Introduction

Dayflow calculations for water year 2004 were completed in February 2005. It was necessary to modify the Dayflow computational scheme to calculate X2 during the Jones Tract levee breach. Dayflow documentation and output files are available on-line at http://www.iep.ca.gov/dayflow/.

X2 Estimation

To simulate the flow into Jones Tract as a result of the levee breach, estimated flow values were assigned to the Dayflow parameter QMISDV (Table 1). These values were estimated by DWR's Emergency Response and Beneficial Reuse Unit.

Date	Estimated Flow into Jones Tract, cfs	QOUT
June 3, 2004	37,812	-29,087
June 4, 2004	25,208	-15,402
June 5, 2004	12,604	-3,349

Table 1: Estimated Flow into Jones Tract from beginning of levee breach until equalization

These flow values were large enough to result in negative values of QOUT[1]:

$$QOUT = QTOT + QPREC - QGCD - QEXPORTS - QMISDV$$

It is not possible to use the Autoregressive Lag equation[1] to calculate X2 for negative values of QOUT, because the log of a negative number is not defined:

$$X2(t) = 10.16 + 0.945 X2(t-1) - 1.487 \log(QOUT(t))$$

An analysis of EC data was performed to estimate the location of X2 for June 3 – June 5. By analyzing bottom EC data at several locations, we determined that X2 was between Sacramento River at Pittsburg (RSAC077) and San Joaquin River at Antioch (RSAN008). EC data for these 3 days are available at these two stations and at Sacramento River at Collinsville (RSAC081).
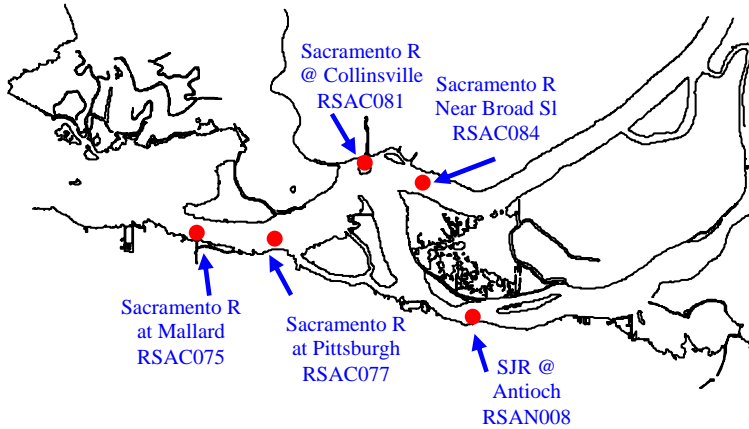
Figure 1: Stations with EC data and/or salinity unit conversion equations

The Water Year Hydrologic Classification Index for water year 2004 was 7.5, which falls into the Below Normal year type[2]. The Sacramento Valley Water Year Hydrologic Classifications are listed in Table 1:

Year Type	Water Year Index
Wet	WSI>=9.2
Above Normal	7.8<WYI<=9.2
Below Normal	6.5<WYI<=7.8
Dry	5.4<WYI<=6.5
Critical	WYI<=5.4

Table 2: WSIHIST Water Year Classification Indices

DWR's Salinity Unit Conversion Document[3] provides equations for converting EC to TDS at Mallard (RSAC075), Sacramento River near Broad Slough (RSAC084), and San Joaquin River at Antioch (RSAN007). Equations are provided for various water year types, including wet, dry, and normal.

No conversion equations were provided for the Below Normal water year type. The results of the normal and dry equations were linearly interpolated (Figure 2).

Assuming that the Normal equation is most accurate for a Water Year Index range centered on 7.8, and that the Dry equation is most accurate for a Water Year Index range centered on 5.4+0.5*(6.5-5.4) = 5.95, then the best estimate of TDS concentration for a WYI of 7.5 would found by interpolation:

$$\frac{TDSnormal - TDSdry}{7.8 - 5.95} = \frac{TDS(WYI = 7.5) - TDSdry}{7.5 - 5.95}$$

$$TDS(WYI = 7.5) = (7.5 - 5.95)\left[\frac{TDSnormal - TDSdry}{7.8 - 5.95}\right] + TDSdry$$

Figure 2: Interpolation by water year index of results of Normal and Dry Salinity Unit Conversion Equations

No conversion equations were provided for the stations RSAC077 and RSAC081, or for the Below Normal water year type. EC values were converted to TDS using the normal and dry equations for the stations RSAC075 and RSAC084. The results were then interpolated by location and water year index to estimate TDS for RSAC077 for a water year index of 7.5. Results are summarized in Tables 3a-3c and Tables 4a-4c.

Date	RSAC077 EC, umhos/cm	TDS, mg/L Using RSAC075 normal equation	TDS, mg/L Using RSAC075 dry equation	Below Normal Interpolated TDS
6/3/2004	4789	2798	2900	2814
6/4/2004	6576	3848	4016	3876
6/5/2004	8441	4944	5180	4983

Table 3a: Interpolation by water year index of results of normal and dry salinity unit conversion equations for station RSAC075 using RSAC077 EC values

Date	RSAC077 EC, umhos/cm	TDS, mg/L Using RSAC084 normal equation	TDS, mg/L Using RSAC084 dry equation	Below Normal Interpolated TDS
6/3/2004	4789	2789	2829	2795
6/4/2004	6576	3827	3889	3837
6/5/2004	8441	4909	4995	4923

Table 3b: Interpolation by water year index of results of normal and dry salinity unit conversion equations for station RSAC084 using RSAC077 EC values.

Date	Spatially Interpolated RSAC077 TDS, mg/L
6/3/2004	2810
6/4/2004	3867
6/5/2004	4969

Table 3c: Spatially interpolated TDS

Date	RSAC081 EC, umhos/cm	TDS, mg/L Using RSAC075 normal equation	TDS, mg/L Using RSAC075 dry equation	Below Normal Interpolated TDS
6/3/2004	2336	1356	1369	1358
6/4/2004	3888	2268	2338	2279
6/5/2004	5366	3136	3261	3157

Table 4a: Interpolation by water year index of results of normal and dry salinity unit conversion equations for station RSAC075 using RSAC081 EC values

Date	RSAC081 EC, umhos/cm	TDS, mg/L Using RSAC084 normal equation	TDS, mg/L Using RSAC084 dry equation	Below Normal Interpolated TDS
6/3/2004	2336	1364	1373	1366
6/4/2004	3888	2265	2294	2270
6/5/2004	5366	3124	3171	3132

Table 4b: Interpolation by water year index of results of normal and dry salinity unit conversion equations for station RSAC084 using RSAC081 EC values

Date	Spatially Interpolated RSAC081 TDS, mg/L
6/3/2004	1360
6/4/2004	2277
6/5/2004	3151

Table 4c: Spatially interpolated TDS

For station RSAN008, the conversion equations provided for station RSAN007 were used. Only water year index interpolation was required:

Date	RSAN008 EC, umhos/cm	TDS, mg/L Using RSAN007 normal equation	TDS, mg/L Using RSAN007 dry equation	Below Normal Interpolated TDS
6/3/2004	1049	596	598	596
6/4/2004	1938	1101	1109	1101
6/5/2004	2962	1682	1698	1685

Table 5: Table 4b: Interpolation by water year index of results of normal and dry salinity unit conversion equations for station RSAN007 using RSAN008 EC values

X2 is defined as the location of 2 ppt bottom salinity, which is equivalent to 2,000 mg/L TDS. The location of X2 was estimated by interpolating to find the location of 2,000 mg/L TDS. Table 6 summarizes the results:

	RSAC077	RSAC081	RSAN008	
Distance from Golden Gate, km	77	81	85	Estimated X2, km
June 3, 2004	2810	1360	596	79.23
June 4, 2004	3867	2277	1102	81.94
June 5, 2004	4969	3151	1685	84.14

Table 6: TDS and Estimated X2 values.

References

1. Dayflow web site: http://www.iep.ca.gov/dayflow/

2. DWR WSIHIST Document: http://cdec.water.ca.gov/cgi-progs/iodir/wsihist/

3. DWR Salinity Unit Conversion Document:
http://www.iep.ca.gov/suisun/facts/salin/index.html