwood Creek) During 2004 Monitoring Period.

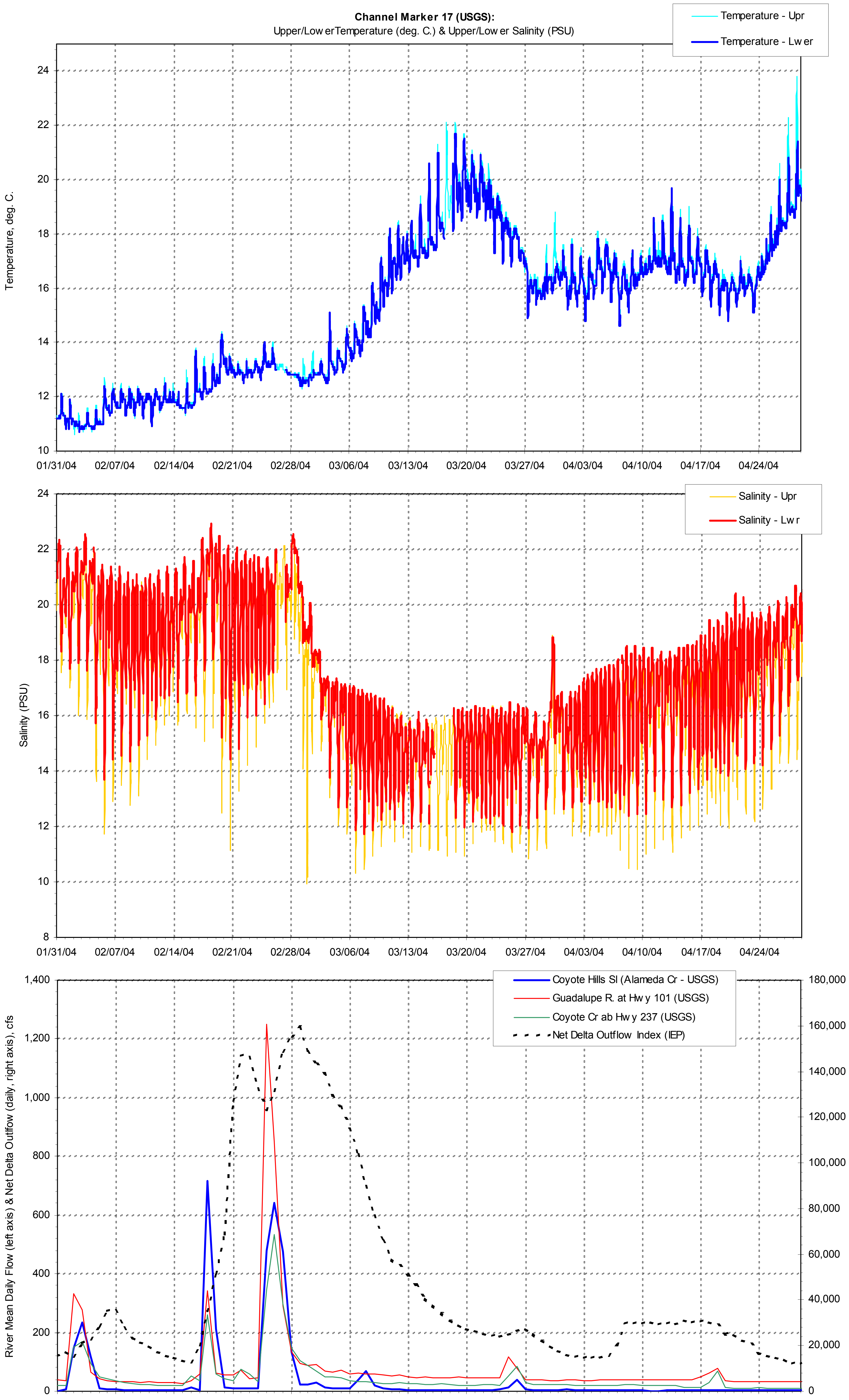


Figure 8 Time Series of Upper and Lower Temperature and Salinity at Channel Marker 17, maintained by USGS.

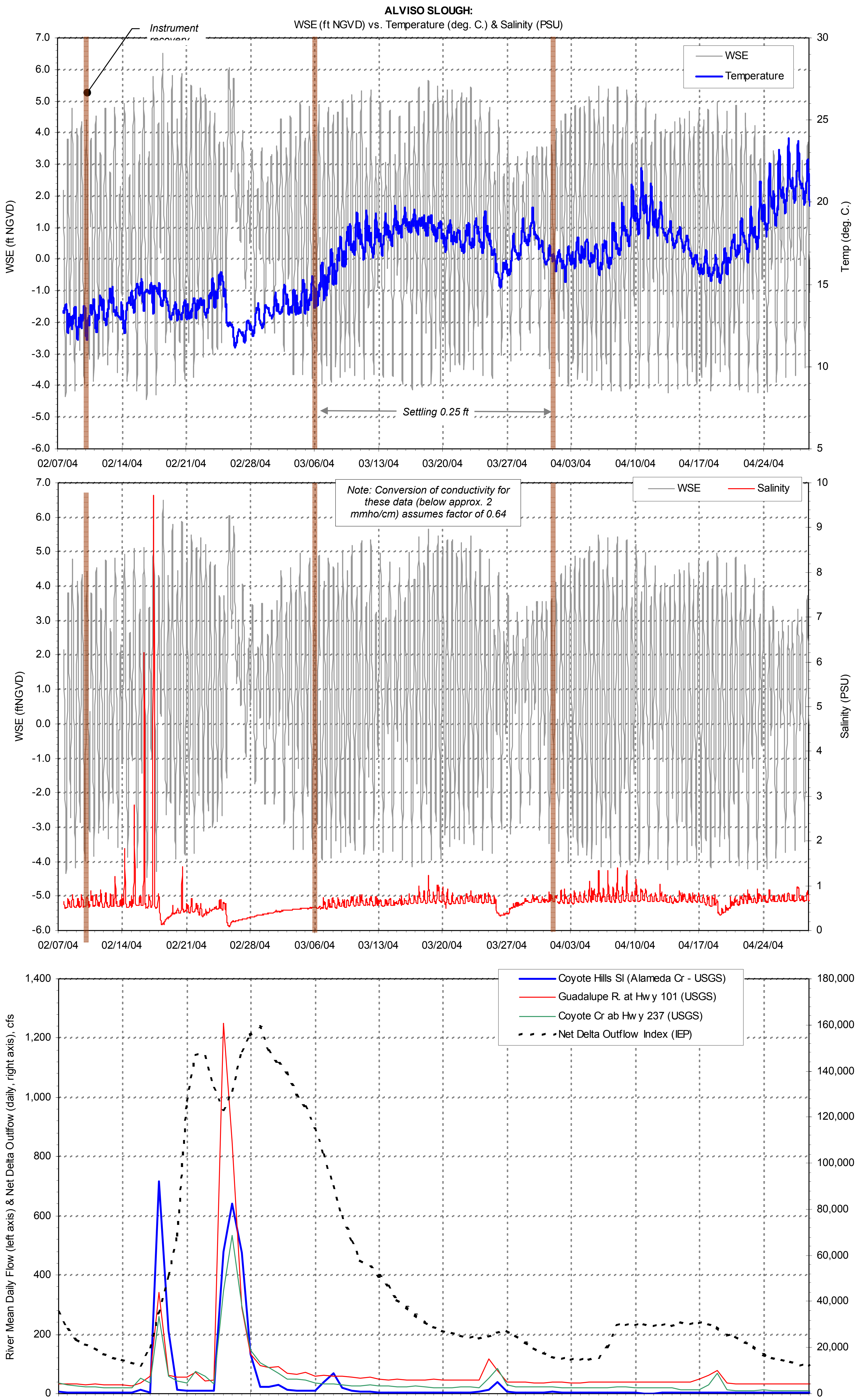


Figure 9. WSE, Temperature and Salinity at Alviso Slough, February to April, Shown With Stream and Delta Flows.

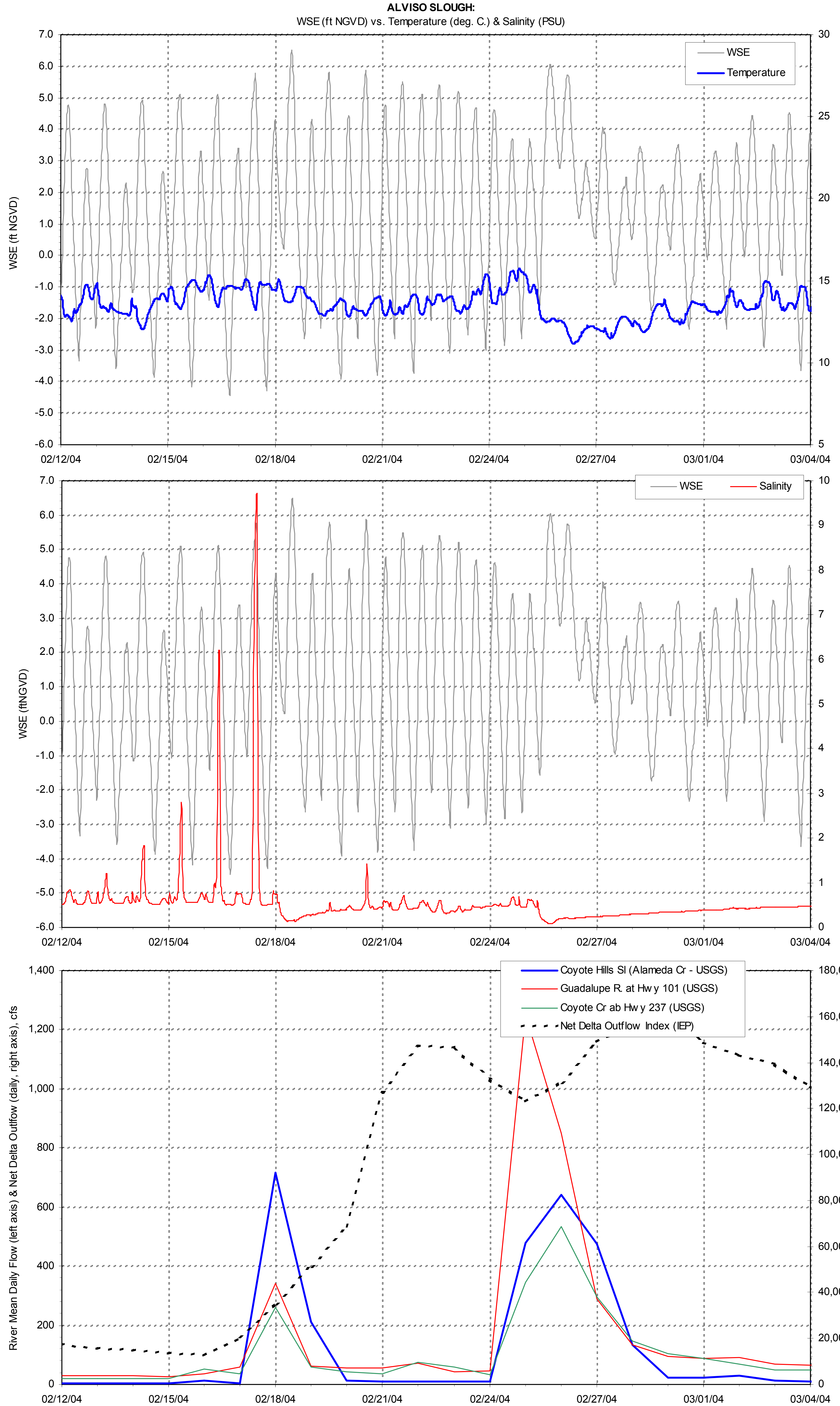


Figure 10. WSE, Temperature and Salinity at Alviso Slough, February 2004, Shown With Stream and Delta Flows.

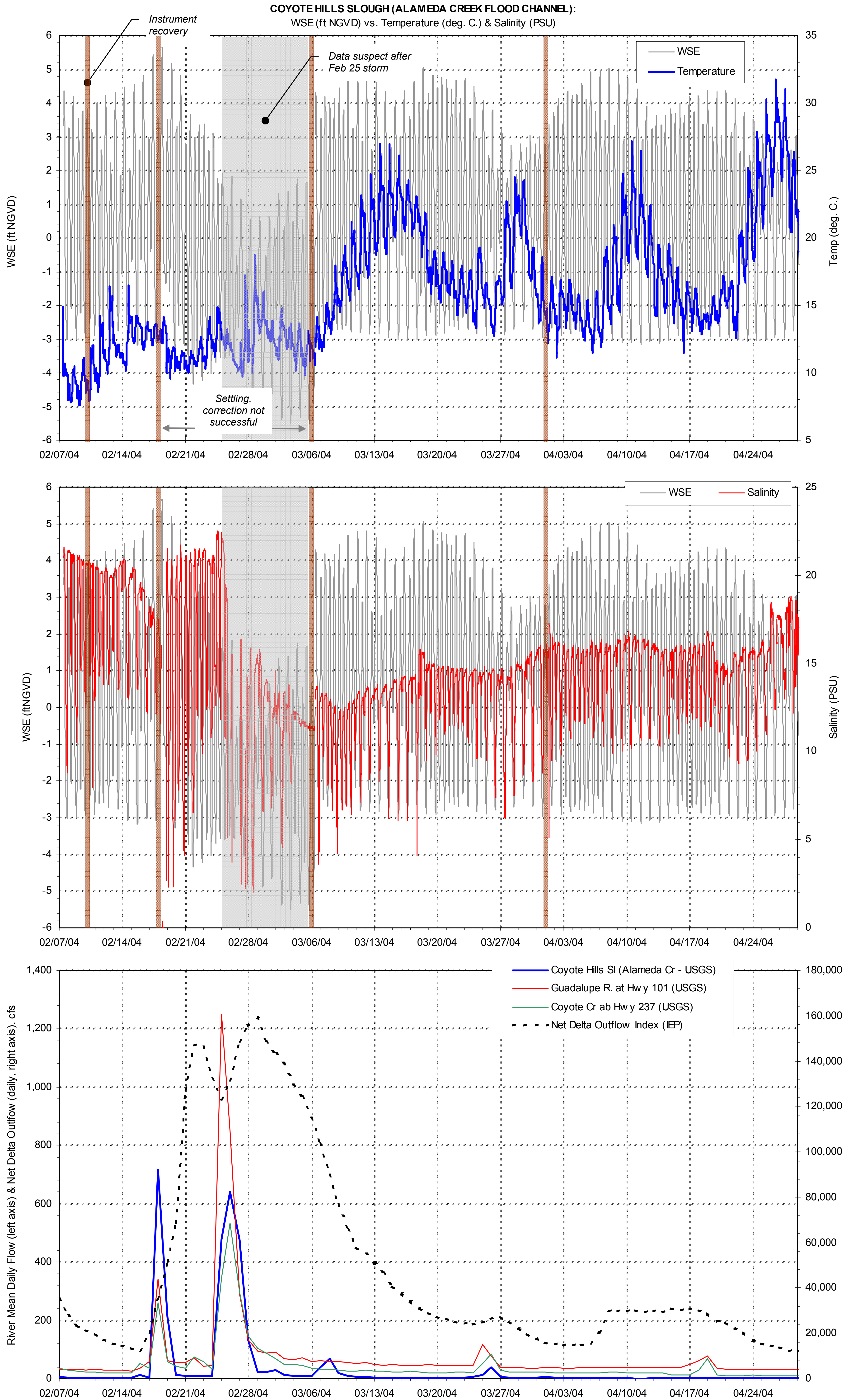


Figure 11. WSE, Temperature, and Salinity at Coyote Hills Slough (Alameda Cr.), February to April 2004, With Stream and Delta Flows.

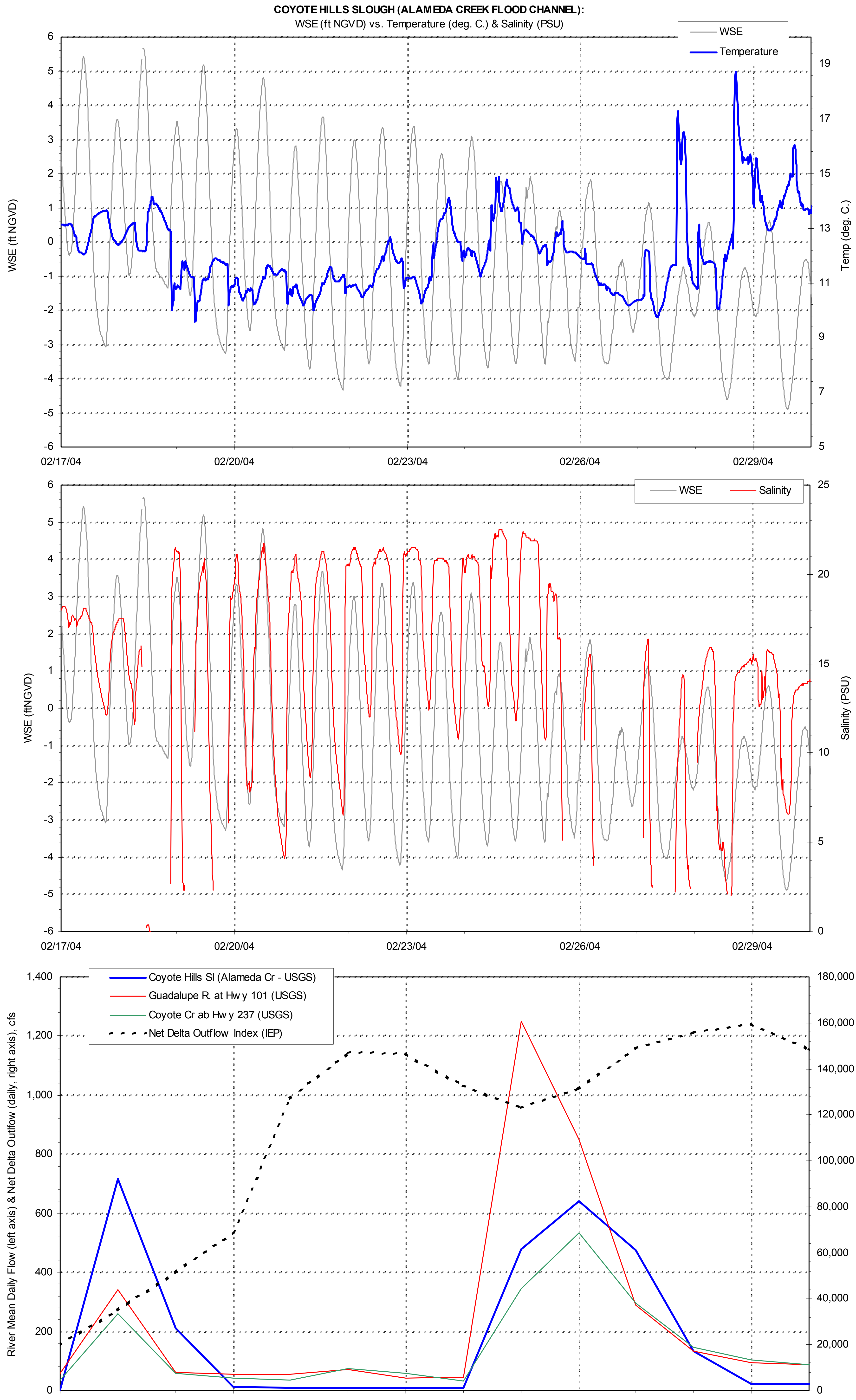


Figure 12. WSE, Temperature, and Salinity at Coyote Hills Slough (Alameda Creek), February 2004, With Stream and Delta Flows.

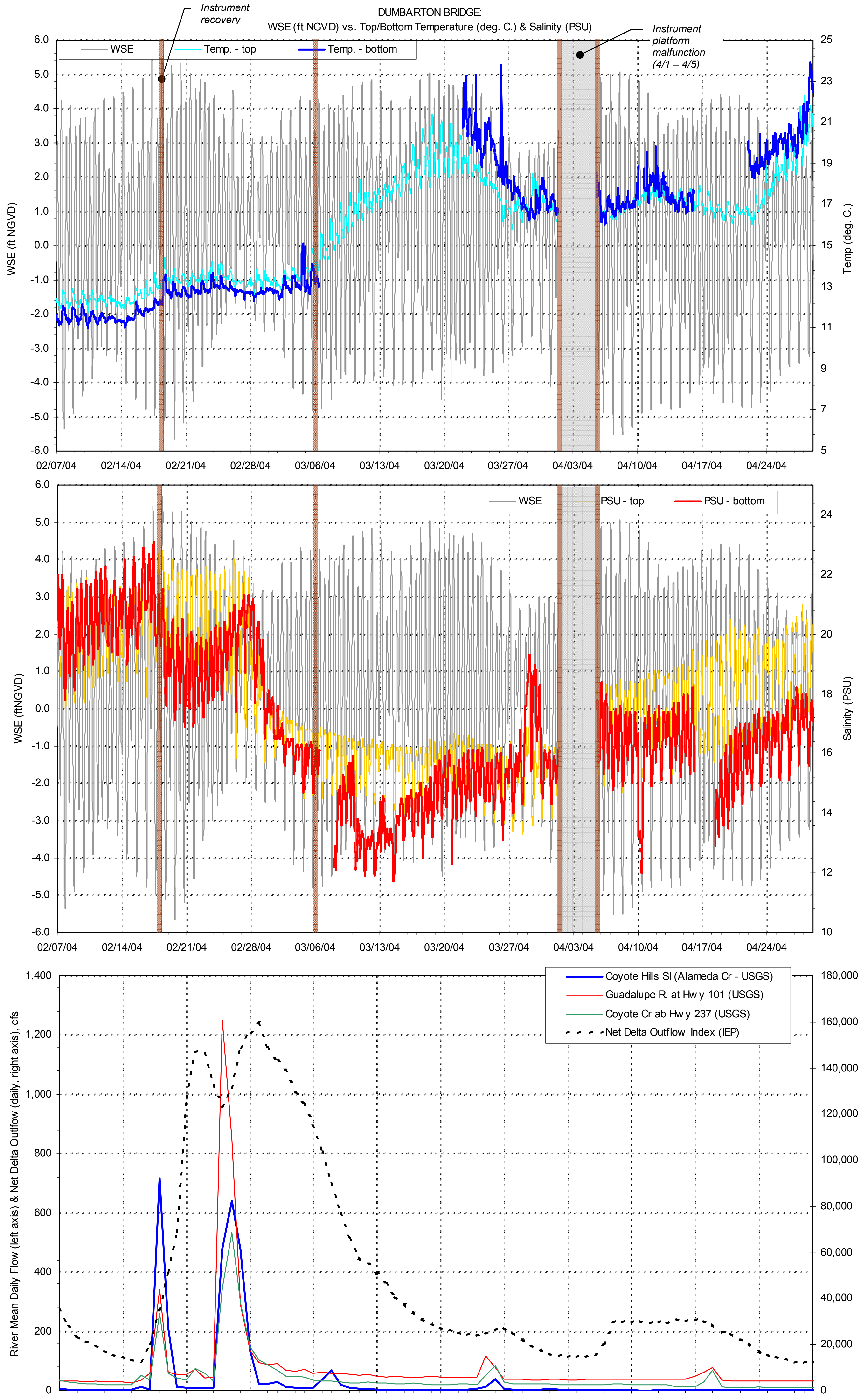


Figure 13. WSE, and Top/Bottom Temperature and Salinity at Dumbarton Bridge, February to April 2004, With Stream and Delta Flows.

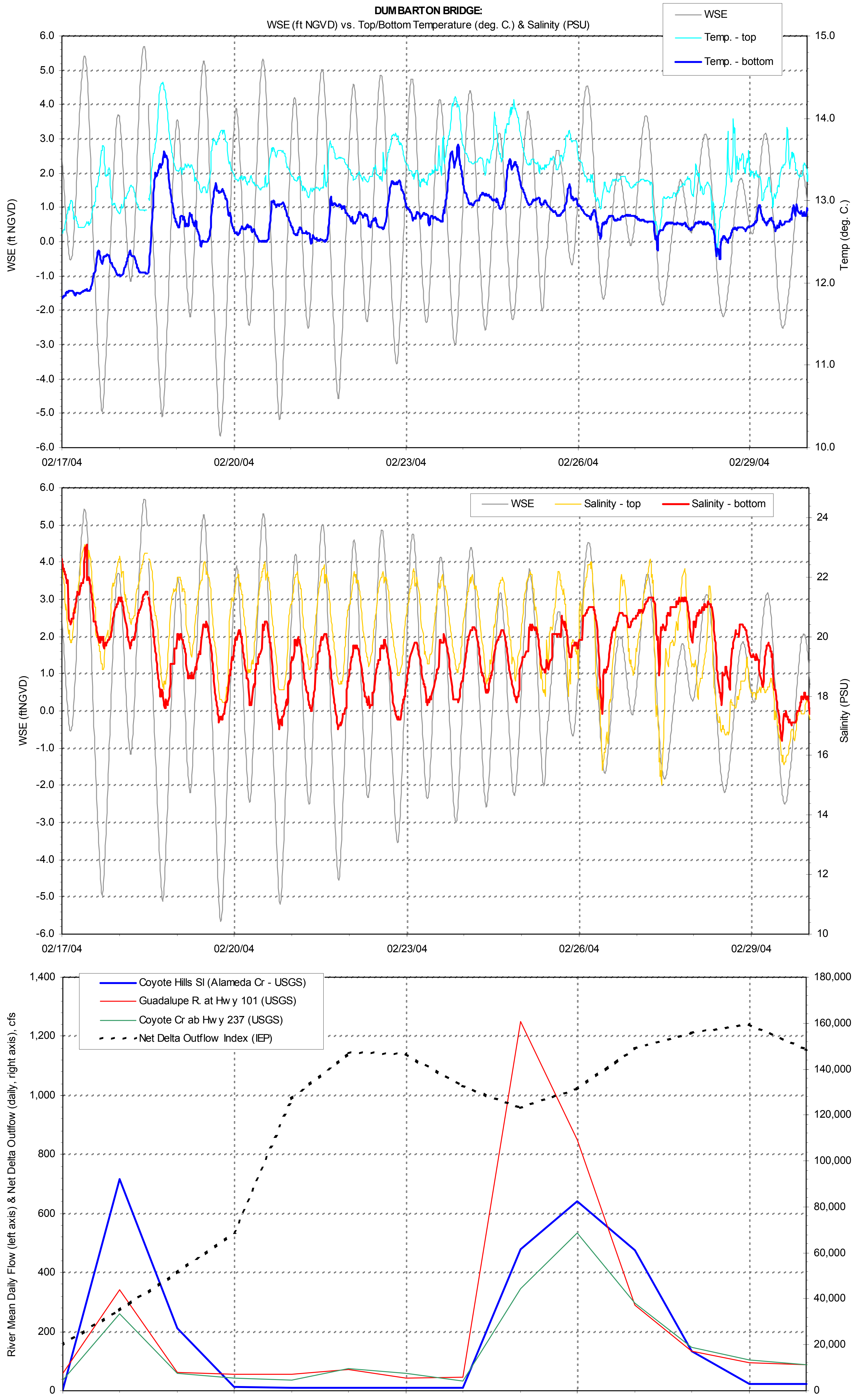
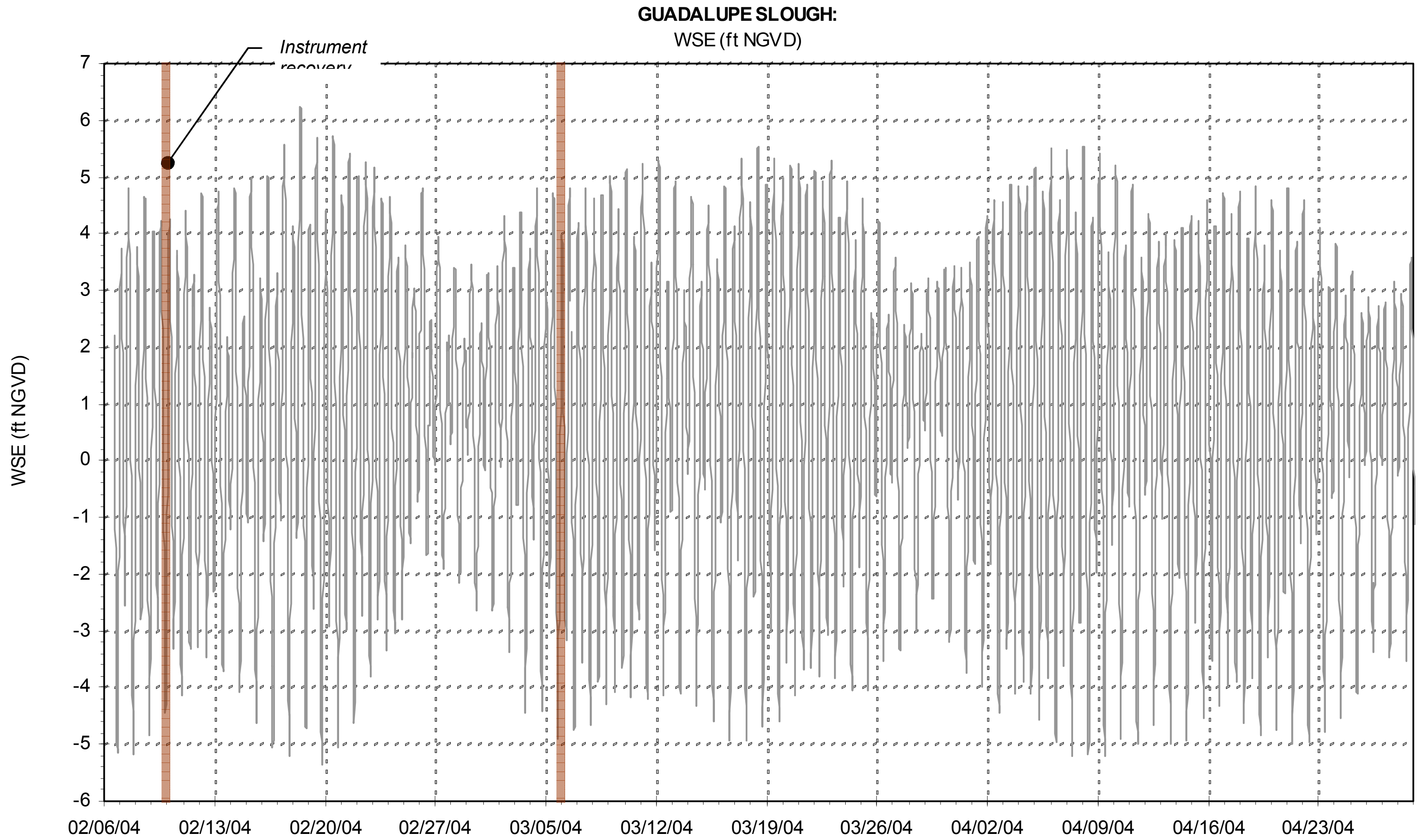


Figure 14. WSE, and Top/Bottom Temperature and Salinity at Dumbarton Bridge, February 2004, With Stream and Delta Flows.



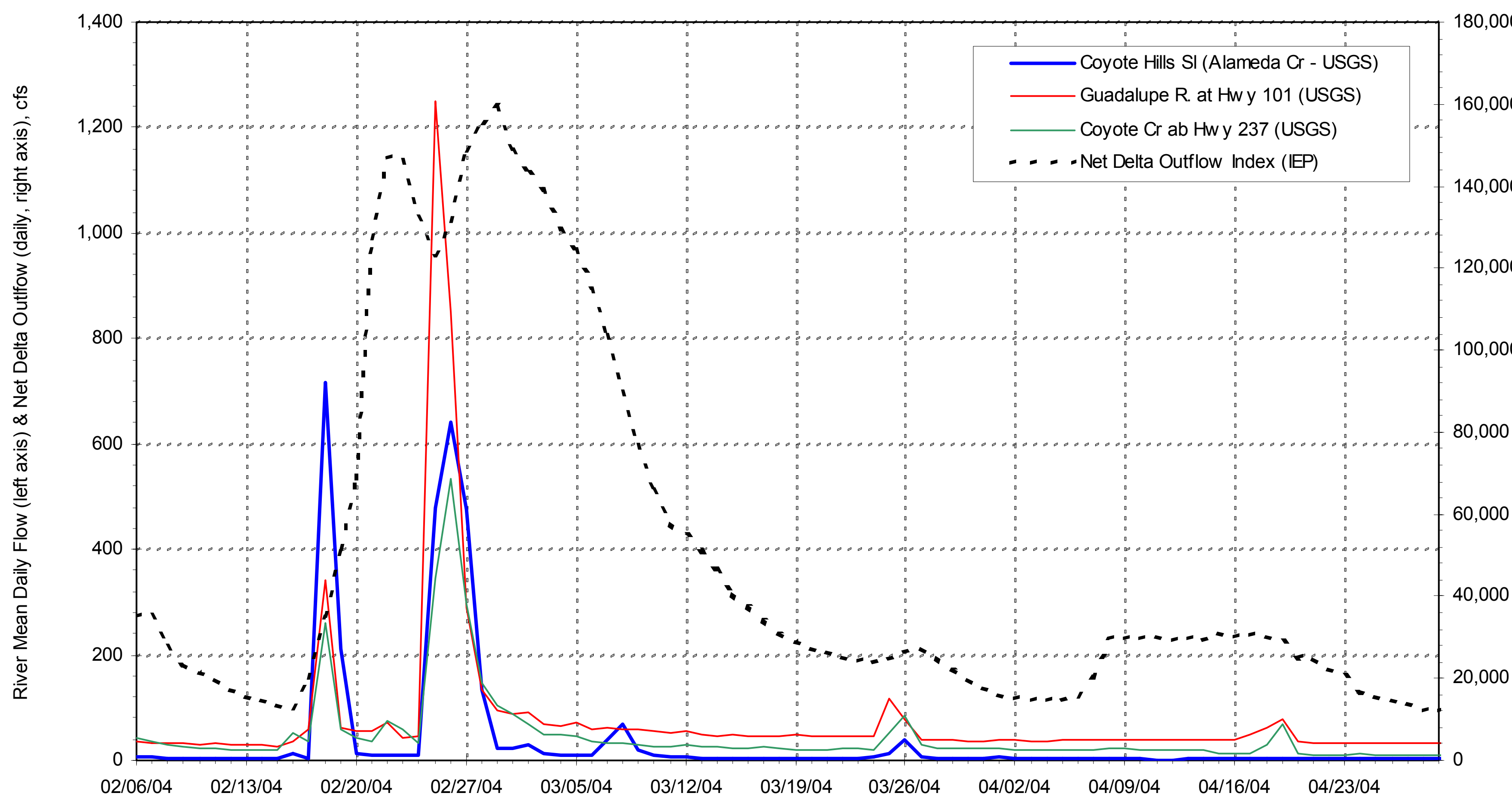
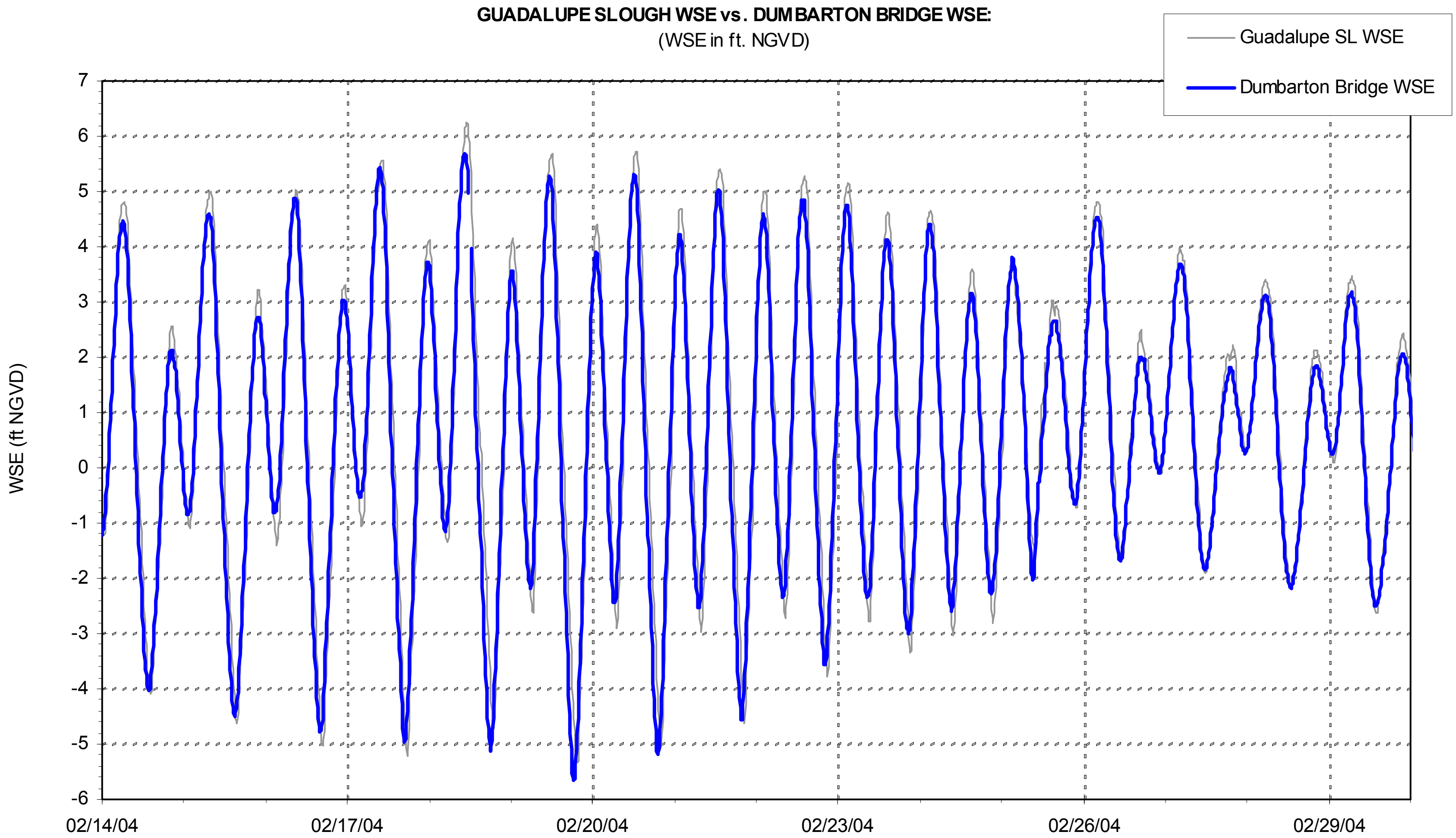


Figure 15. WSE at Guadalupe Slough, February to April 2004, Shown With Stream and Delta Flows.



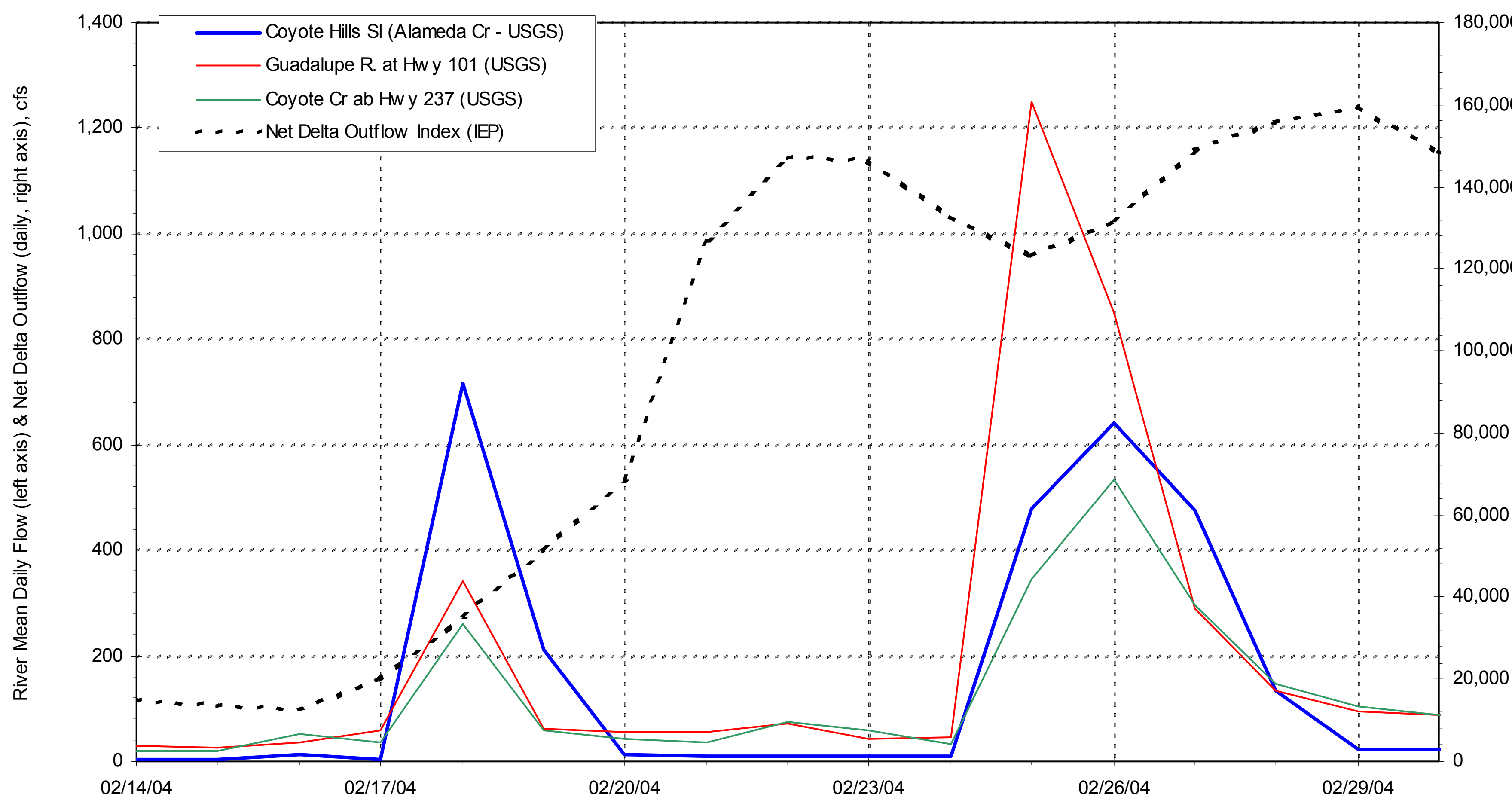


Figure 16. WSE at Guadalupe Slough and at Dumbarton Bridge, February 2004, Shown With Stream and Delta Flows.

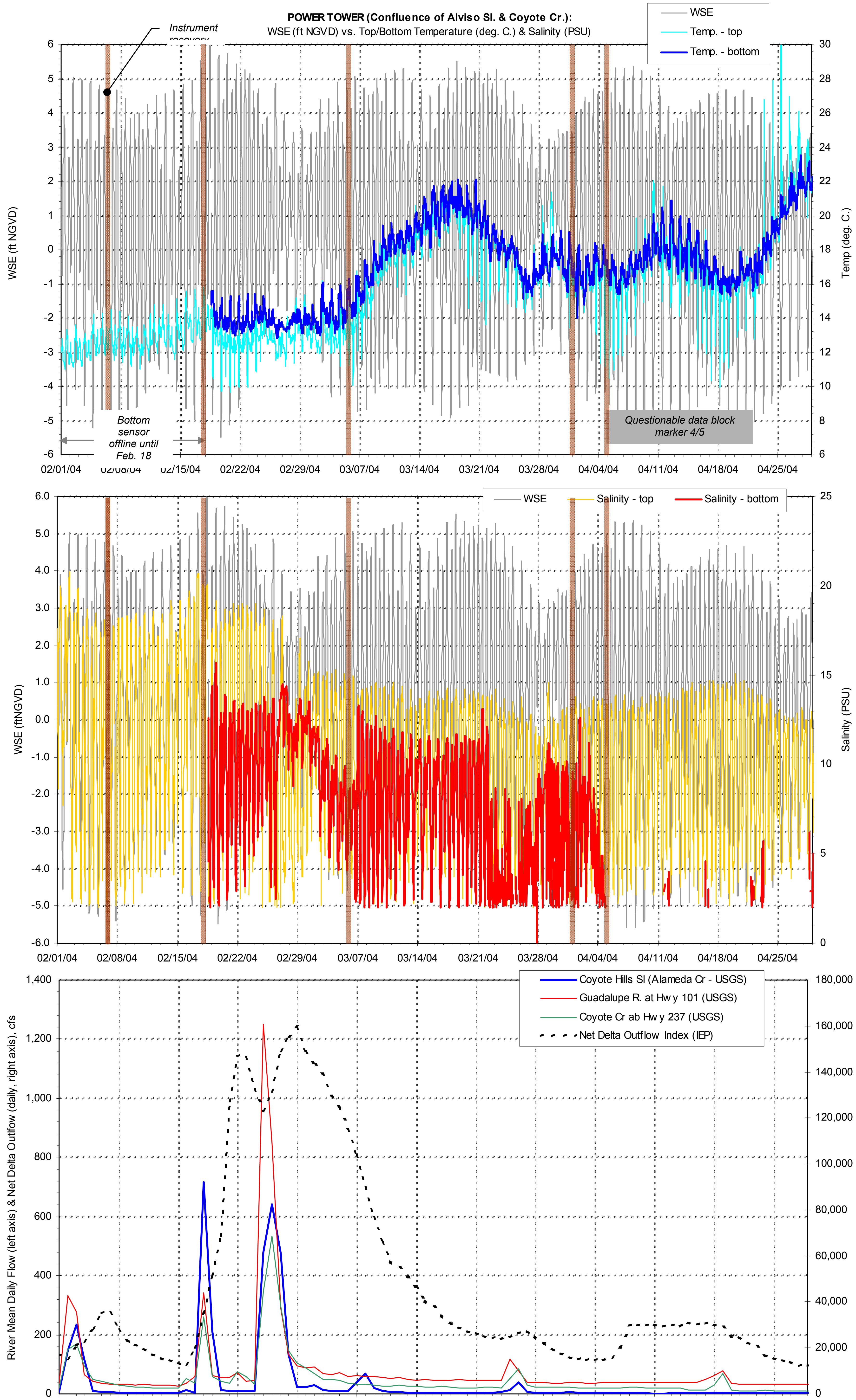


Figure 17. WSE, and Top/Bottom Temperature and Salinity at PG&E Power Tower, February to April 2004, With Stream and Delta Flows.

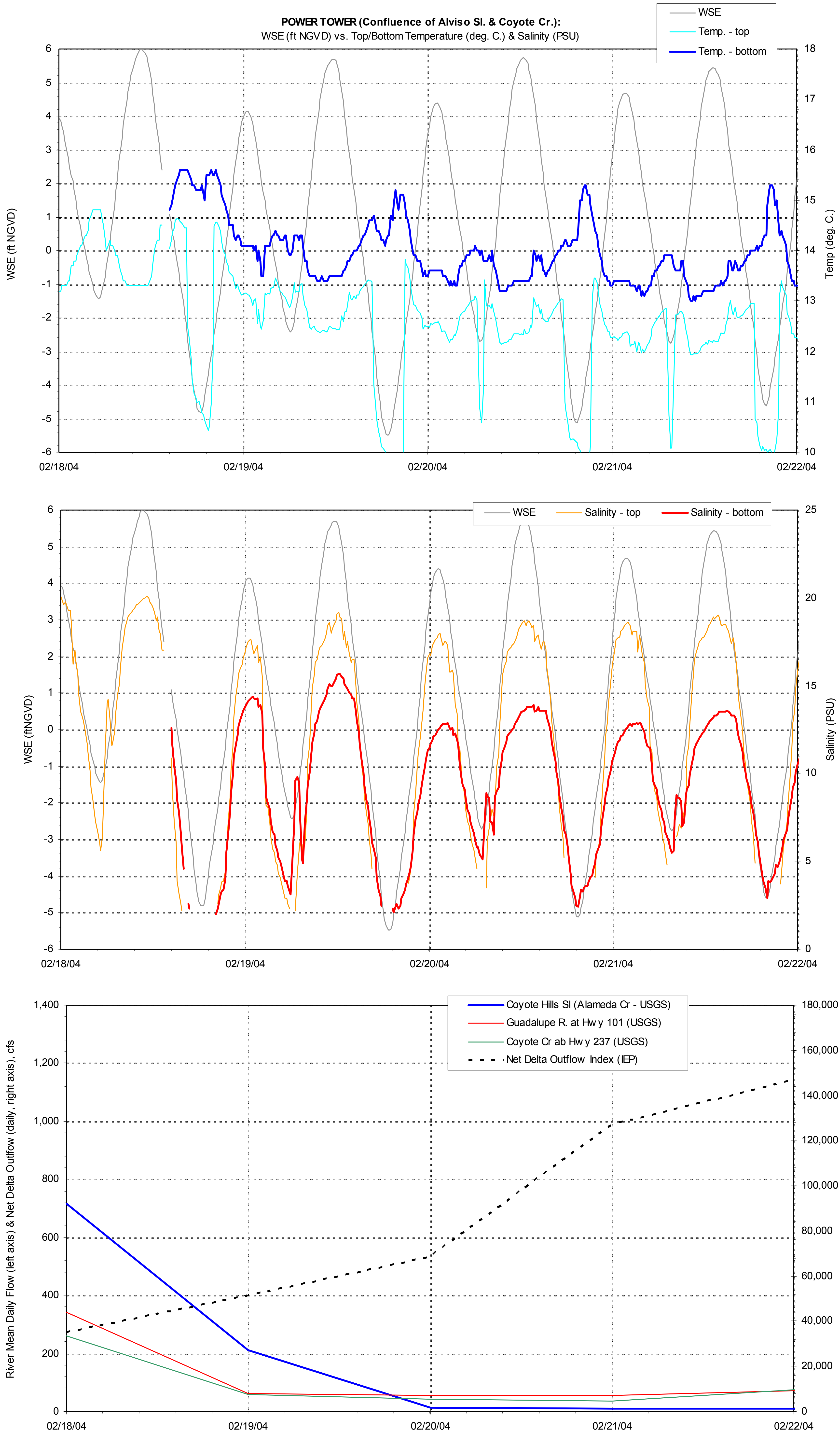


Figure 18. WSE, and Top/Bottom Temperature and Salinity at PG&E Power Tower, February 2004 With Stream and Delta Flows.

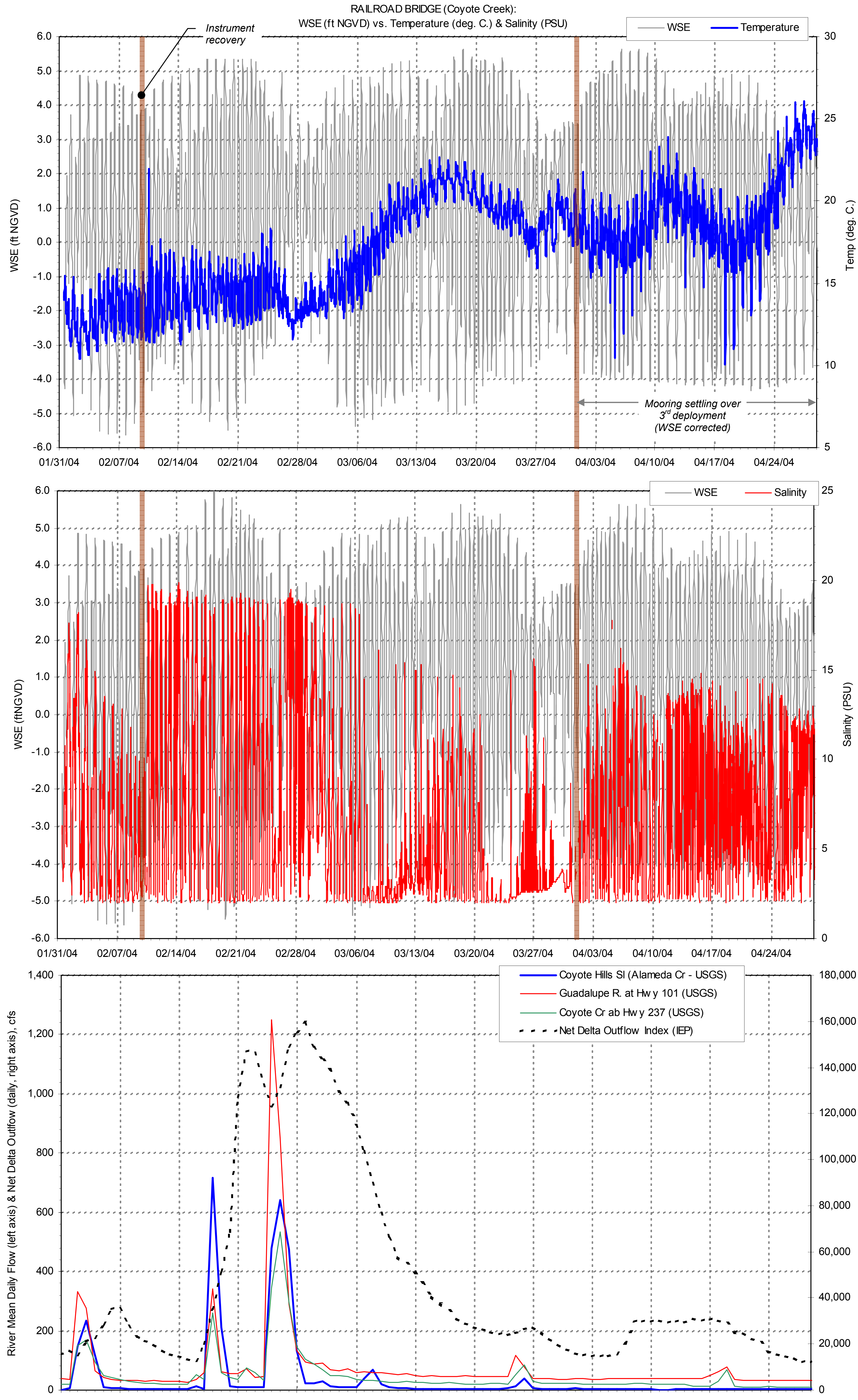


Figure 19. WSE, Temperature, and Salinity at Railroad Bridge (Coyote Creek), February to April 2004, With Stream and Delta Flows.

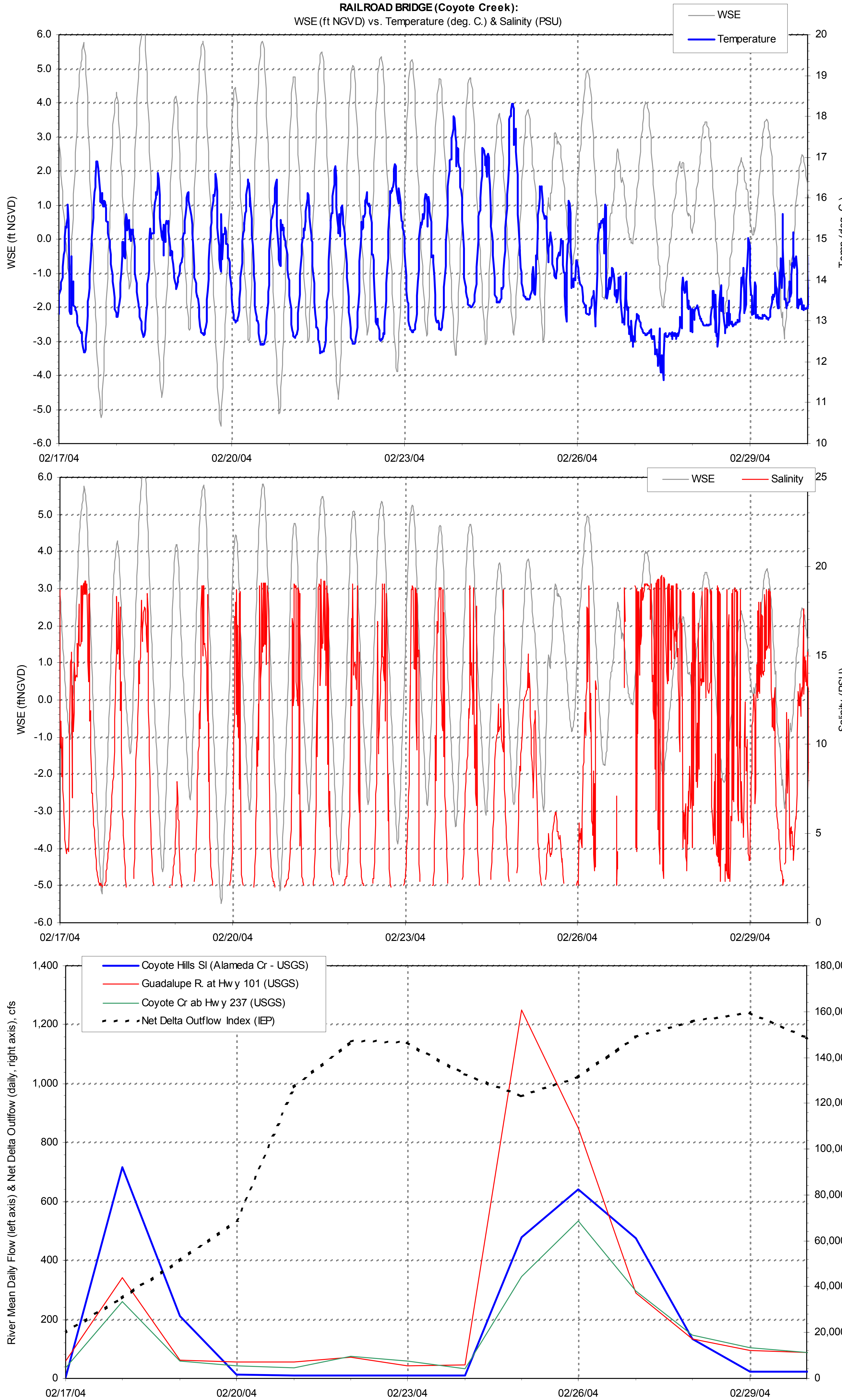


Figure 20. WSE, Temperature, and Salinity at Railroad Bridge (Coyote Creek) , February 2004, With Stream and Delta Flows.

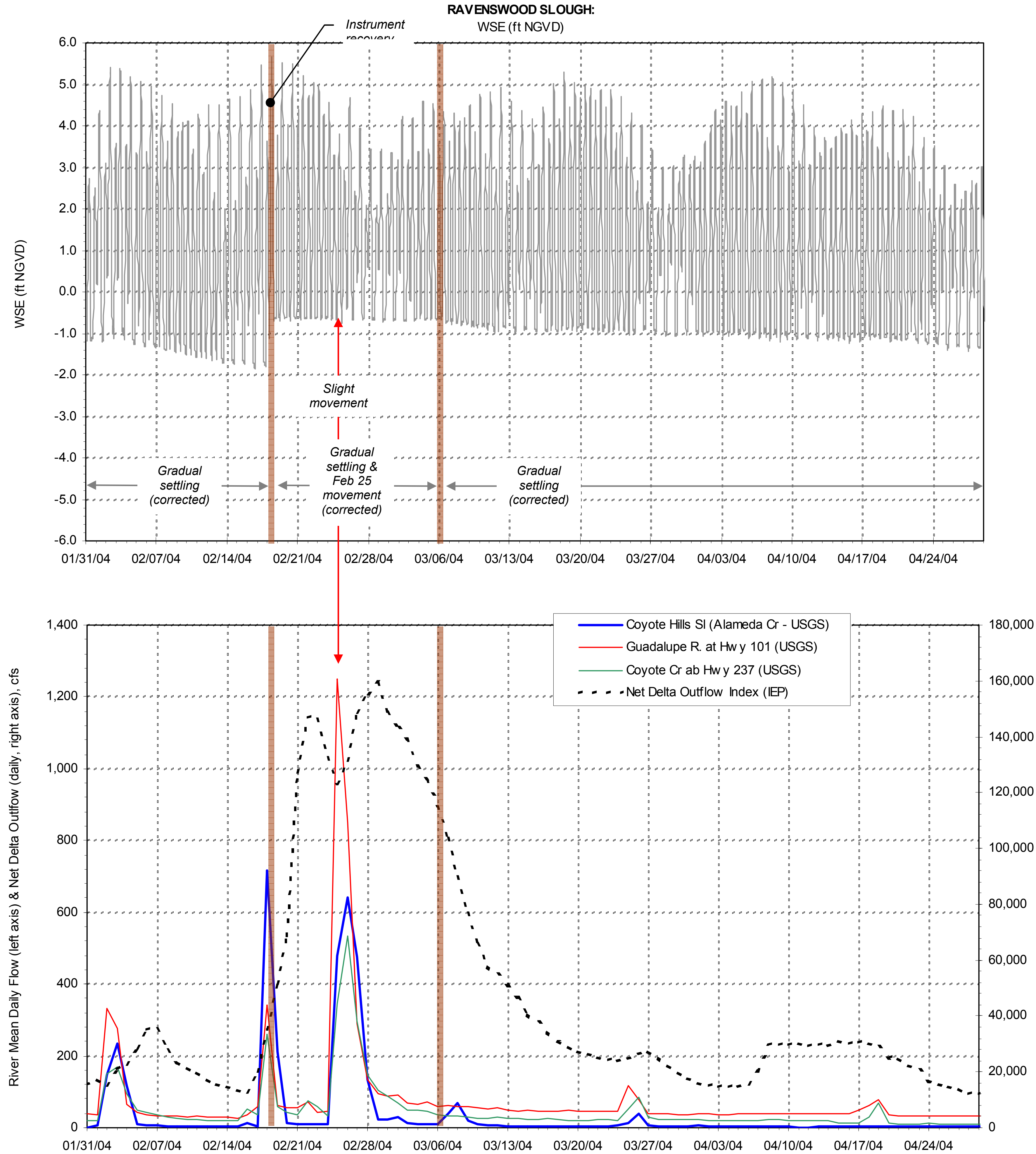
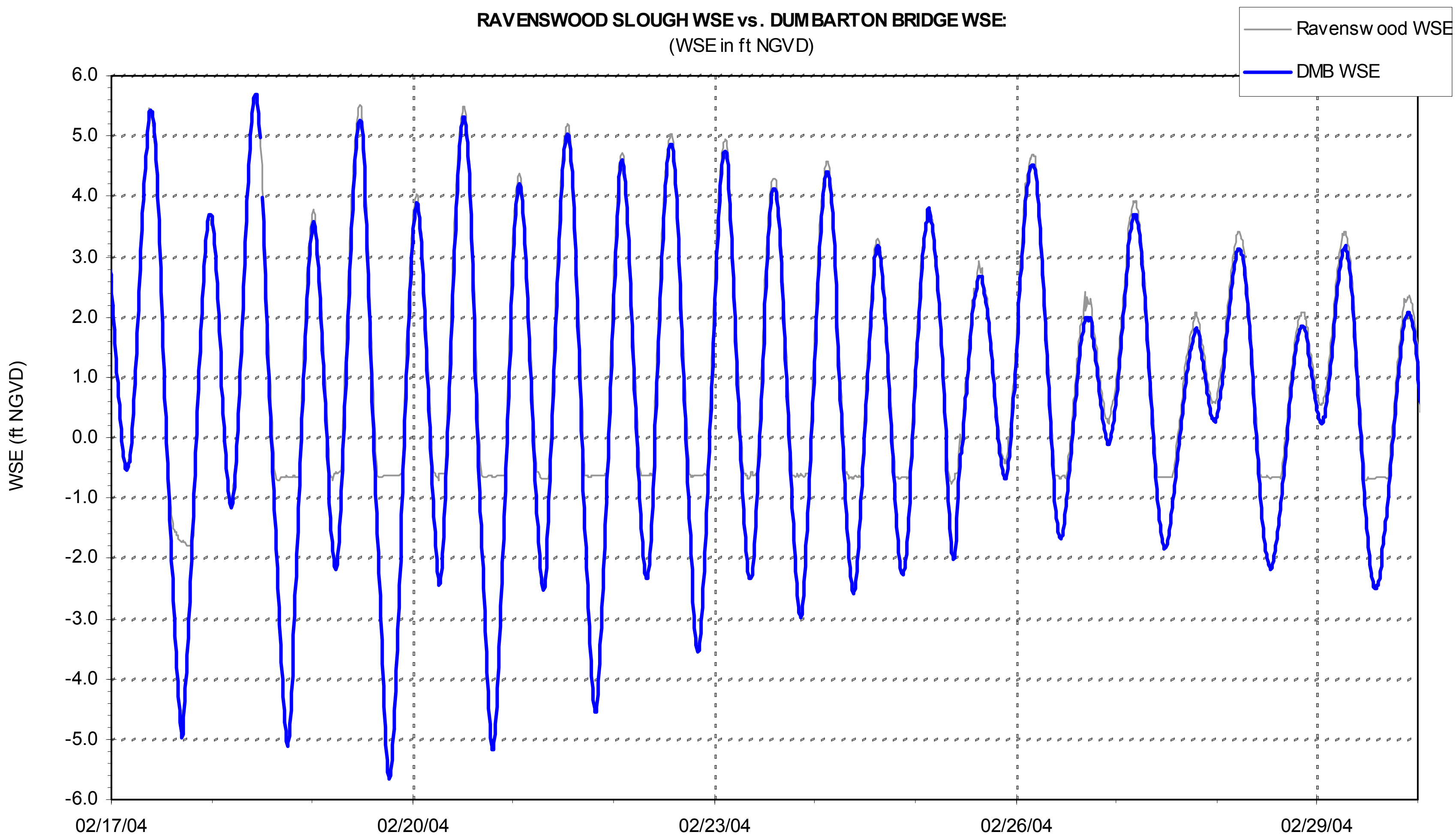


Figure 21. Time Series of WSE at Ravenswood Slough, February to April 2004, Shown With Stream and Delta Flows.



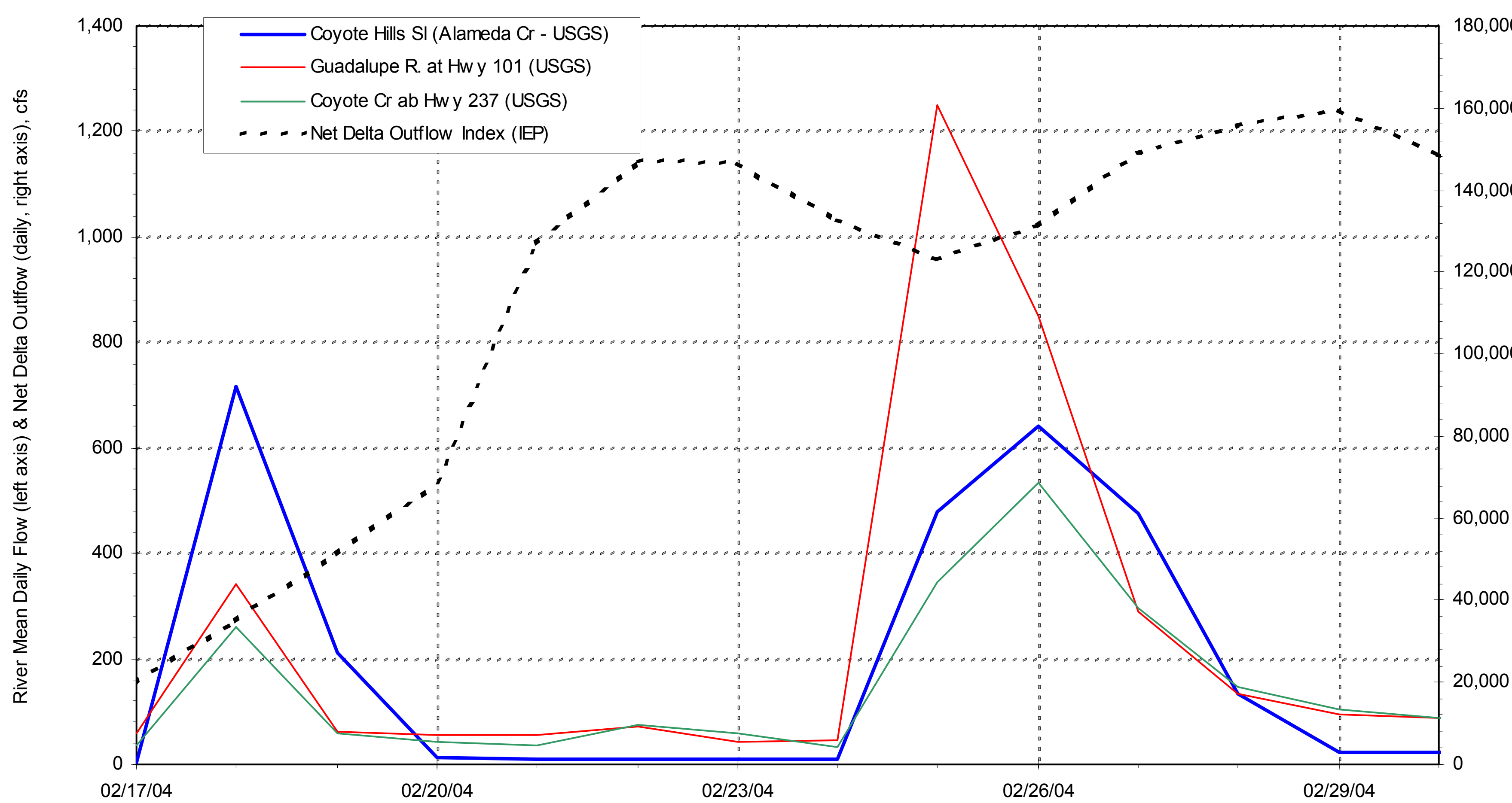


Figure 22. Time Series of WSE at Ravenswood Slough and Dumbarton Bridge, February 2004, With Stream and Delta Flows.

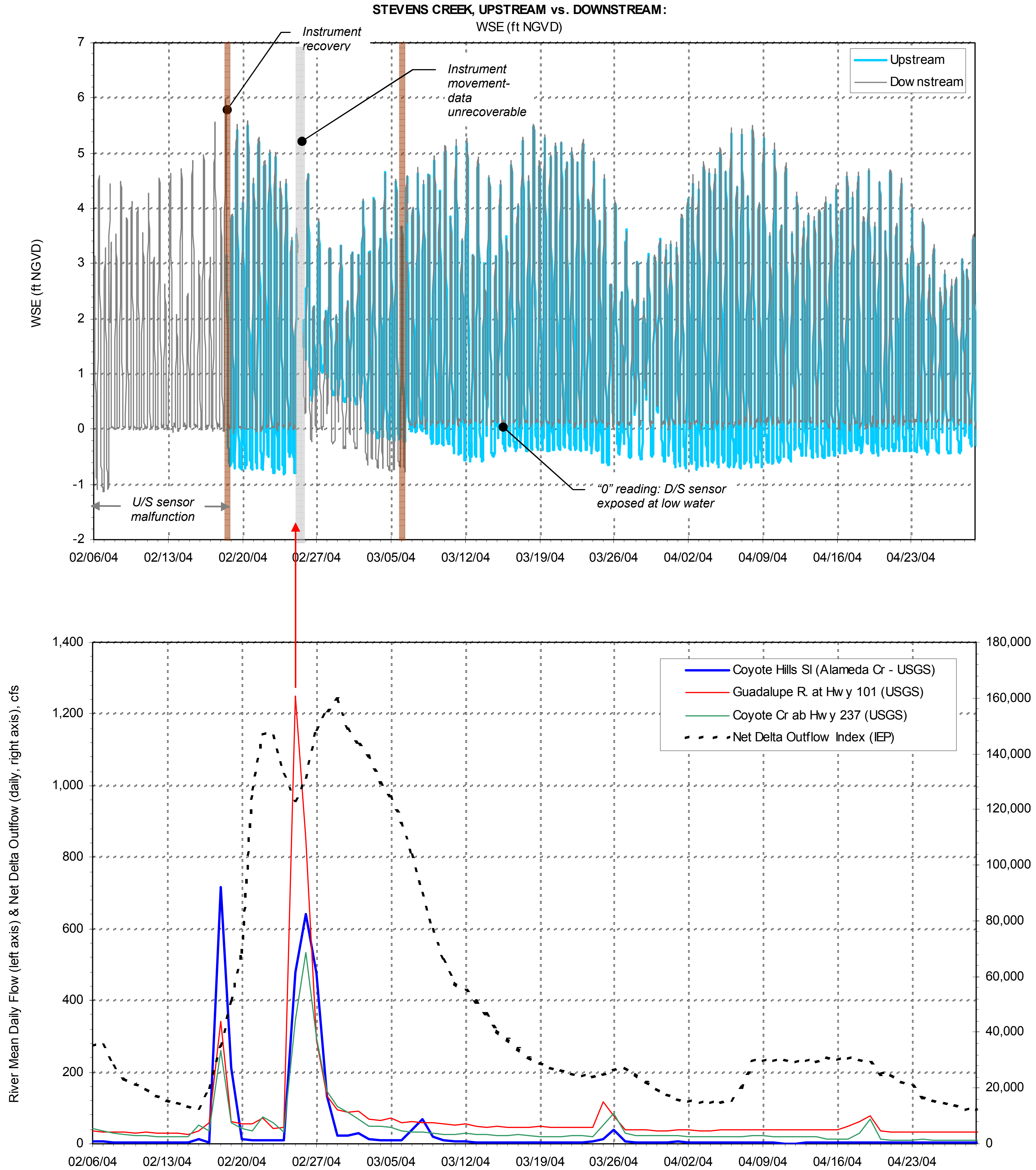


Figure 23. WSE at Stevens Creek Upstream and Downstream, February to April 2004, Shown With Stream and Delta Flows.

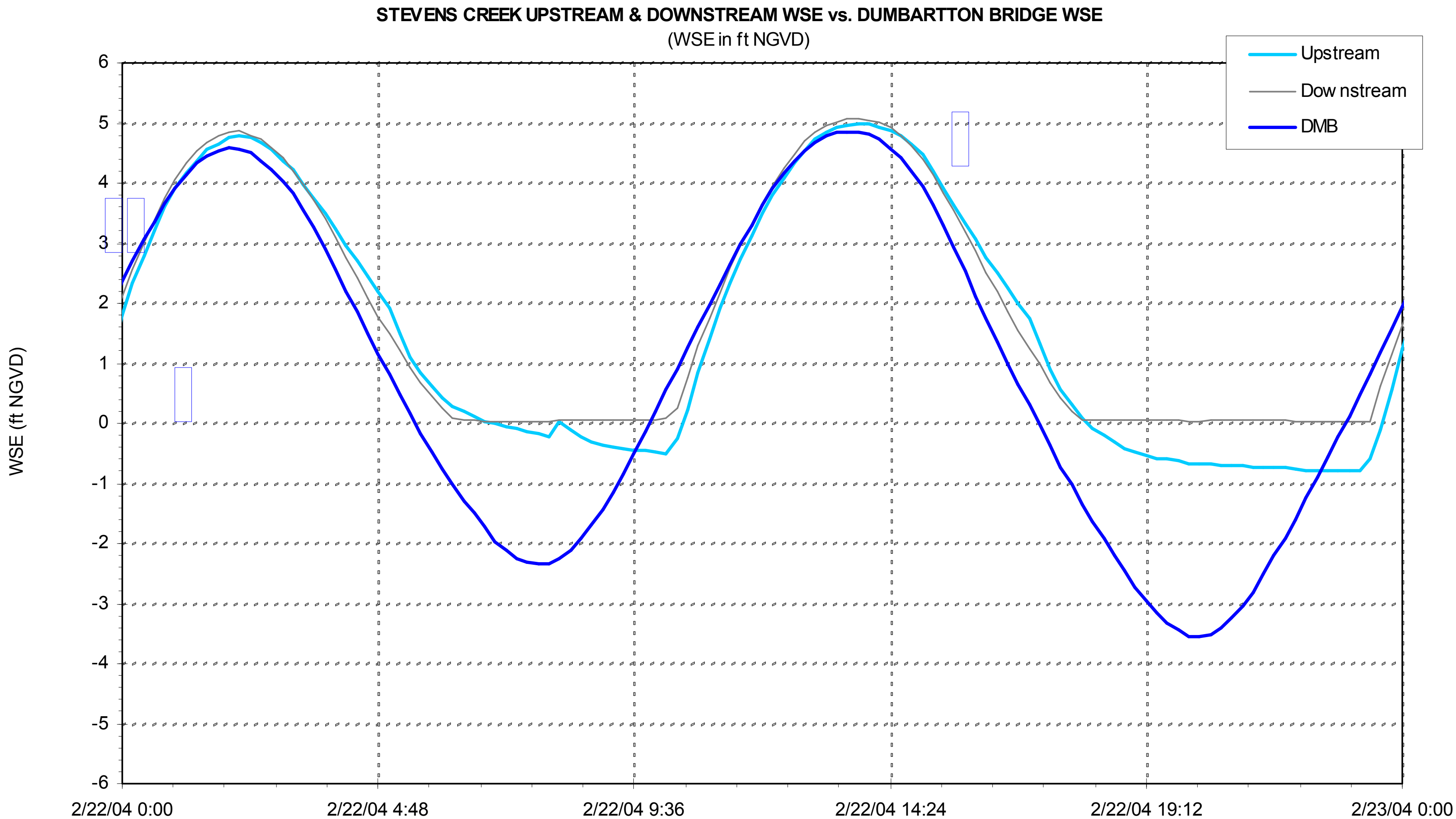


Figure 24. WSE at Stevens Creek Upstream/Downstream and Dumbarton Bridge, February 2004, With Stream and Delta Flows.

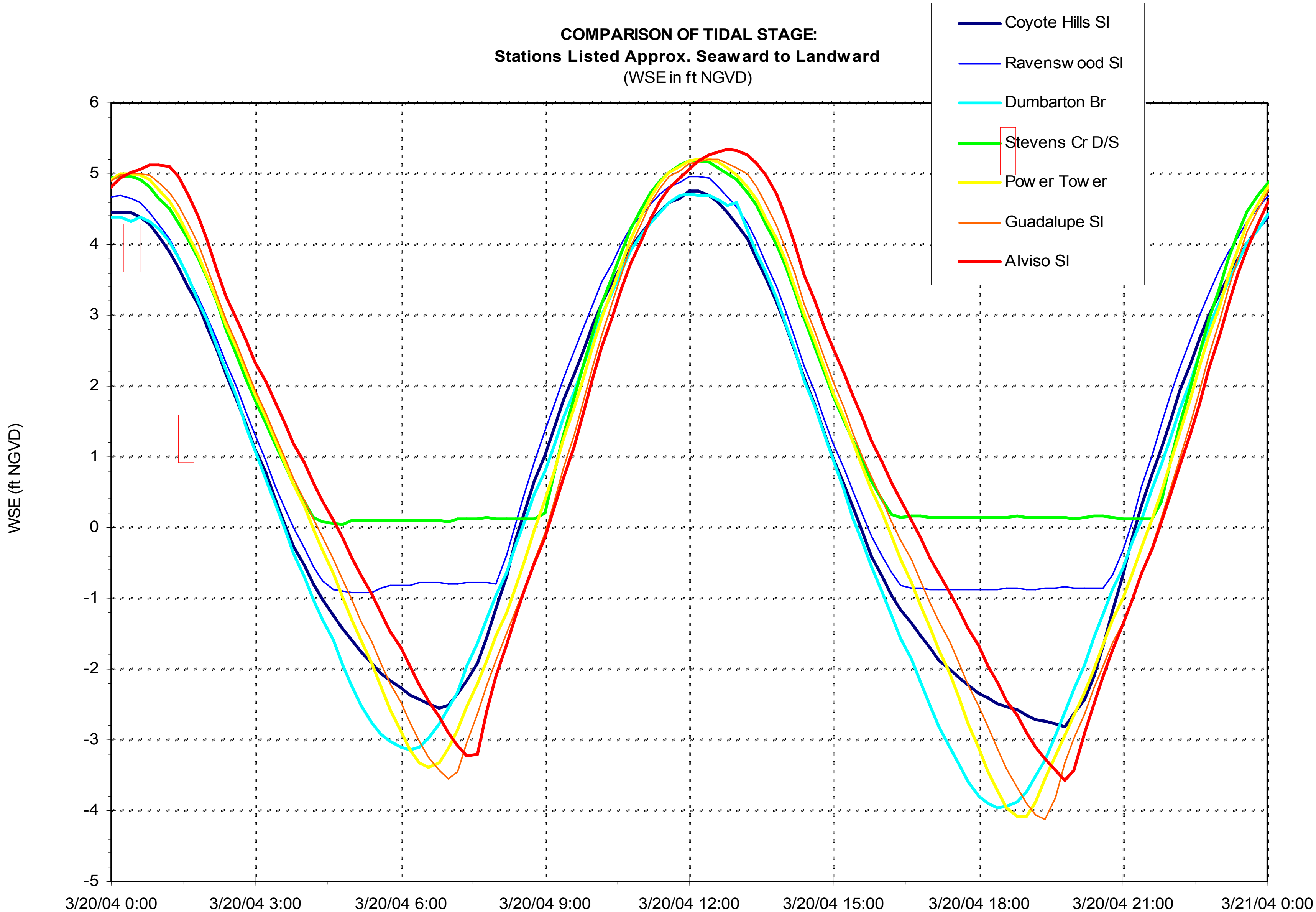


Figure 25. Comparison of Tidal Stage at Various Locations.

APPENDIX A

SCOPE OF WORK

MOFFATT & NICHOL ENGINEERS
2001 North Main St, Ste 360, Walnut Creek, CA 94596
Ph: 925-944-5411 ; Fx: 925-944-4732

MEMORANDUM

To: Amy Hutzel, California State Coastal Conservancy

From: Dilip Trivedi

Date: September 24, 2003

Subj: Immediate Data Needs/Gaps
South Bay Salt Pond Restoration Project
M&N File No: 5196-03

This memo presents an inventory of available hydrologic data, and recommendations for interim data collection for the salt pond project. Although data collection is anticipated as part of alternatives analysis and modeling for the larger environmental contract, it is likely that data collection may not be possible during this winter given the schedule for the Environmental Contract. This data will be critical in characterizing existing conditions for model verification and formulation of the project alternatives, which will likely happen next summer/fall.

The objective of this interim data collection is to obtain hydrologic and suspended sediment data for this winter season which is fast approaching, and not slip the schedule for a year in order to fill data gaps in the existing set. Much of the seasonal variability in water quality and hydrodynamics due to wet weather flows from the Guadalupe, Alameda, and other watersheds in the South Bay is limited to the vicinity of the ponds themselves. Therefore, the proposed data collection efforts discussed in this memo is limited to the southern part of the South Bay and within the vicinity of the Baumberg and West Bay ponds. Although numerical model development and calibration will require additional field data farther north of the restoration area (up to and perhaps even beyond the Bay Bridge) to account for far field and boundary effects, it is not discussed here because it is assumed that the Environmental Contract will include collection of these data.

An inventory of existing water level, suspended sediment, and salinity data is presented below and locations shown on Figure 1.

1. Water Level & Flow Data

- The only real time tide gage in the South Bay is in Redwood Creek (near the Port), which is part of NOAA's SFPORTS monitoring system for navigation.
- Other recent water level related data include tide range and statistics from the NOS in the vicinity of Dumbarton Bridge (1996-97), Palo Alto Yacht Harbor (1984-85) and the mouth of Alviso Slough (1984-85).
- Tidal statistics for Guadalupe River, Coyote Creek, Alviso Slough, and the Baumberg area are all from the mid 1970's. Many of these were based on short-term wet weather duration measurements to determine flood levels, rather than tidal elevations. Also, significant flood control projects and deposition in the creeks has occurred since these data were collected.

- Flows from the wastewater treatment plants are monitored and are available.
- Very limited data is available at present on water levels near the mouth of all creeks. The SCVWD collects river stage and flow data as part of the ALERT system, most of which is upstream of the salt ponds. Almost all of SCVWD's hydraulic analysis, which emphasize flood control, is based on 100-year tidal water level estimates established by the Corps in 1984. USGS stage and flow data is also for locations upstream of the salt ponds.

The Flood Management component of the restoration project will require hydrodynamic analysis, including modeling, of water levels and flow in the far South Bay including the creeks up to the limit of tidal action. Calibration and validation of the models will be based on discrete time histories which should include tidal stage and phase. In addition, design criteria will be based on high *winter* river discharge and stage.

Available flow records will be useful in establishing boundary conditions for the model and alternatives analysis; However, additional water level data in the downstream tidal portion will be needed for model calibration and validation.

2. **<u>Sediment Data</u>**

- Real time suspended sediment data (TSS) is collected by USGS near both bridges (Dumbarton and San Mateo), and in the far South Bay (Marker 17). Near-bottom and mid-depth continuous samples are collected.
- RMP data, in the form of USGS cruise data, is also available for suspended sediment as profiles of the water column along the "spine" of the Bay.

Establishing a sediment budget for the South Bay is going to be critical in determining the restoration timeline and success potential. Modeling of cohesive suspended sediment will also be required for determining the potential for mudflat erosion. The primary sources and processes of suspended sediment in the far South Bay (wind resuspension, creeks, Bay Delta) need to be characterized both over the mudflats and in the main tidal channels. Also, the sediment regime is significantly different in the winter season due to lower wind resuspension, and high inflow from the creeks.

3. **<u>Salinity Data</u>**

- Very limited salinity-related data is available at present for the study area. USGS cruise data as part of the RMP program is available along the main tidal channel. Some additional data, although limited, may be available from the treatment plants for the vicinity of the outfalls.

Salinity data will be required for the creeks to establish limits of salt water intrusion, and for simulations addressing stratification and groundwater intrusion.

4. **<u>Bathymetry</u>**

- The far South Bay has not been surveyed since the mid 1980's, and the creeks themselves have very limited survey information in the lower tidal reaches.

Given the very shallow depths in the far South Bay, hydrodynamic models are going to be very sensitive to the channel and mudflat bathymetry. The wetting and drying of the mudflats need to be characterized well for the hydrodynamic and sedimentation models. The creeks in particular need to be surveyed in the lower reach to determine flood levels and potential for additional flooding.

RECOMMENDATIONS FOR ADDITIONAL DATA COLLECTION

We understand that the USGS is planning to measure the bathymetry in a number of the salt ponds, inlets, and mudflats in the area. Assuming these measurements will be available in a few months (by the beginning of 2004), additional pond bathymetry is not required at this time. However, water level, salinity, and suspended sediment measurements in the restoration area are needed in order to better characterize ephemeral winter conditions and to assist with alternatives formulation and pond management alternatives.

We propose that gages presented in the following table, and shown on Figure 2, be installed for data collection this winter. Most of the gages are in clusters, for ease of deployment, maintenance, and downloading data. Duration of data collection can vary between 2 and 5 months depending on location and type of instrument, and could continue over the summer if desired.

PROPOSED GAGE TYPE AND LOCATION

	Location	Water Level	Currents and/or Waves[w]	Suspended Sediment (OBS)	CTD (Salinity)
1	Coyote Hills Slough, near mouth	●		●	
2	Coyote Hills Slough, upstream	●			
3	South Bay below Dumbarton Br.	●	●		●
4	East Mudflats (so of Dumbarton)		●[w]	●	
5	Mountain View Slough, upstream	●			
6	West Mudflats (near Palo Alto)		●[w]	●	
7	Stevens Creek, near mouth	●			
8	Stevens Creek, upstream	●			
9	Guadalupe Slough, near mouth				
10	Guadalupe Slough, upstream	●			
11	Alviso Slough, near mouth	●	●	●	●
12	Alviso Slough, upstream	●			●
13	Mud Slough	●	●		
14	Coyote Creek, D/S of Artesian Slough				
15	Coyote Creek, U/S of Artesian Slough	●	●	●	●
16	Mowry Slough, near mouth	●			
17	Ravenswood Slough	●		●	

In addition, we recommend that TSS/ADCP profiles along 3-4 sections across So Bay also be performed to determine the variability in suspended sediment due to wind- and tidal-induced currents.

The following data will also be needed for model calibration, but may be collected after this winter :

- Bathymetry along 2-3 sections across the mudflats
- Bottom grab samples/shallow cores at 8 to 10 locations to determine sediment type
- Bathymetry across the creeks at 2-3 locations (Mountain View, Stevens, Guadlaupe, Alviso, Coyote, Mud)

I have put the above together at a very preliminary level, and would welcome suggestions/comments on location, need, and duration. Lets discuss when you have a chance.

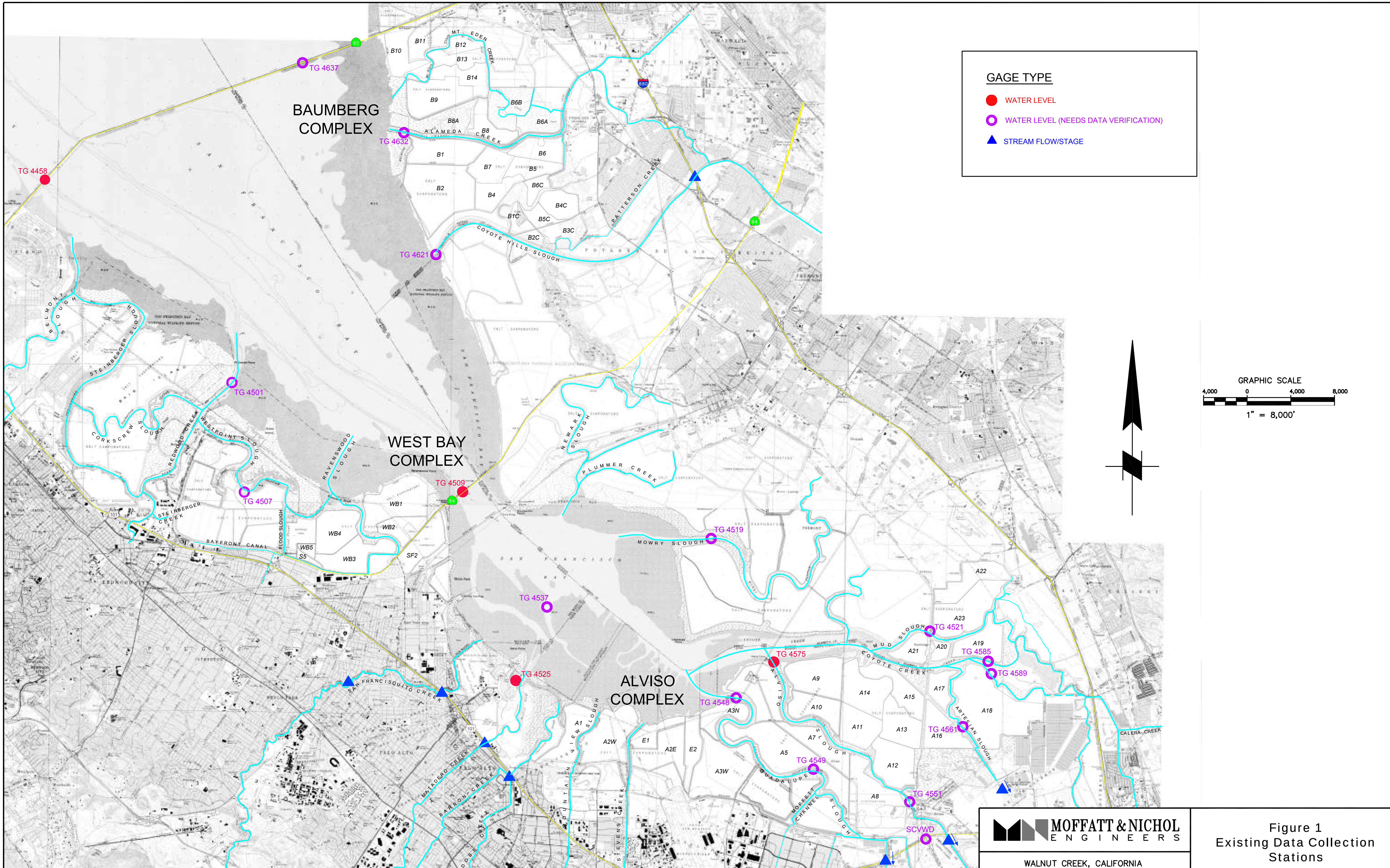


Figure 1
Existing Data Collection Stations

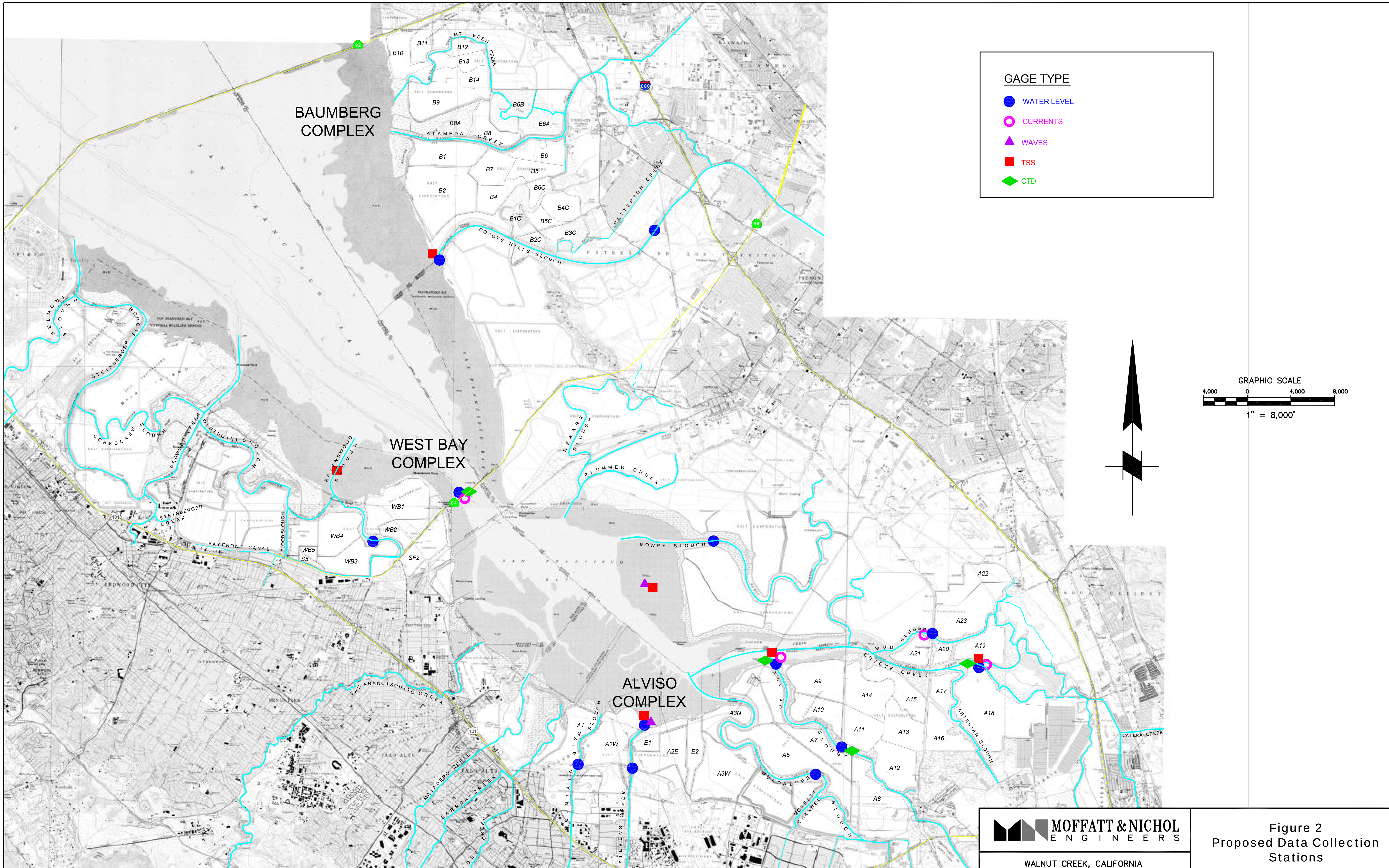


Figure 2
Proposed Data Collection Stations

MOFFATT & NICHOL
ENGINEERS

November 14, 2003

Ms. Amy Hutzel
California State Coastal Conservancy
1330 Broadway, 11th Floor
Oakland, CA 94612-2530

Subj: Proposal For Winter 2003 Data Collection
South Bay Salt Ponds Restoration Project
State Coastal Conservancy Contract No: 02-169
M&N File No: 03258

Dear Ms. Hutzel:

We are pleased to provide you with this proposal for hydrologic field data collection for the South Bay to assist with characterizing winter 2003/2004 conditions. We have incorporated most of the comments received from USGS and SCVWD, pursuant to our discussions, into the attached proposal. Other comments, which asked for clarifications, more specificity, etc. are addressed in a separate response. We understand that suspended sediment data collection is not envisioned at this time, and is therefore not included in the attached proposal. These services are being proposed under our flood management and related engineering issues contract for the South Bay Salt Ponds Restoration Project.

The attached scope of work and budget includes Environmental Data Solutions (EDS) as a sub-consultant to us, for measurements of water level and CTD over a period of 3 months, and limited surveys of the lower portion of several creeks (up to 2 field days of surveying). It also includes an optional budget for up to 2 additional CTD's at the Bay Bridge should the need arise. If the CTD's at 3 of the locations shown on the figure in the attached can be accurately surveyed in, then the water level gages will not be necessary. We can make that determination after a reconnaissance visit to the proposed gage locations is conducted. The corresponding budget for the water level gages will also not be expended, and could serve as an allowance for some more water level measurements if necessary. EDS is available to begin work immediately.

Schedule:

We propose the following schedule:

Deliverable	*Schedule*
Detailed Field Plan & QA/QC Program	4 weeks from NTP
Draft Data Collection Report	16 weeks from NTP
Final Data Collection Report / Electronic Data	4 weeks from receipt of comments on draft

Budget and Personnel:

The proposed fee, key personnel, and direct expenses are described in the attached fee summary. We will invoice monthly based on time and materials, per the contracted rates listed in our agreement with the Conservancy. We will not exceed this amount without your authorization.

As always, I look forward to assisting you on this aspect of the project. Should you have any questions or comments on this proposal, please call me at your convenience.

Sincerely,

MOFFATT & NICHOL ENGINEERS

Dilip Trivedi, Dr. Eng., P.E.
Project Manager

Scope of Work:
South San Francisco Bay Water Level, Conductivity and Temperature Monitoring

Prepared for
Dilip Trivedi
Moffatt & Nichol Engineers
2001 North Main Street, Suite 360
Walnut Creek, CA 94596

Prepared by
Environmental Data Solutions
1010 B Street
Suite 425
San Rafael, CA 94901

November 12, 2003

Environmental Data Solutions

1. APPROACH TO SCOPE OF WORK

1.1 Introduction

Environmental Data Solutions is pleased to submit the following proposal to deploy, service and survey 12 automated instrumentation gages / platforms throughout South San Francisco Bay. Seven gages / platforms will be measuring and recording water surface elevations while the remaining 5 gages / platforms will be measuring and recording conductivity, temperature and depth (water surface elevations) for 12 weeks. We have included an optional task in the budget that will allow for deployments longer than 12 weeks if necessary.

We are proposing a thorough and tested approach that will ensure a high data return rate despite the harsh and remote conditions of the area. Various sensors, moorings and mounting schemes will be utilized depending on the variables of each location.

It is understood that the deployment of these platforms should take place as soon as possible in order to record and characterize hydrologic conditions during storm events. In order to meet this requirement, it would be necessary to submit all the required permits as soon as possible.

2. SCOPE OF WORK

Task 1. Initial Instrument Platform Location Reconnaissance:

- The field program manager and field technician will conduct a one-day reconnaissance. The intent of this initial site visit is two fold; choosing specific instrumentation platform locations and to assess the potential for vandalism at each location. Assessing these two variables before full deployment will enable the project manager to properly match the instrument and mounting (or mooring) combinations with the sampling location.

  Since the field team is very familiar with all the sites south of the Dumbarton Bridge, the reconnaissance will focus more on the Coyote Hills and Ravenswood Slough areas.

Task 2. Create Detailed Field Plan and Quality Assurance / Quality Control Program

- The field plan document will outline sensor / data logger configurations, sampling intervals, and mounting and or mooring specifications. Site water level and access conditions will dictate the type of mounting or mooring to be used which will be outlined in this document.

- The QA / QC program will outline specific protocols that will help in the generation of an accurate time series. Some of these protocols will include reading independent staff gages at each water level recording station to monitor possible sensor drift and recording hand-held instantaneous sensor readings during each site visit to the CTDs. EDS QA / QC protocols will follow those outlined in:

  Wagner, R.J., H.C. Matthew, G.F. Ritz and B.A. Smith. 2000. Guidelines and standard procedures for continuous water-quality monitors: site selection, field operation, calibration, record computation and reporting. USGS Water-resources Investigations Report (WRIR) 00-4252, Reston, Virginia, 53 pp.

Task 3. Coast Guard and CALTRANS Permit Filing / Administration

- If project managers decide that certain instrumentation mountings will include attaching structures to existing day-use channel markers, then it will be necessary to file the proper use permits and insurance certificates to the office of real property at the U.S. Coast Guard in Alameda. These types of permits require some lead time and follow up.

Task 4. Instrumentation / Mooring Mobilization

- All sensors will be calibrated and checked. Data loggers will be outfitted with power supplies, desiccant and programmed. Mounting and mooring structures will be procured and matched with associated hardware and fabricated.

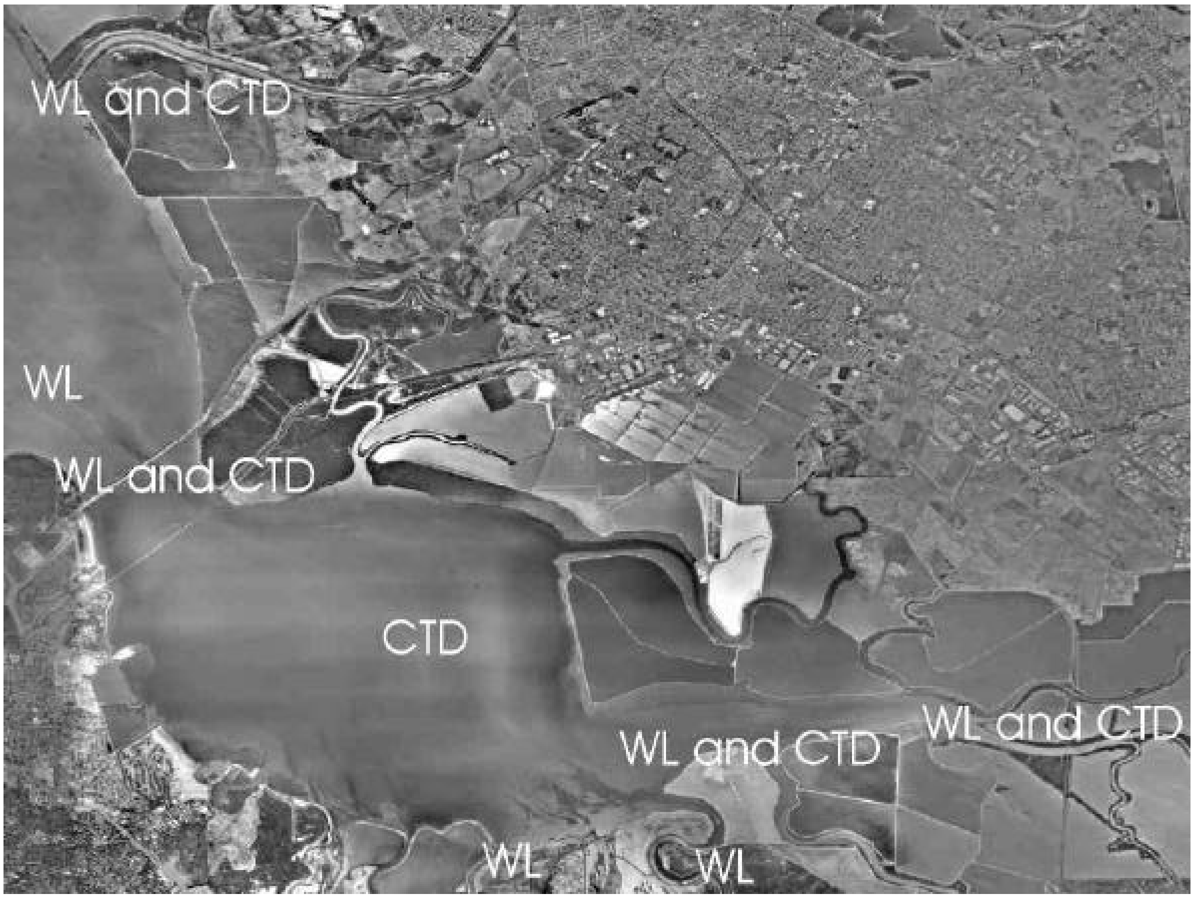
Task 5. Install Water Level Recording Stations

- This task will require two days to deploy 7 water level recording stations in the following areas:

  - Coyote Creek at the railroad bridge
  - The mouth of Alviso Slough
  - Guadalupe Slough ~ mid point
  - The mouth of Stevens Creek
  - Dumbarton Bridge
  - The mouth of Coyote Hills Slough
  - The mouth of Ravenswood Slough

  We anticipate using pressure transducers of the non-vented type, since they are fully contained which will minimize vandalism, and because accurate atmospheric pressure measurements are available from the immediate vicinity.

We have used this successfully on other projects in the Bay, and will document the calibration and verification as part of the QA / QC program.



LEGEND:
Water Level Recording Stations = WL
Conductivity, Temperature, Depth Stations = CTD

NOTE: all locations are approximate
Photo Source: NASA, 1999

Task 6. CTD Station Installation

- A total of 8 CTD stations will be located throughout 5 different locations. Three locations will contain a top and bottom (water column) array and the remaining 2 locations will contain a single CTD either at the surface or at mid depth depending on depths and tidal range.

  - **Fixed/Floating CTDs**

    - These CTD stations will be located on Coyote Creek at the railroad bridge and near the mouth of Coyote Hills Slough.
    - The Coyote Creek station will be mounted on a dolphin structure located near the bridge – thus eliminating the need to deploy a mooring / buoy setup.
    - If a fixed structure is not located in or near the mouth of Coyote Hill Slough (such a structure will be sought during the initial site reconnaissance – Task 1), than a moored platform with a tag-line pick-up buoy will be deployed.

  - **Top and Bottom CTDs**

    - Three top and bottom mounted CTD arrays will be located at the mouth of Alviso Slough, on Day Use Marker Number 17 (NW of Calaveras Point) and at the Dumbarton Bridge.

Task 7. Post-Deployment Download / Platform Reconnaissance

- All of the instrument platforms will be checked and downloaded within 2 days after deployment. This task is designed to ensure a continuous time series by making sure all of the sensor parameters are performing after initial deployment.

Task 8. Mid-Deployment Download / Platform Reconnaissance

- All platforms will be downloaded and serviced 4 weeks after initial deployment.

Task 9. Platform Surveys

- Each instrument platform will be surveyed so the corresponding time series may be presented and archived in either feet, NAVD ’88 or NGVD ’29. The basis for each survey (datum, benchmark locations) will be supplied by the project surveyor, Mr. Tom Tucker. At the time of this writing, the exact locations of benchmarks are unknown, as a result, the current fee estimate will allow for benchmark reconnaissance and a possible line of levels between each platform and nearest benchmark.

- RTK GPS equipment might be utilized for the more-remote platforms.

Task 10. Platform removal

- Provided that project managers have determined that the monitoring effort has characterized enough high flow events, all stations will be subjected to final QA checks and then removed after 12 weeks. However, if the 12 week period proves to be quiescent in terms of storm activity, than the monitoring platforms will not be removed. Platforms will be left in place until project managers have determined that enough high flow events have been sampled.

Task 11. Channel Geometry Surveys

- A total of 18 slough channel geometry cross sections will be surveyed at three locations (mouth and 2 more upstream, to be determined prior to the survey) on each of the following channels:

    - Alviso Slough
    - Coyote Creek
    - Coyote Hills Slough
    - Guadalupe Slough
    - Ravenswood Slough
    - Stevens Creek

  Exact locations of the upstream cross sections will be provided by M&N to the field team prior to mobilization, but will most likely be limited to the reach along the salt ponds. A standard hydrographic survey is envisioned, using a fathometer and differential GPS system with measurements every 1 to 2 seconds, which translates to points every 5 feet or less. The survey will be conducted at high tide to include the mudflats and fringe marshes along the sloughs.

Task 12. Data Management

- This task will be designed to handle the data stream (time series and survey data) that will have to be subjected to QA / QC protocols, graphed and archived as the project progresses.

TASK 13. Data Collection Report and Time Series CD ROM

- A final data collection report will be produced which will outline methods, locations, site visit diaries, survey notes and final data reduction methods

APPENDIX B

CROSS SECTION SURVEY OF SLOUGHS

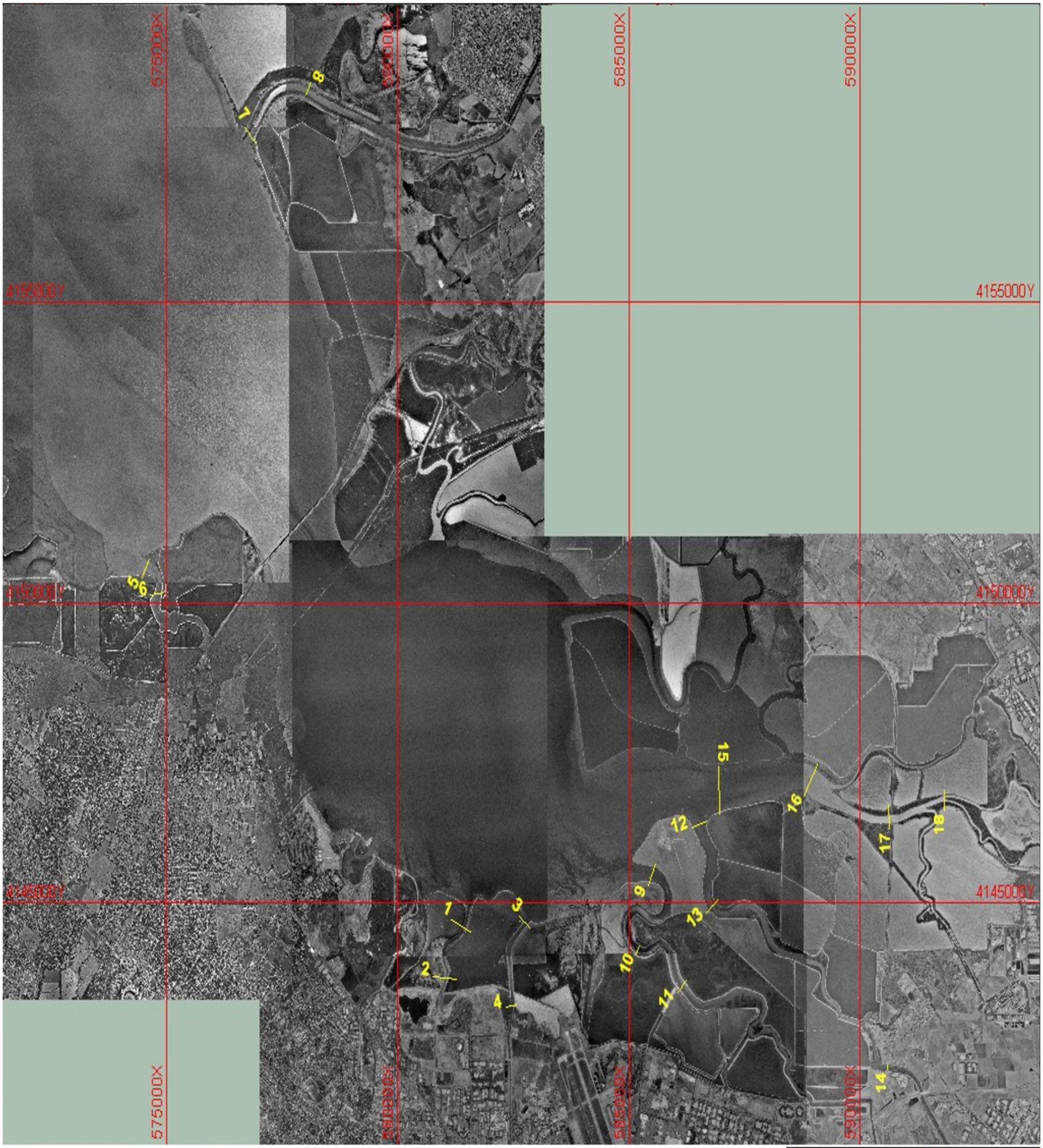


FIGURE 2.0
SURVEYED CHANNEL
CROSS SECTION LOCATIONS, OCTOBER, 2004
South San Francisco Bay CTD Monitoring

Legend

1— Channel Cross Section Location

Data Sources: Environmental Data Solutions, USGS
GIS/Cartography by Jake Schweitzer, Nov. 2004
Map File: CTD-XS_SBay_A-P_110704.mxd

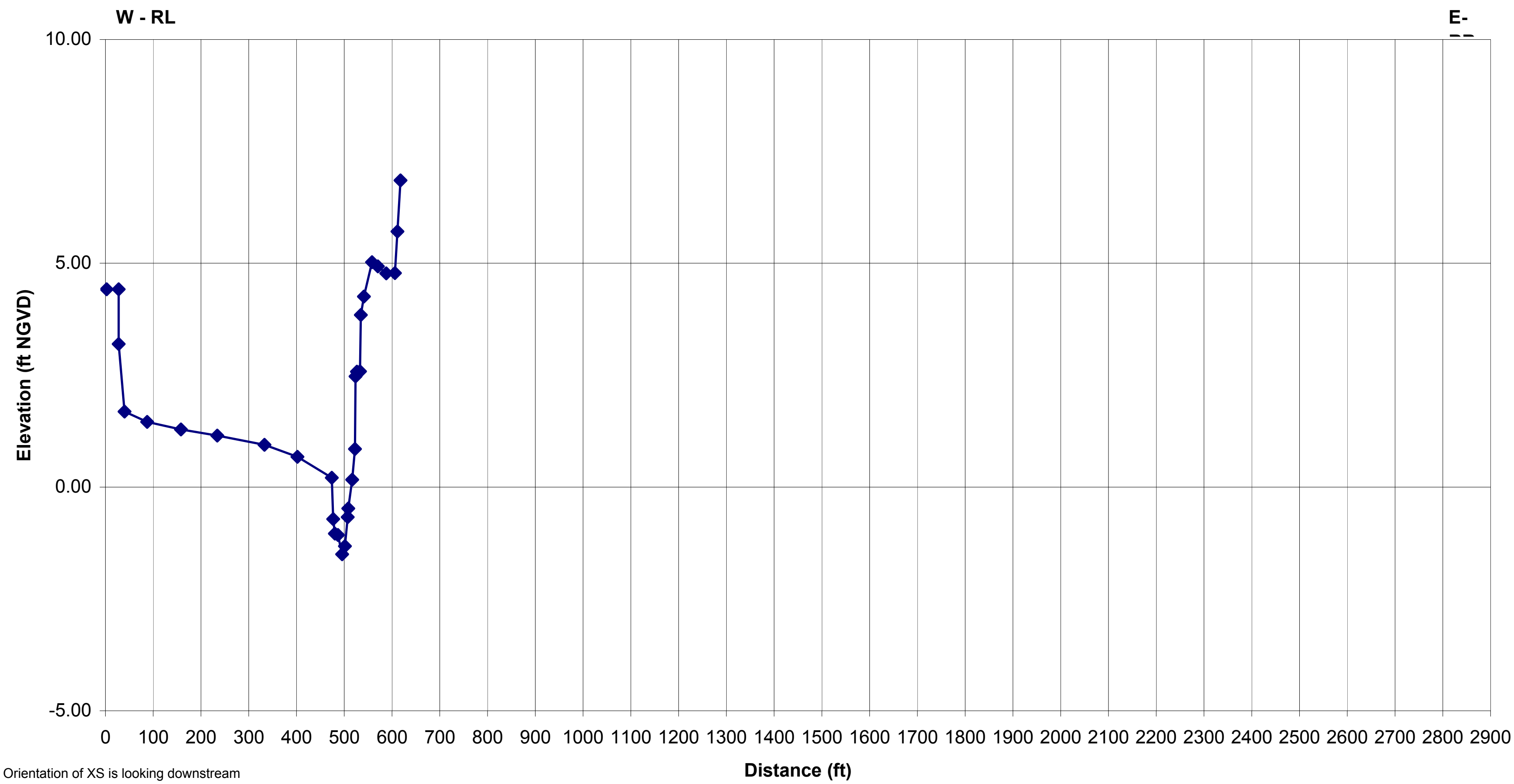
Environmental Data Solutions

N

1:90,000

0 1 2 Kilometers

0 1 2 Miles

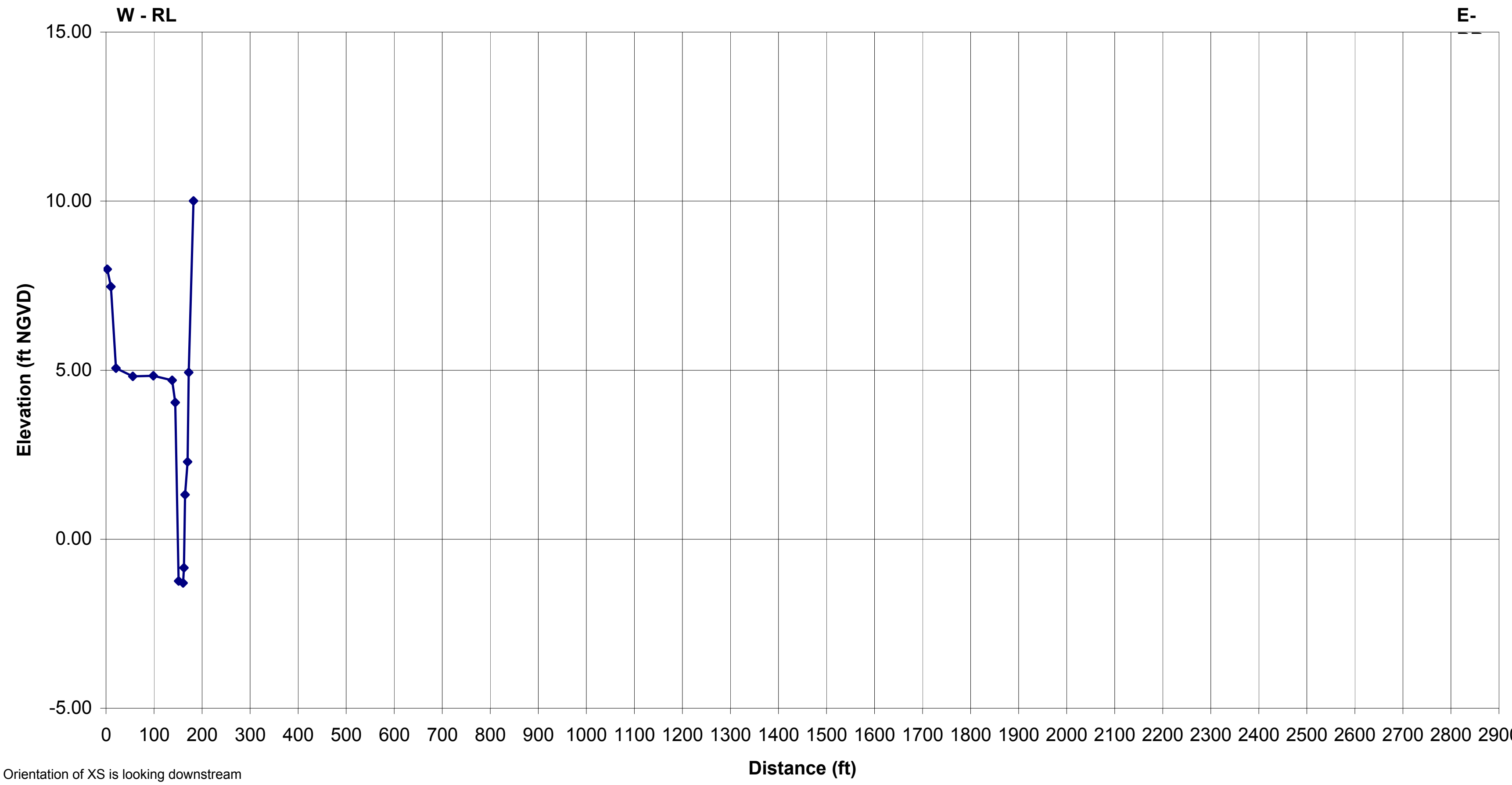


Orientation of XS is looking downstream
at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Permanente Creek Mouth XS - (XS # 1)

October 28, 2004

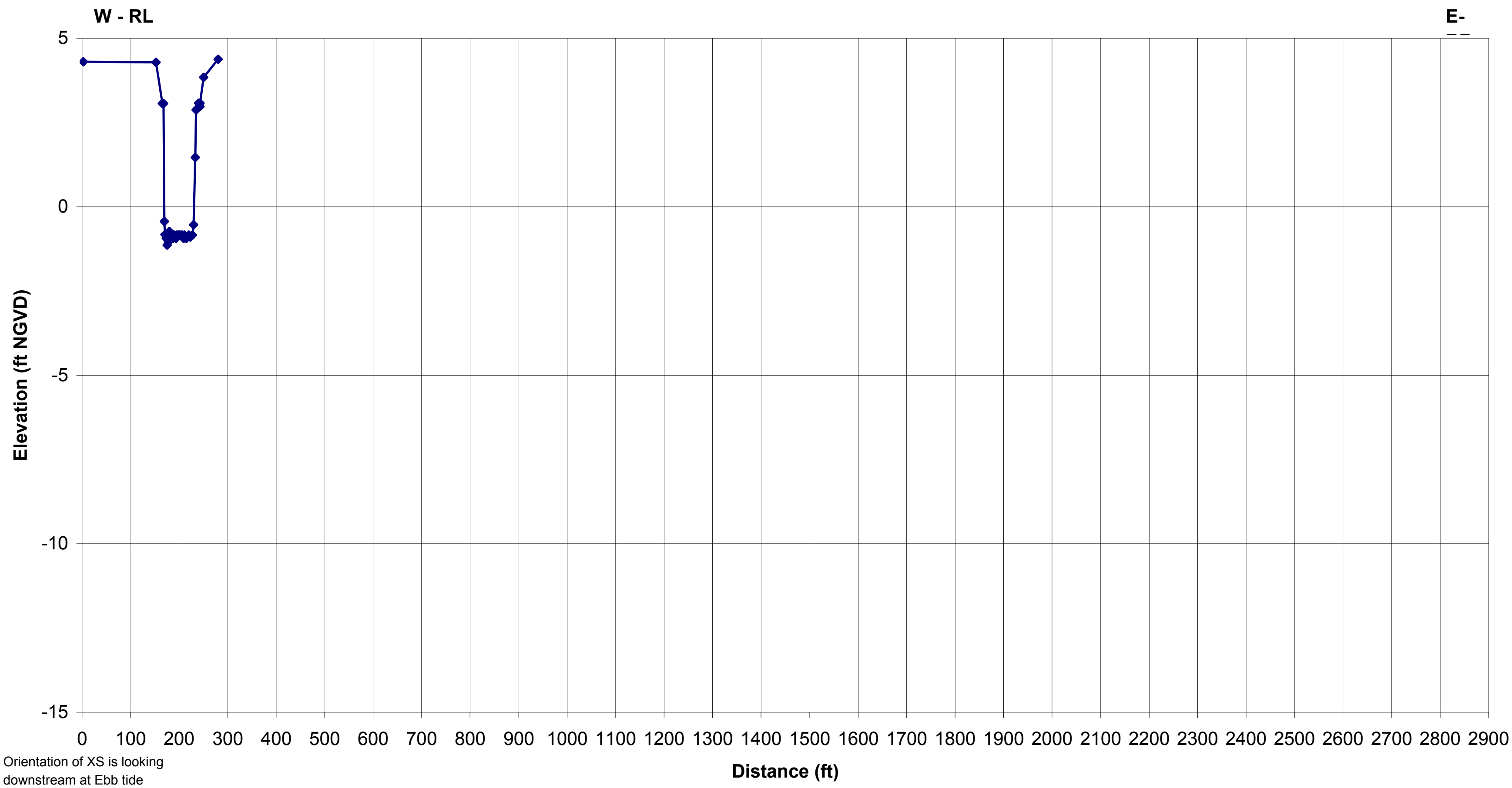


Orientation of XS is looking downstream
at Ebb tide

Environmental
Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Permanente Creek US XS - (XS # 2)

October 28, 2004

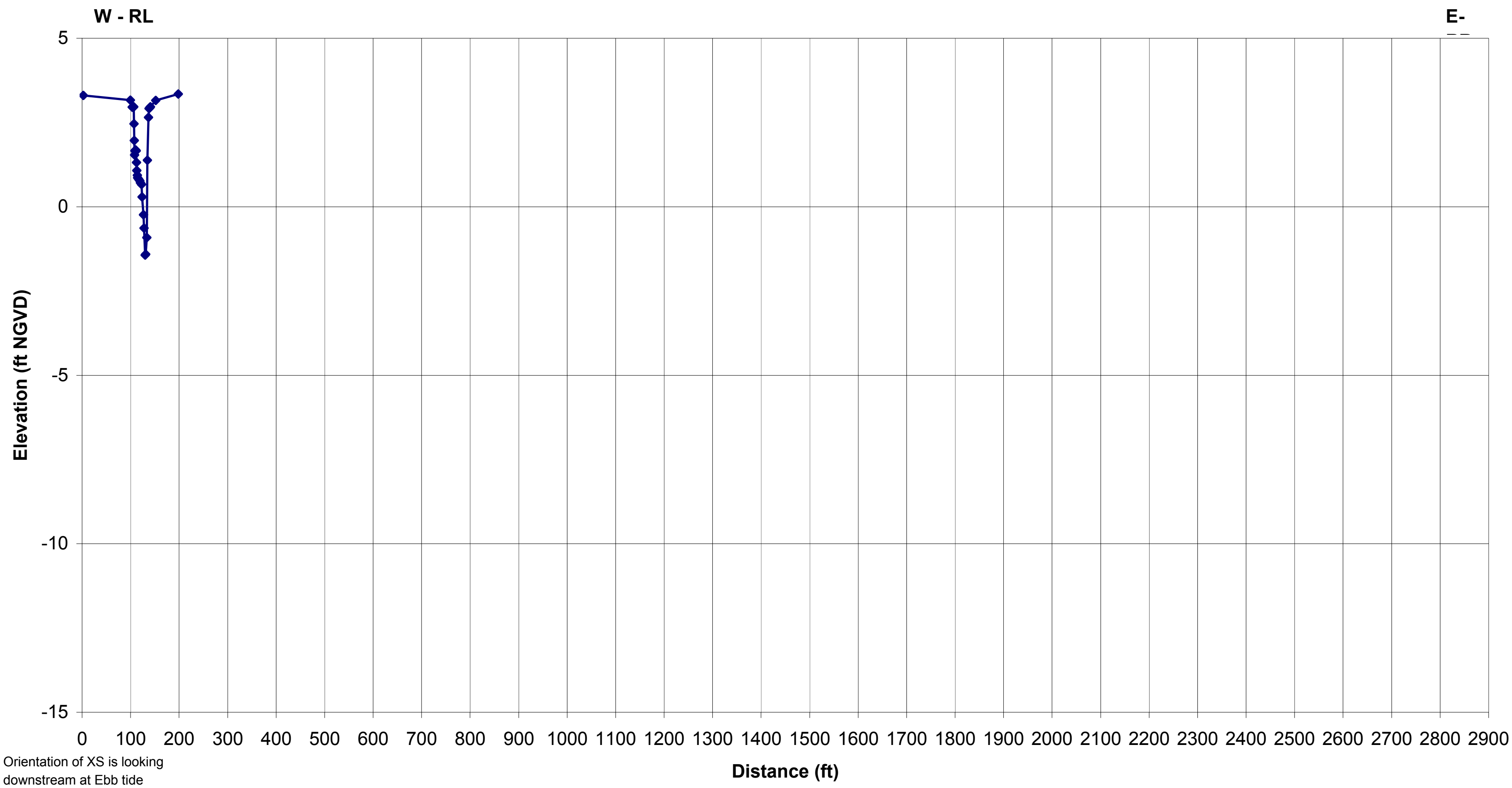


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Steven's Creek Downstream XS (XS#3)

November 5, 2004

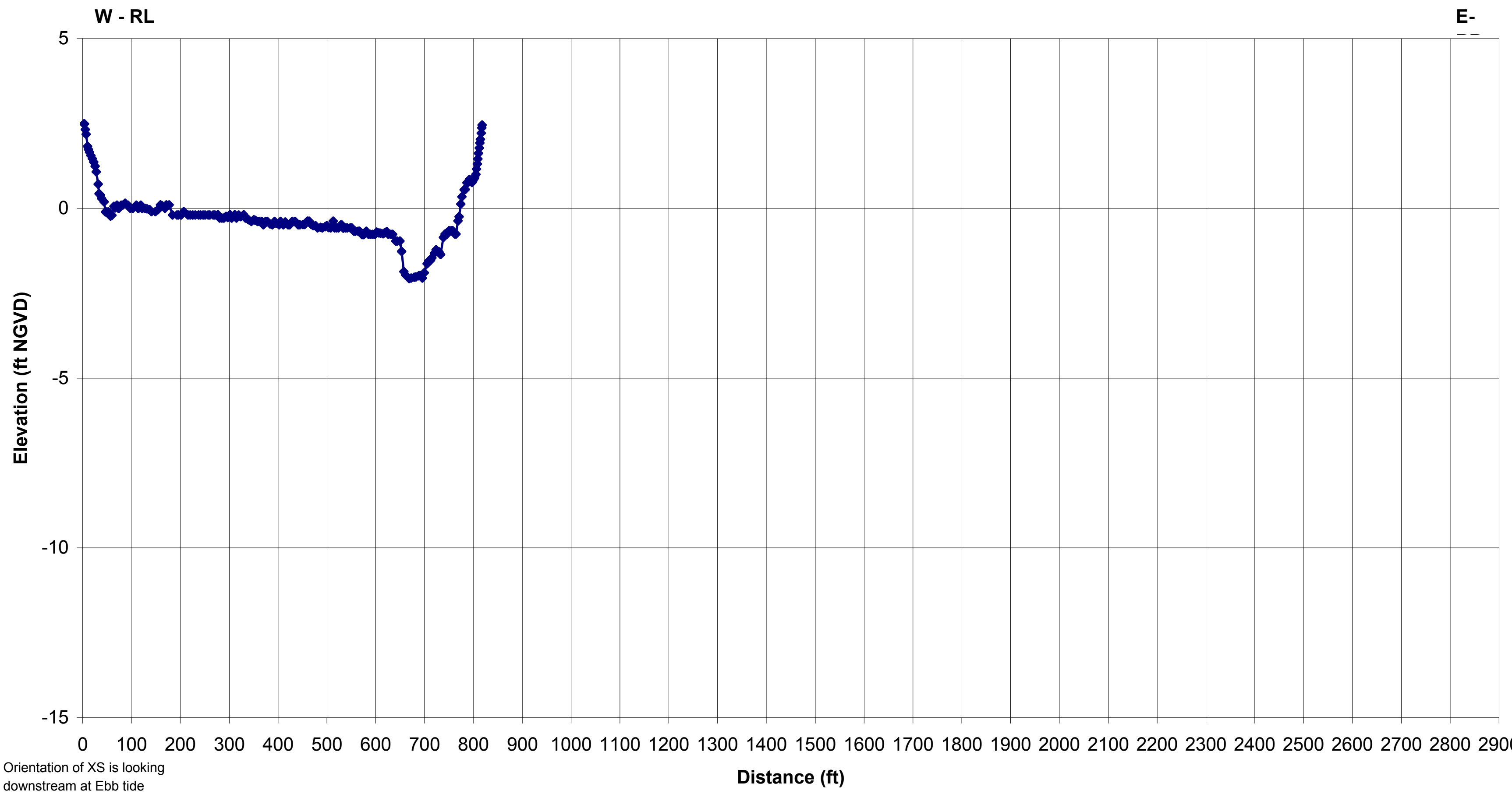


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Steven's Creek Upstream XS (XS#4)

November 5, 2004

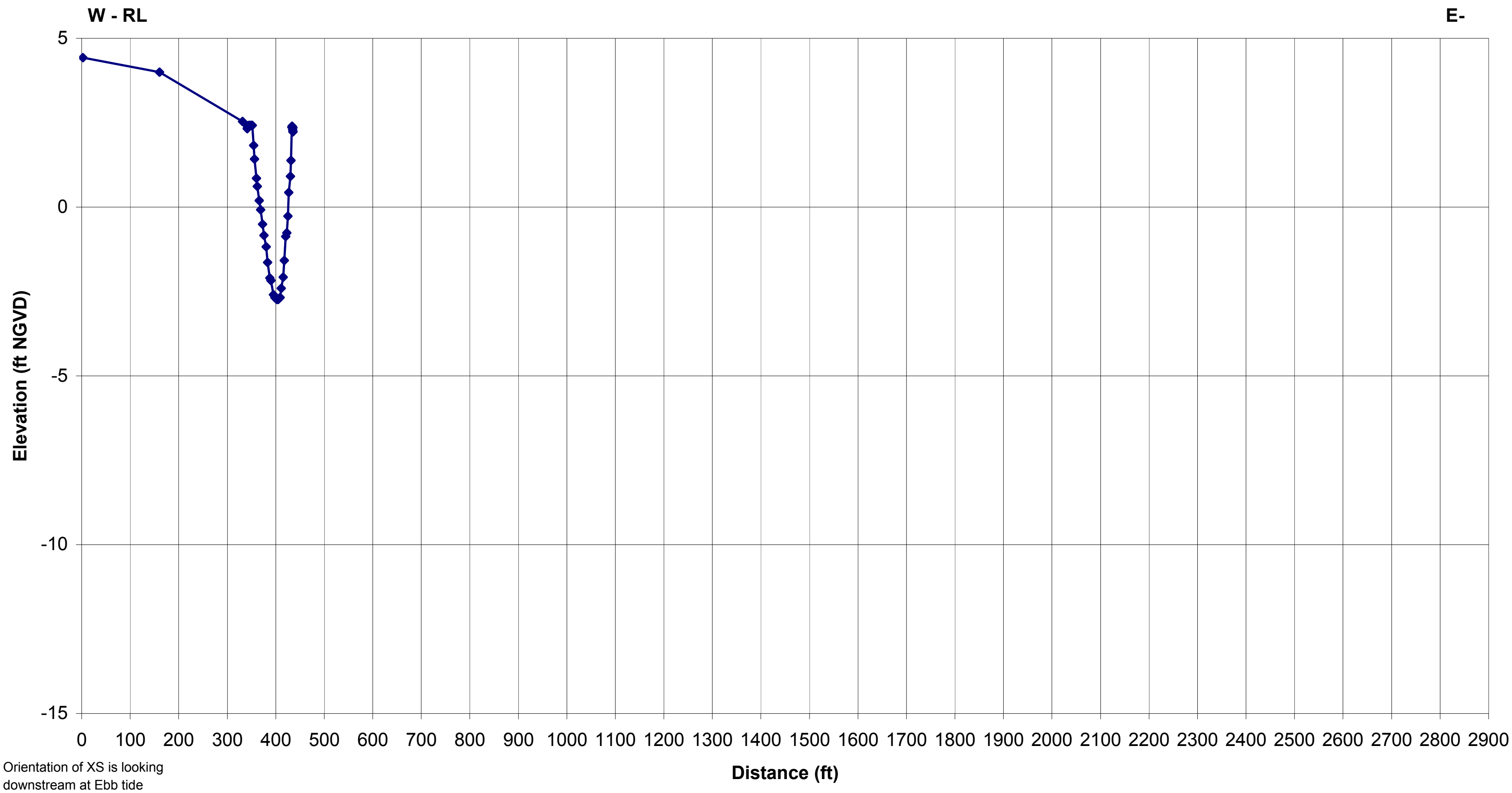


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Ravenswood Slough Downstream XS (XS#5)

November 5, 2004

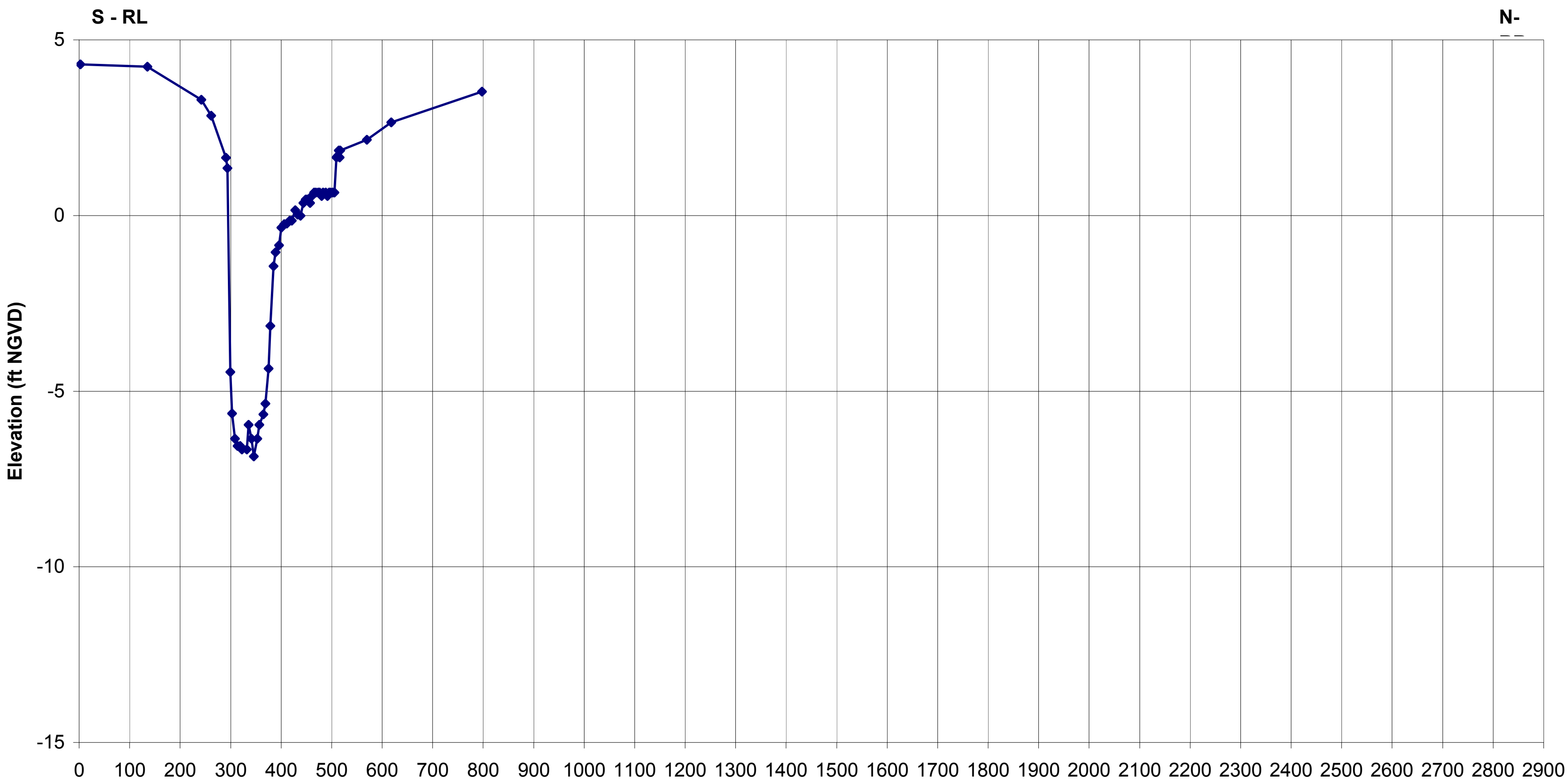


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Ravenswood Slough Upstream XS (XS #6)

November 5, 2004

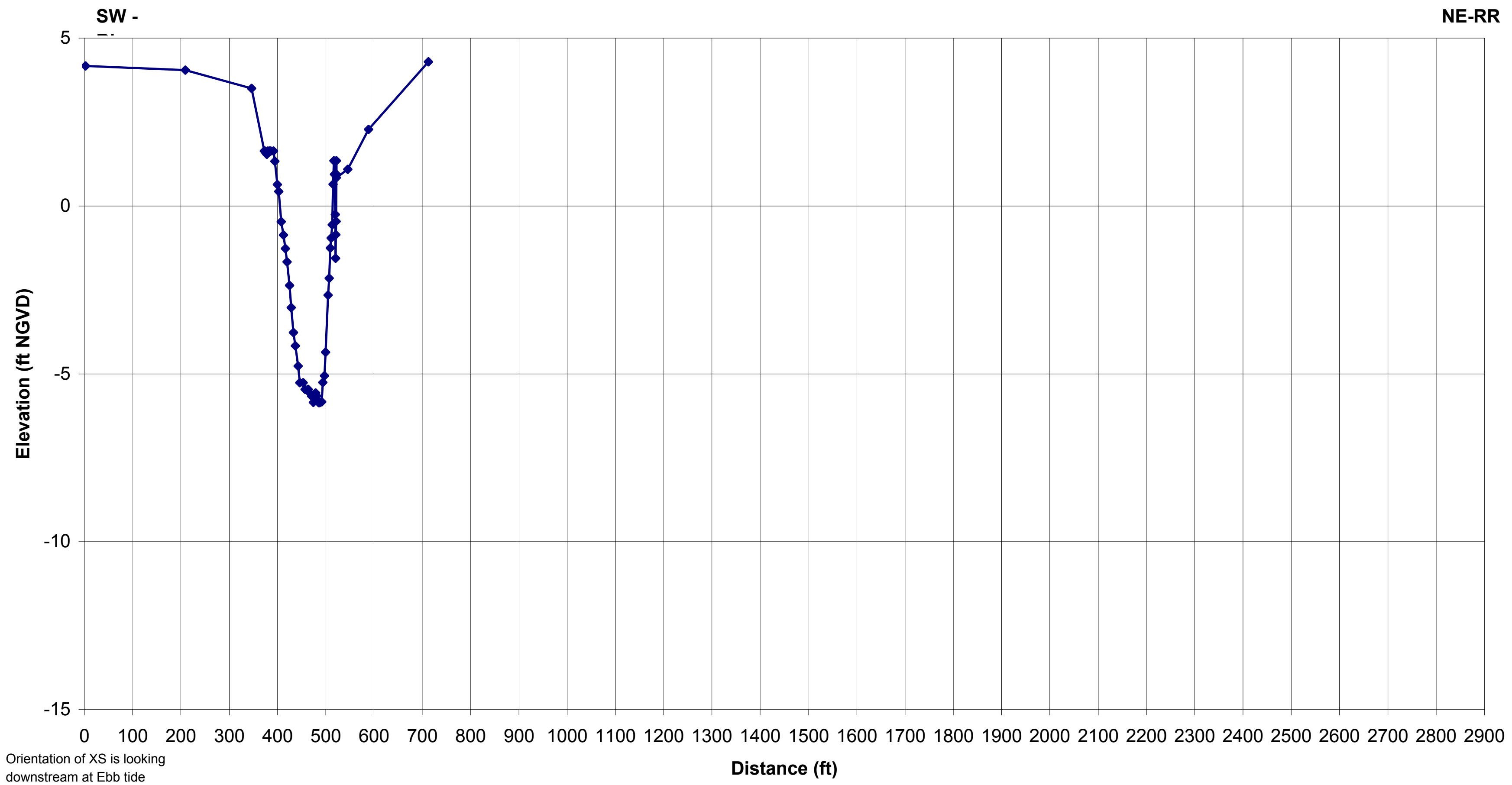


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Coyote Hills Slough Mouth XS (XS#7)

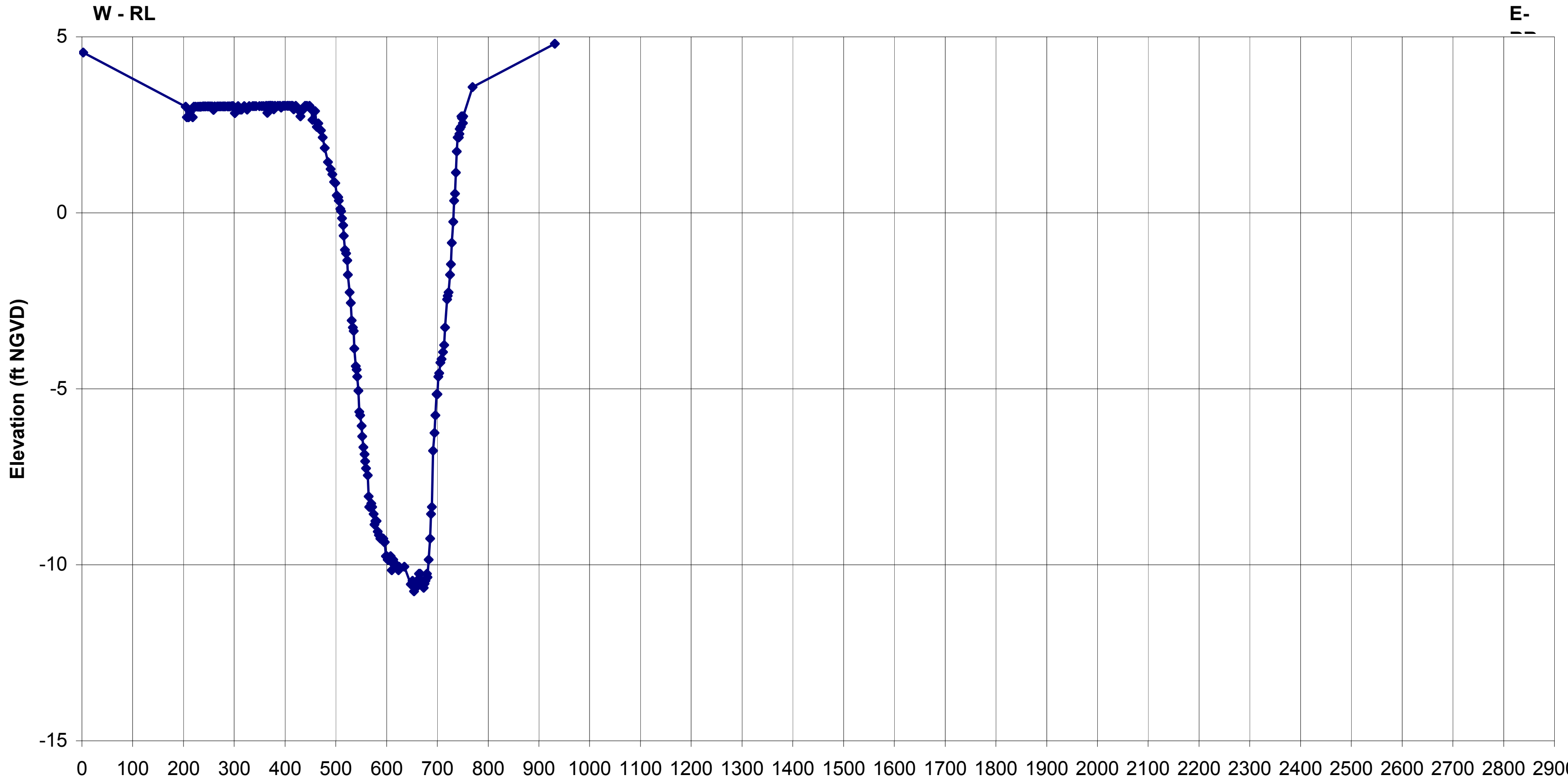
November 5, 2004



Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Coyote Hills Slough Upstream XS (XS#8)

November 5, 2004

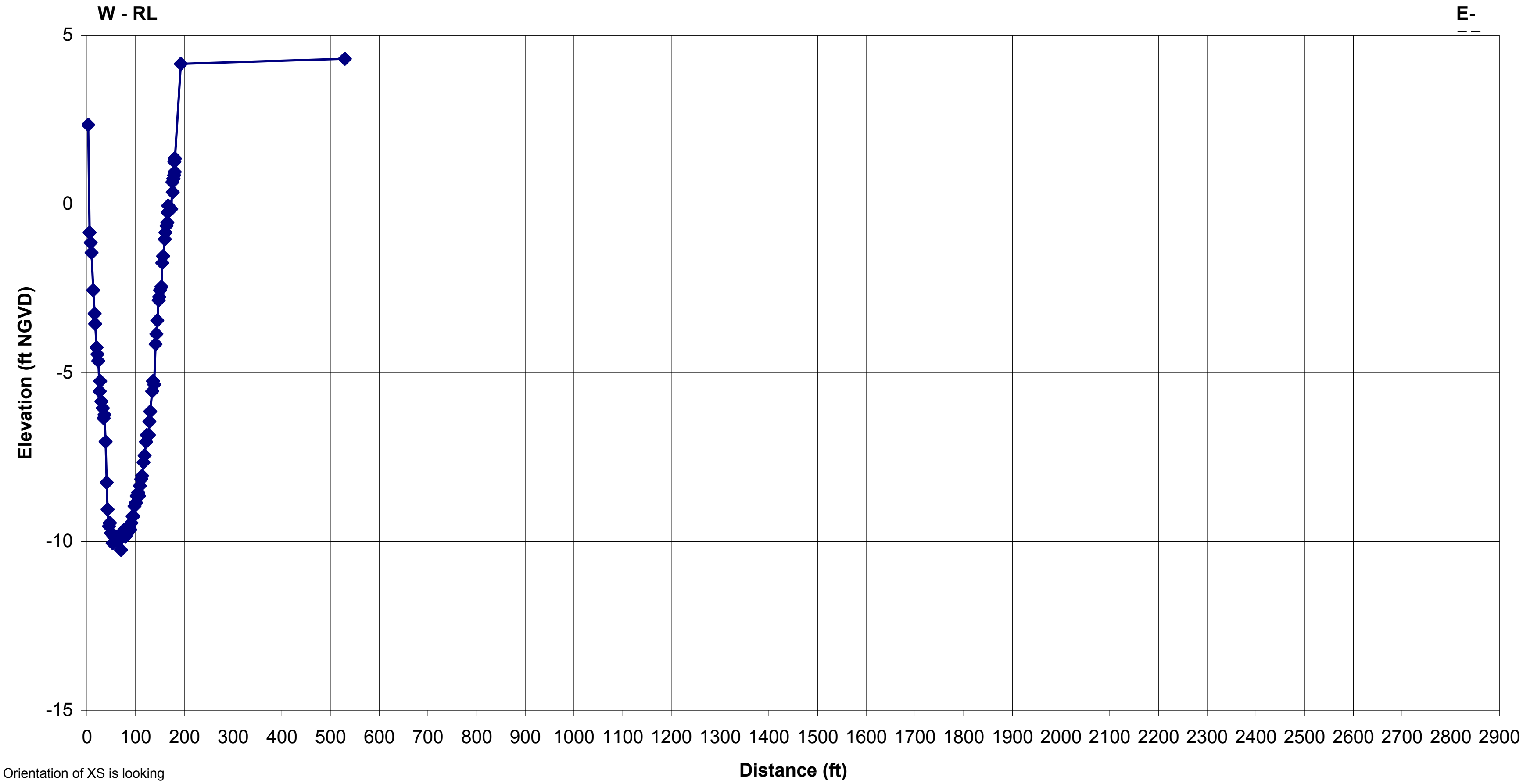


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Guadalupe Slough Mouth Xs - (XS # 9)

October 28, 2004

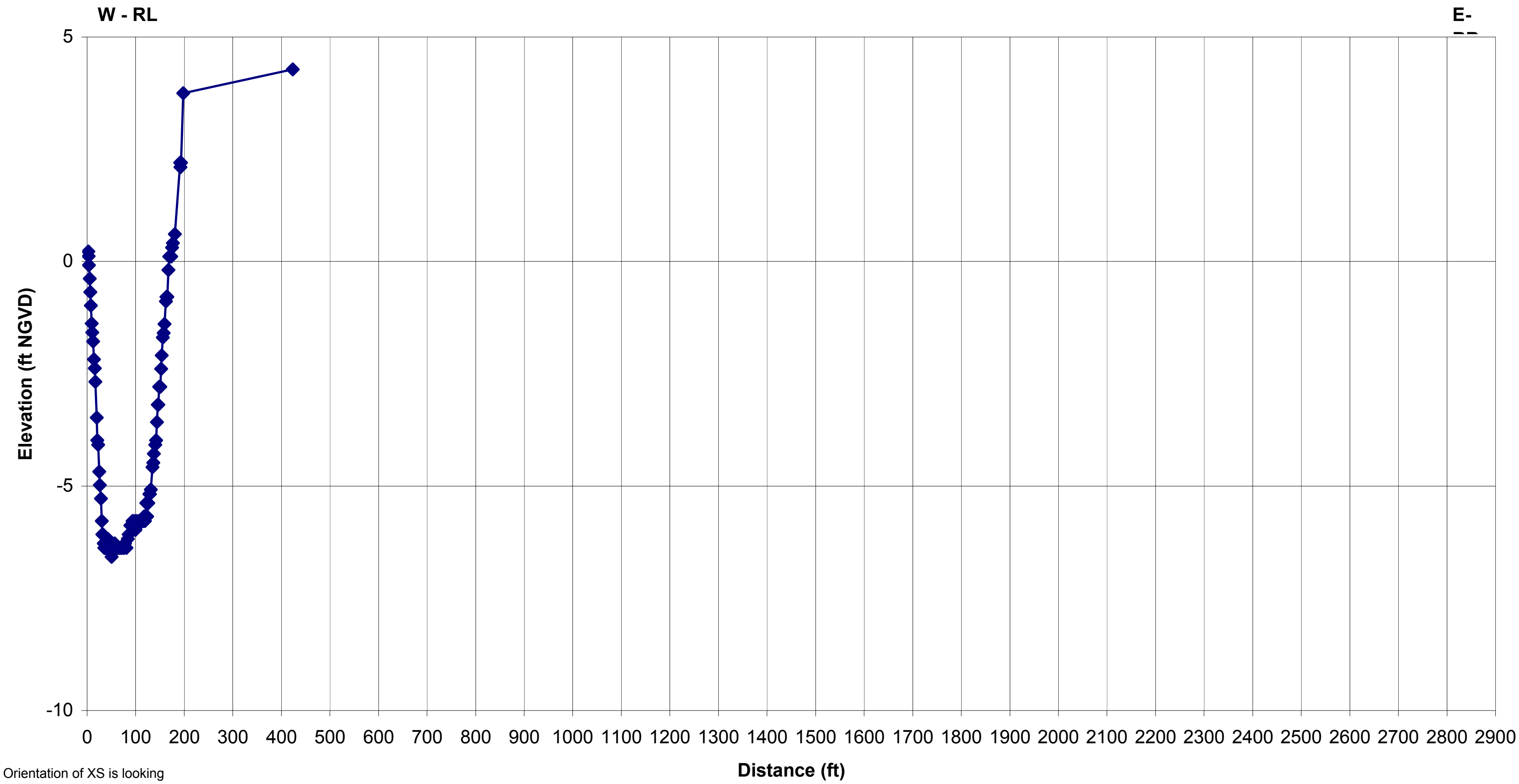


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Guadalupe Slough Mid Xs (XS # 10)

October 28, 2004

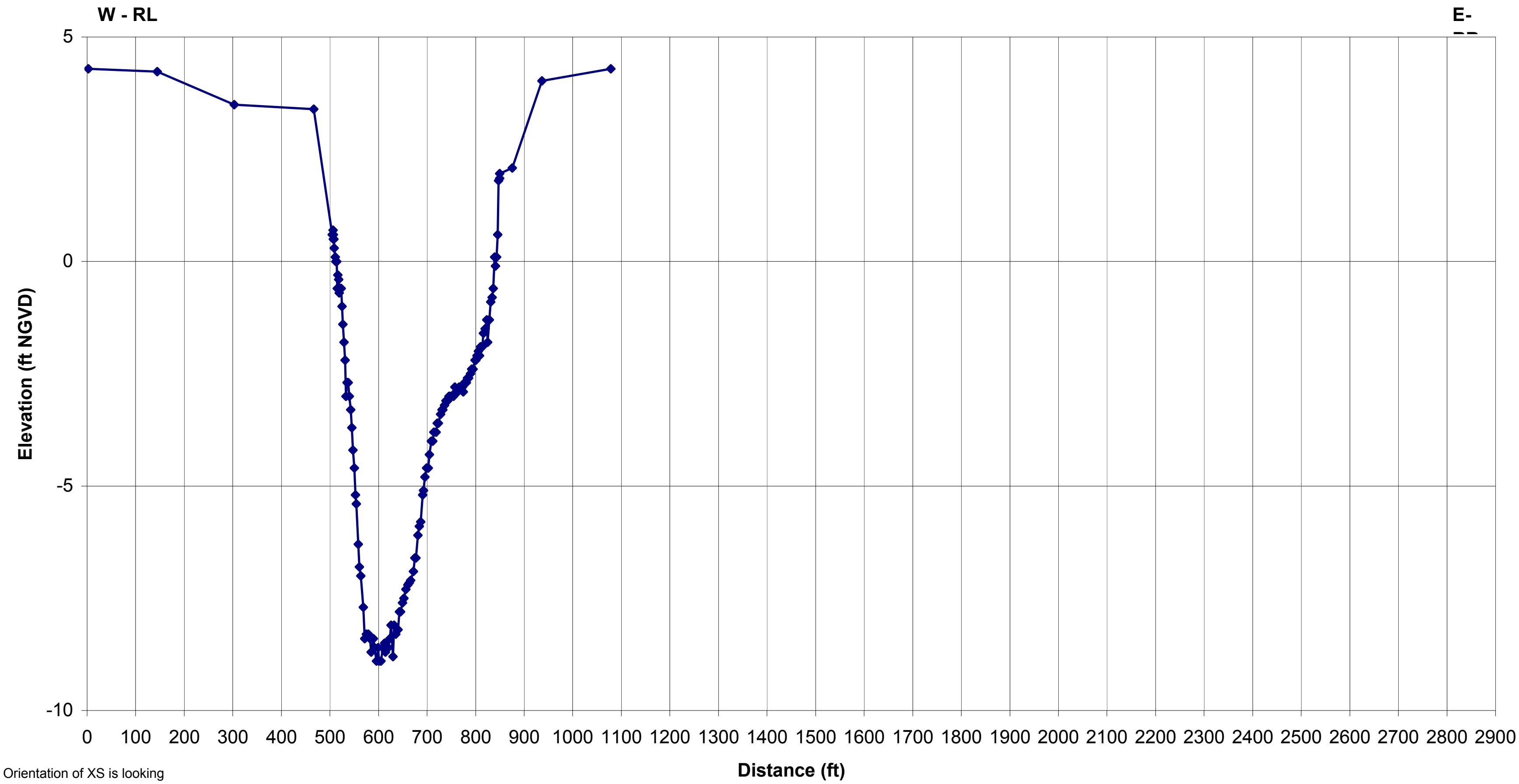


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Guadalupe Slough Upstream XS - Instrument Location (XS # 11)

October 28, 2004

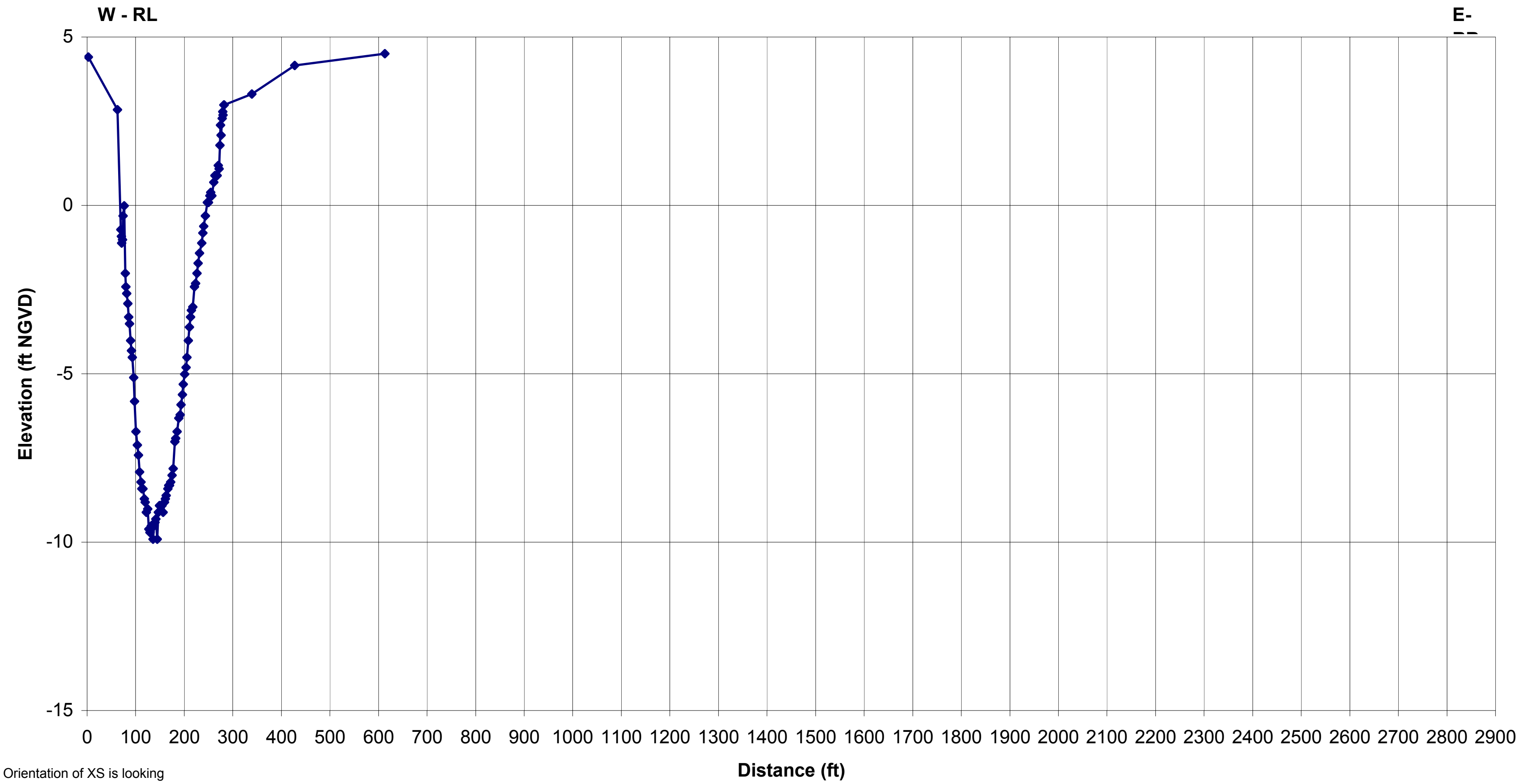


Orientation of XS is looking
downstream at Ebb tide

Environmental
Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Alviso Slough Mid XS - (XS # 12)

October 28, 2004

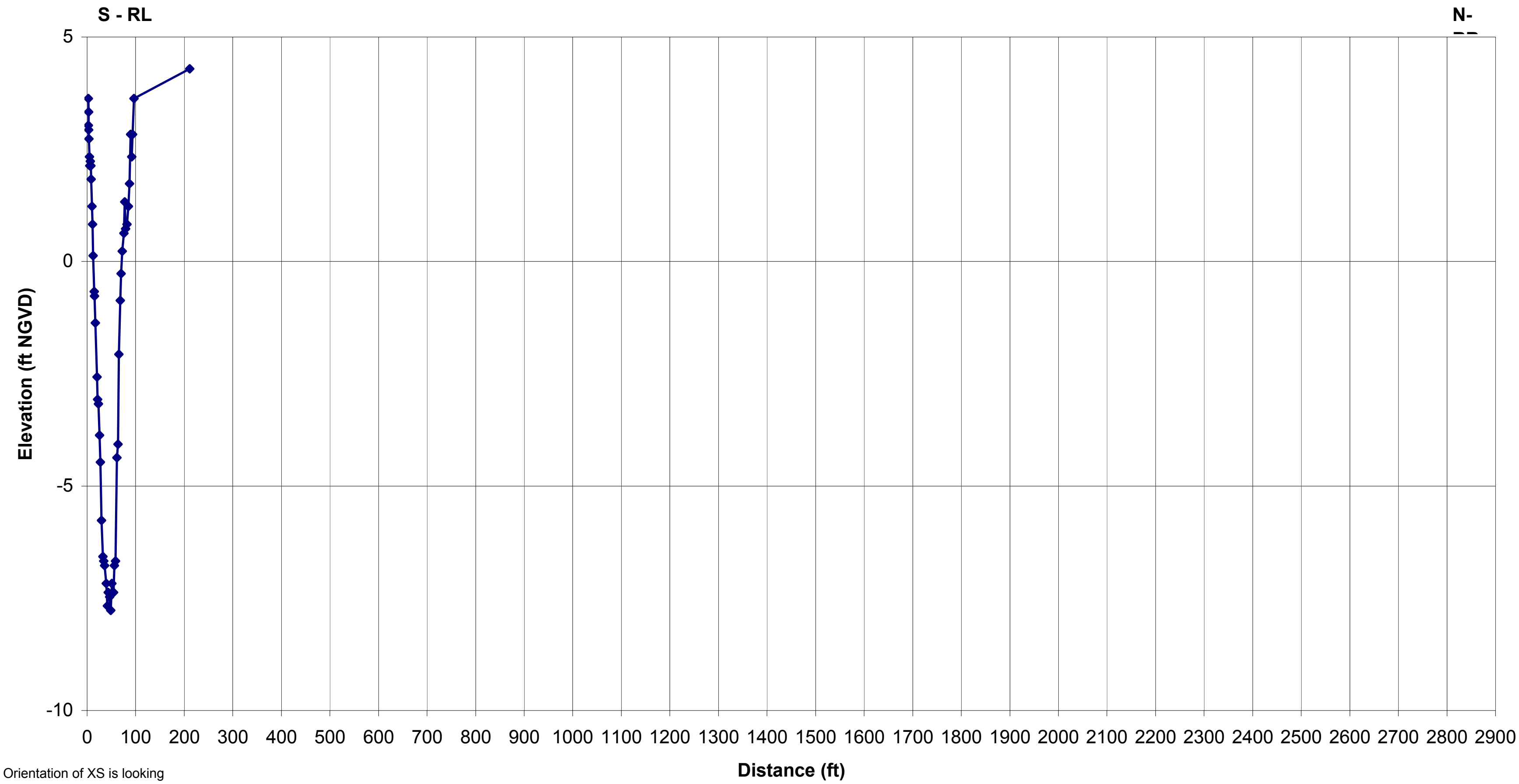


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Alviso Slough Mid XS - (XS # 13)

October 28, 2004

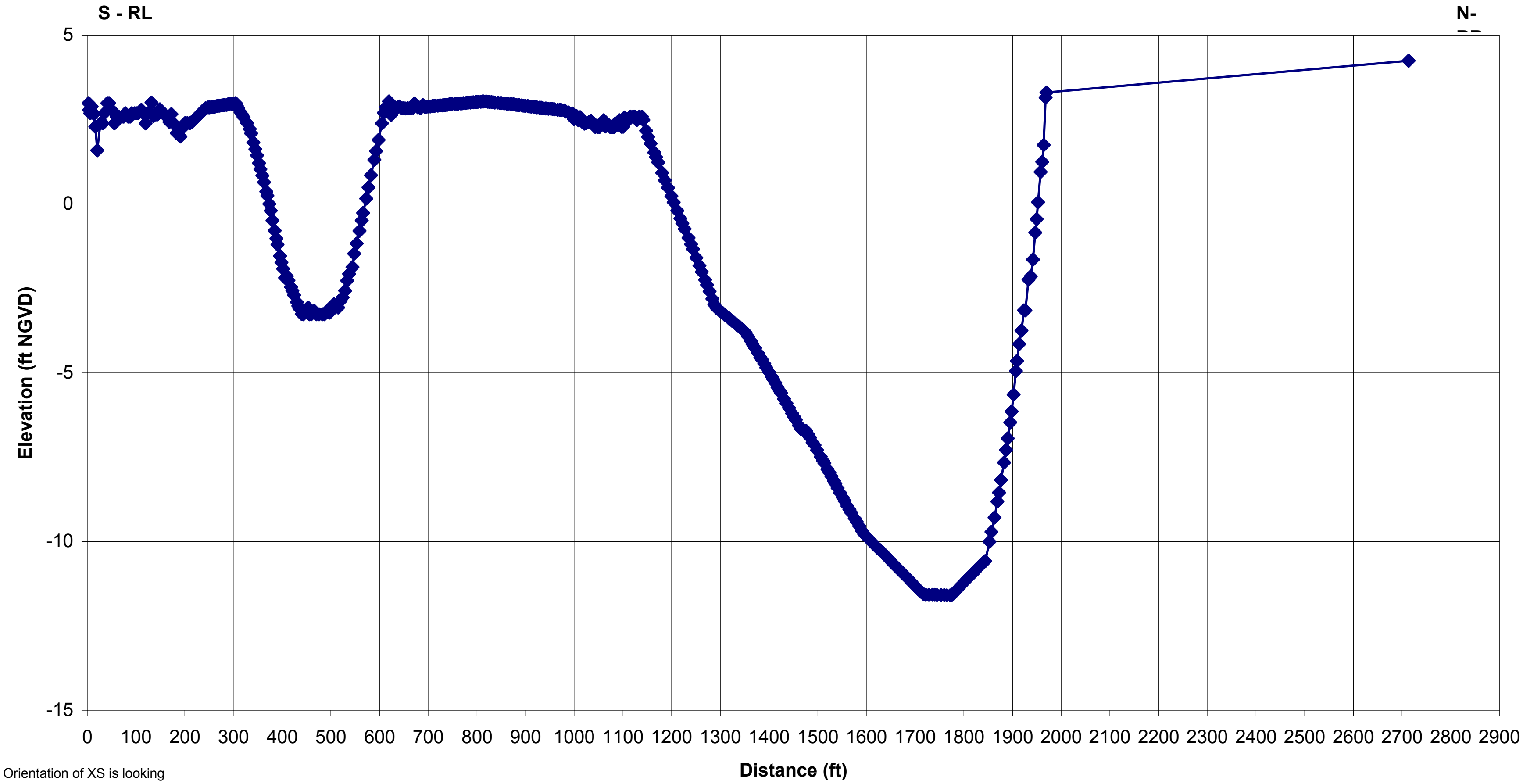


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Alviso Slough Upstream at CTD - (XS # 14)

October 28, 2004

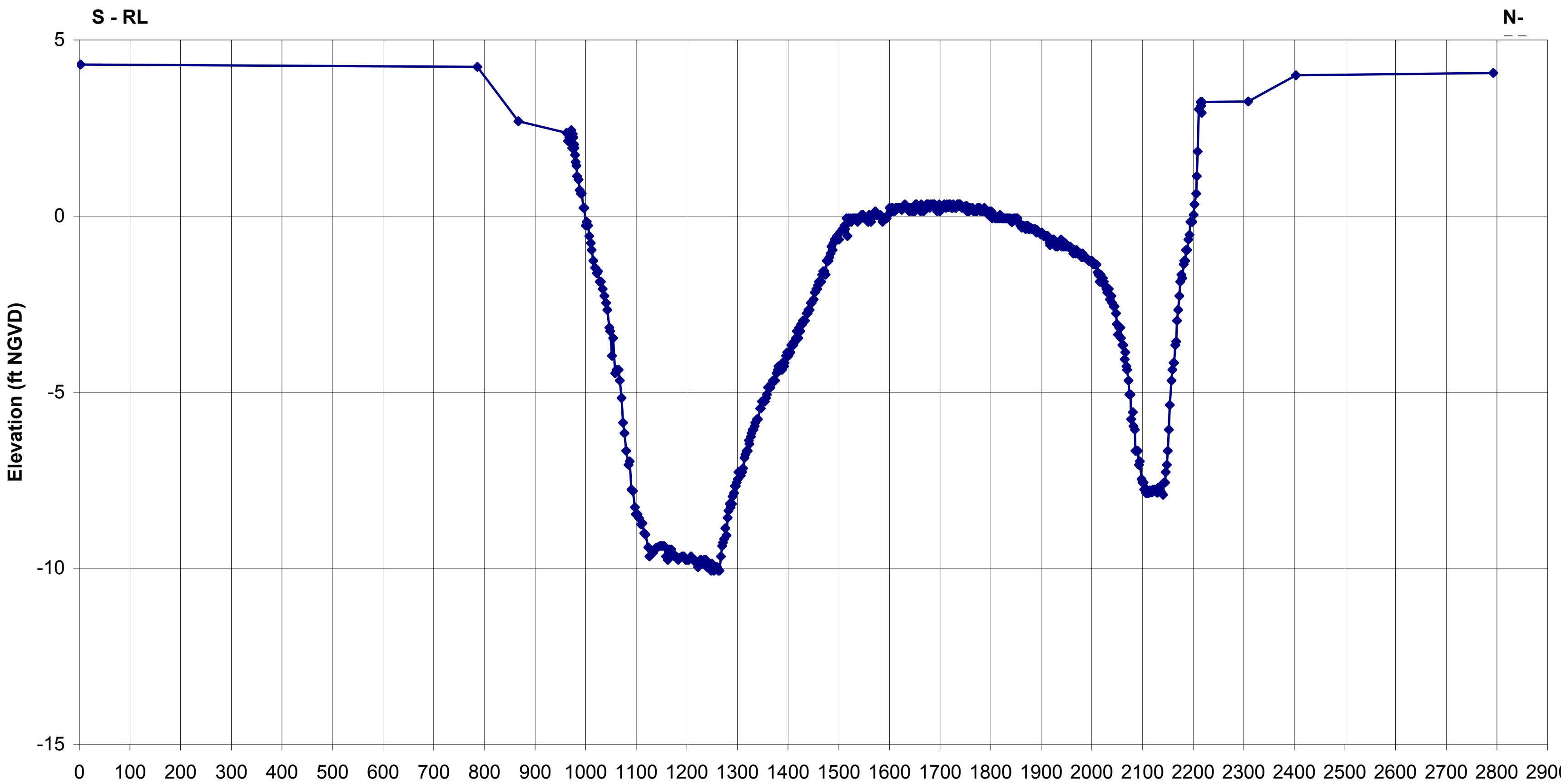


Orientation of XS is looking
downstream at Ebb tide

Environmental
Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Coyote Creek Mouth XS - (XS # 15)

October 28, 2004

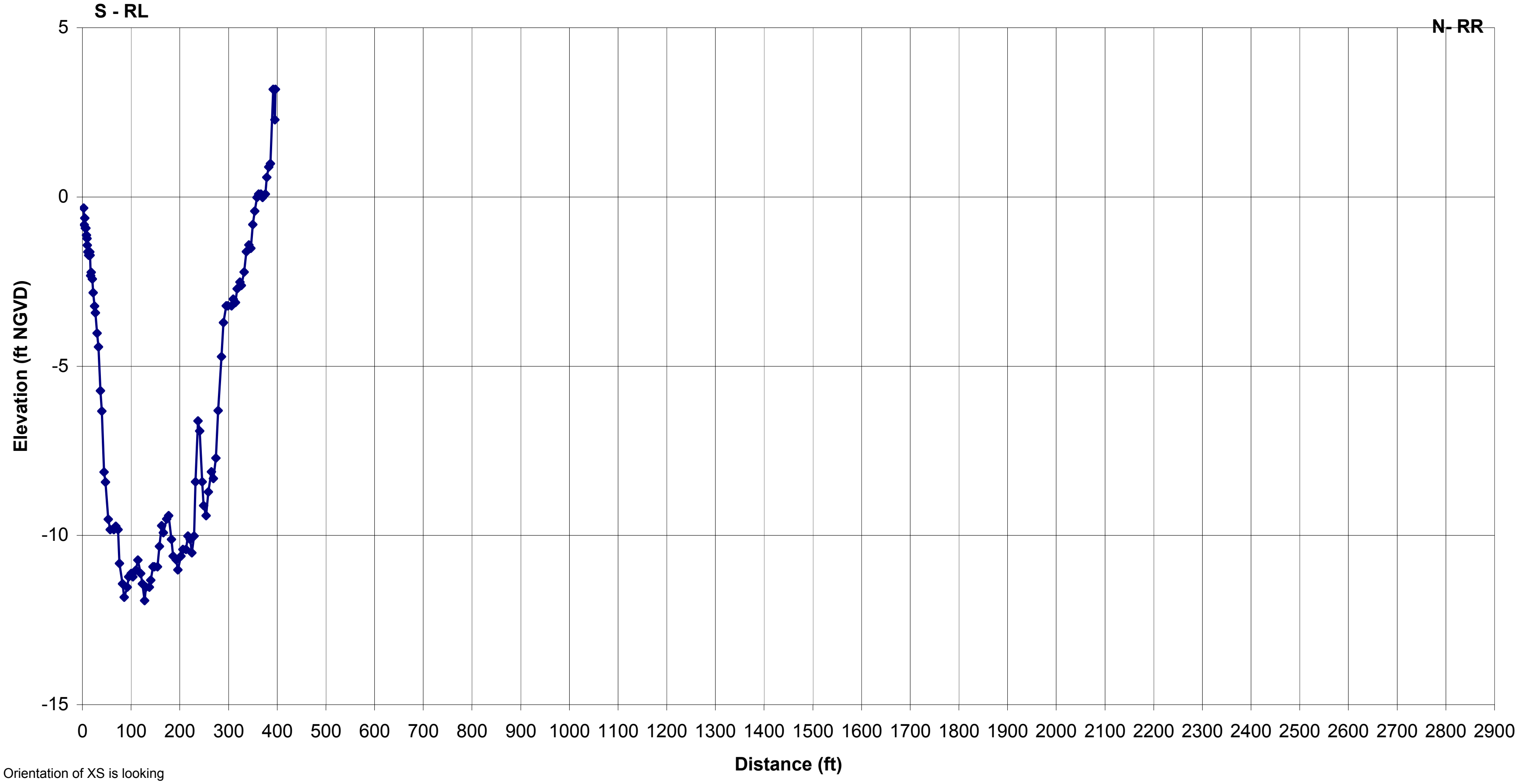


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Coyote Creek Mid-XS (XS#16)

November 5, 2004

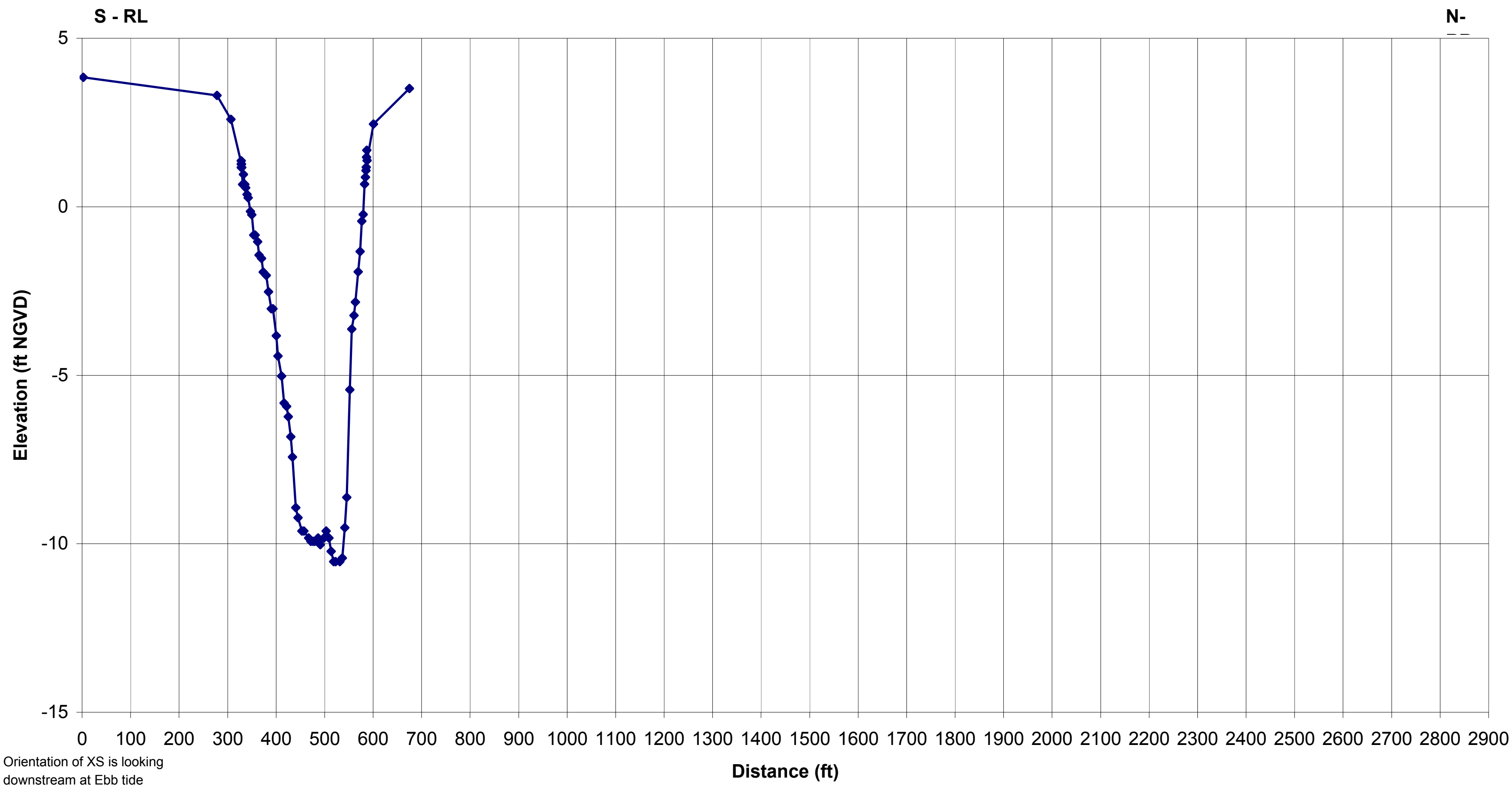


Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Coyote Creek at Railroad Bridge XS (XS#17)

November 5, 2004



Orientation of XS is looking downstream at Ebb tide

Environmental Data Solutions

Southern San Francisco Bay Monitoring
Hydrographic Cross Section Surveys
Coyote Creek Upstream XS (XS#18)

November 5, 2004

APPENDIX C

EDS 2003 FIELD DEPLOYMENT PLAN

South San Francisco Bay Water Level, Conductivity and Temperature Monitoring
-Field Plan and QA Protocols

Prepared for
Dilip Trivedi
Moffatt & Nichol Engineers
2001 North Main Street, Suite 360
Walnut Creek, CA 94596

Prepared by
Environmental Data Solutions
1010 B Street
Suite 425
San Rafael, CA 94901

December 15, 2003

Environmental
Data Solutions

1. INTRODUCTION

This document outlines specific protocols that will govern the planning, deployment, maintenance and demobilization of each instrument and associated mooring in a manner that will ensure an accurate and robust time series.

2. PRE DEPLOYMENT INSTRUMENT CHECK OUT

Prior to the deployment of each instrument, the following set of protocols will be performed. Each instrument will have a corresponding deployment certification outlining the results of each test.

2.1 Water Level Recording

1) Batteries at 100%
2) Check Desiccant
3) Check and lubricate O-ring seals
4) Perform an open-air calibration; Instrument needs to read 0.00 out of the water
5) Perform a submerged calibration: immerse transducer in a column of water and note reading and corresponding water level.
6) Check memory capacity
7) Program data logger to record 30 readings at 1-second intervals every 12 minutes than average and record with a time and date stamp.

2.2 Conductivity, Temperature and Depth Recording (CTD)

1) Batteries at 100%
2) Check and lubricate O-ring seals
3) Perform an open-air calibration; Instrument needs to read 0.00 out of the water – for pressure transducer component
4) Clean then calibrate conductivity electrodes using three conductivity standards: 100 ms, 1,400 ms and 58,000 ms. Establish a conductivity constant cell for each instrument (Radtke, Davis and Wilde, 1998) and record.

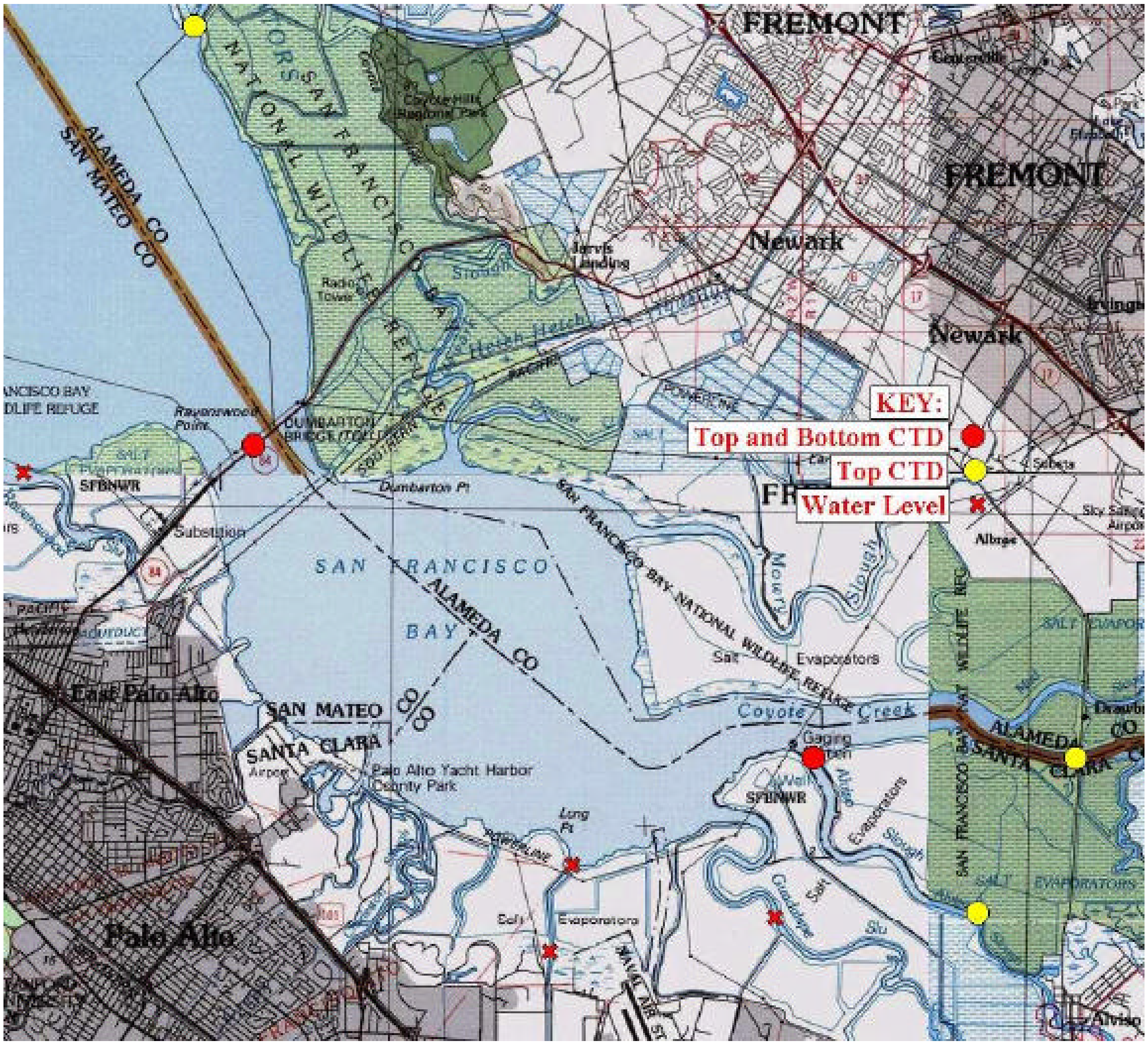
3. MONITORING LOCATIONS, MOORING TYPES AND DEPLOYMENT PROCEDURES

3.1 Instrument Locations

3.1.1 Water Level Recording Stations

As of the date of this writing (12/15/03) 4 stand-alone, submersible pressure transducers will be deployed within the thalweg of the following channels (Figure 1):

1) Guadalupe Slough channel mid-point
2) Mouth of Stevens Creek
3) Stevens Creek mid-point
4) Mouth of Ravenswood Slough



NOTE:
Top CTD stations will also double for water level recording stations.
Bay Bridge top and bottom array not shown

NOTE: all locations are approximate
Photo Source: USGS Quad Sheet

3.1.2 CTD Stations

A total of 5 CTD stations will be deployed throughout the project area (Figure 1):

1) Coyote Creek at the Railroad Bridge
2) The mouth of Alviso Slough
3) Alviso Slough mid-point
4) The Dumbarton Bridge
5) Coyote Hills Slough

The Dumbarton Bridge and Alviso Slough (mouth) station locations will consist of a self-contained CTD sensor approximately half the distance from MLLW to the channel bottom and a second sensor approximately 2 – 3 ft below approximate MLLW.

The remaining sites (Coyote Creek, Alviso Slough mid-point and Ravenswood Slough) locations will consist of one sensor just below expected MLLW.

3.2 Mooring Types and Deployment Procedures

3.2.1 Water Level Recording

Each water level recording station will contain a pressure transducer mounted to a mooring structure that will rest on the thalweg of the aforementioned channels. The mooring device will consist of a small metal frame that has a footprint of 3 ft x 3 ft. The instrument will be attached to a small spindle located in the middle of the structure. A 50 lb lead weight will be attached to each corner of the mooring device.

Two “drag chains” will also be attached to 2 of the 4 corners of the mooring, laid-out and attached to either an existing fixed object (pilings at Ravenswood Slough and the mouth of Stevens Creek), or an anchor that will be dug into the mud. The mooring itself, and the drag chain endpoints, will have a sub-meter GPS point assigned to them.

A permanent staff gage will be installed in the vicinity of each water level station to provide an independent source of water level verification. At the time of deployment, the water level on the staff gage and time will be noted when the instrument is scheduled to record the first point. This instrument reading will correspond to a concurrent staff reading and the difference noted. It is this difference that will act as a monitor for possible instrument drift; This difference should always be constant.

A temporary benchmark (tbm) will be installed in the vicinity of each instrument location and a set of levels between the tbm, water surface elevation and staff gage will be taken. This set of levels will serve as another layer of “drift monitoring checks” and will eventually be used to tie-in the water level time series to a vertical datum.

All deployment QA protocols will be repeated each time the instruments are serviced and demobilized.

3.2.2 CTD Recording

Each CTD location is unique and therefore requires custom moorings that take advantage of individual site characteristics.

- Dumbarton Bridge

Both CTD sensors will be attached to a stainless steel cable and suspended in a gap between the bridge pier (the pier east to the east of the main ship channel) and boat fender. A 200 lb weight will keep the instrument array stable has it is suspended in the water column. The cable will be attached to an existing shackle that is bolted to the pier at this location (as noted during the November 24th site reconnaissance).

The channel is approximately 42 feet deep at this location (at MLLW): The top sensor will be attached approximately 2- 4 feet below MLLW and the bottom sensor will be attached 20 feet below the top sensor.

- Alviso Slough Mouth

The field crew will use the same mooring type at this location as with the Dumbarton Bridge location. The instrument array will be attached to the NW footing of a PG&E power tower located at the junction of Coyote Creek and Alviso Slough. The channel is approximately 10 feet deep at this location (MLLW): The top sensor will be mounted approximately 1 - 2 feet below MLLW and the bottom sensor will be attached 5 – 7 below the top sensor.

- Coyote Creek at Railroad Bridge

A “top” CTD will be mounted on an existing dolphin that is located on the north side of the channel, just west of the Railroad bridge. This sensor will be bolted to the bottom of a galvanized pipe, which will be mounted to the dolphin. The channel is approximately 4 feet deep at MLLW: The sensor will be mounted 1 foot below MLLW.

- Alviso Slough Channel Mid-Point

The channel is approximately 5 ft deep at MLLW and there are no fixed structures in this reach. As a result, this sensor will be attached to the same type of mooring device that will be utilized at the water level recording stations. The sensor will be mounted approximately 2 off the channel bottom. This location poses the biggest vandalism risk that results in the need to keep the sensor as far below the surface as possible at MLLW.

- Coyote Hills Slough

There are no fixed structures within Coyote Hills Slough, resulting in the need to utilize a fixed, bottom-mounted mooring. Since this channel experiences relatively high flows, the field crew will affix the mooring in place using a 1 inch, galvanized pipe that will be driven into the channel bottom. The weighed mooring spindle will then be “threaded” around this pipe and dropped to the bottom. This deployment will take place at the lowest tide possible.

As with the water level recording stations, a staff gage and temporary benchmark will be installed near the CTD stations; A staff gage reading and water surface elevation survey point will be taken and recorded during deployment, each servicing event and demobilization.

A separate, hand held conductivity meter and refractometer will be used to record a data point during CTD deployment and servicing. These independent data points will be used as a sensor drift monitoring check. If sensor drift is identified, than these independent data points can be used to post-calibrate a time series if necessary.

Pre-deployment calibration procedures (utilizing conductivity standards) will be employed on each sensor when the sensors are removed.

4.0 BATHYMETRIC SURVEYING

All hydrographic cross section surveys shall use Class 1 methods and accuracies as outlined in the U.S. Army Corps of Engineers *Hydrographic Surveying Manual* (EM 1110-2-1003, October 1994). Soundings shall be horizontally referenced to the NAD-83 California State Coordinate System, Zone 3, and vertically to MLLW and NGVD (after corrections are made for tide).