

337

# Memorandum

Date : April 20, 1995

To : Tom Howard, Chief  
Bay-Delta Unit  
State Water Resources Control Board  
901 "P" Street  
Sacramento, California 95814

From : Department of Water Resources

Subject: DWRDSM Study: Draft Water Quality Control Plan

In response to your March 23, 1995 request, attached are results of a DWRDSM study conducted to simulate Delta water quality conditions resulting from the December 1994 draft Water Quality Control Plan. If you have any questions, please call me.

*Francis Chung*  
Francis Chung  
Supervising Engineer  
CALNET 453-5601

Attachment

# Estimating Water Quality Conditions in the Delta Under the December 1994 Draft Water Quality Control Plan

Division of Planning  
DWR  
April 20, 1995

## Summary

The State Water Resources Control Board requested the DWR to conduct hydrodynamics and water quality simulations comparing a draft Water Quality Control Plan hydrology representative of the December 15, 1994 Delta accord (DWRSIM study 1995c6b-SWRCB-409), to a "base" study hydrology, representative of nominal D1485 operations (DWRSIM study 1995c6b-MONTEREY-412). The DWR Delta Simulation Model was used to estimate monthly average flow, stage, and salinity for the period from water year 1987 through water year 1992. (memo from Tom Howard, March 23, 1995; Attachment I).

The request was made in response to comments received by the Board on the draft Plan. The comments regard 1) the potential impacts on water quality in the central Delta due to new Delta Cross-Channel (DCC) operation rules increased flow on the San Joaquin River, and 2) the water quality needs for irrigation and leaching in months not covered by the agricultural standards in the Plan.

## **Findings:**

Monthly or semi-monthly average time-series salinity at ten locations for water years 1987 through 1992 are shown in Figures 1 through 10. Several observations can be made on the basis of these results:

Under the draft Plan hydrology, salinity at central delta stations (Jersey Point, San Andreas, and Prisoners Point) increase significantly during the November through January period when the DCC is closed the first half of each month. The increase persists into February when the DCC is closed continuously. The Terminous station shows similar increases but tends to lag by one month. The magnitude of delta outflow in the plan study is only slightly greater than the base in the November through January period (Figure 11A).

Under the draft Plan, the DCC is continuously closed between February and June, and delta outflow is 15 to 66% greater over the same period compared to the base (Figure 11B). The result is generally lower spring and summer salinity at Jersey Point, San Andreas, Prisoners Point, and Terminous in the Plan (Figures 2, 3, 4, 5). The increase in delta outflow is attributable mainly to reductions in project export to meet X2 requirements and export/inflow ratios.

Draft Plan agricultural water quality standards are satisfied within the bounds of model accuracy for the central and north delta stations requested for analysis by the Board. Standards in the south delta are often exceeded however because DWRSIM was run using a 70 TAF cap on flows released to the San Joaquin River for water quality purposes. As a result, standard exceedences occur in dry and critical years during the April through August period when the standard is 0.7 mmhos/cm.

South delta water quality is only marginally affected by DCC operation. Most salinity differences between the draft Plan and the base hydrology are due to temporal differences in inflow and export magnitudes.

The body of this report presents the study request, modeling assumptions, results and discussion.

## Background

The State Water Resources Control Board (Board) requested the DWR to conduct hydrodynamics and water quality simulations to determine the effect of the 1994 draft Water Quality Control Plan (draft Plan) standards on water quality in the delta (memo from Tom Howard, March 23, 1995; Attachment I). Board hearings to solicit comments on the draft Plan identified concerns about the impact of the DCC operation on water quality in the north and central delta. Specifically, concerns were raised about the effect of increased San Joaquin River flow and DCC closure during the irrigation and leaching months not covered by agricultural standards in the draft Plan.

The Board requested that the simulations be conducted using hydrology generated by statewide reservoir operations studies (DWRSIM). A "base" study hydrology, representative of nominal D1485 operations (DWRSIM study 1995c6b-MONTEREY-412), and a "draft Plan" study hydrology, representative of the December 15 1995 Delta accord (DWRSIM study 1995c6b-SWRCB-409), were identified. Using these studies as input hydrology, the DWR Delta Simulation Model was used to estimate monthly average flow, stage and salinity for the period from water year 1987 through water year 1992.

The Board requested model output results for ten delta locations including hydrodynamics as instantaneous maximum, minimum, and average monthly flows, and water quality as average monthly electrical conductivity. The ten output locations are shown in Figure 13.

## Modeling Approach and Assumptions

The following assumptions were used for modeling delta hydrodynamics and water quality under monthly changing hydrologic conditions generated by DWRSIM studies 1995-Monterey-412 (base) and 1995-SWRCB-409 (plan). Assumptions are required with regard to delta temporary barrier operation, DCC operation, Montezuma Slough operation, Clifton Court Forebay operation priority, and San Joaquin River boundary input salinity. The assumptions used are listed below.

- 1) Simulation Model: Hydrodynamics and water quality modeling was conducted using the DWR Delta Simulation Model (DWRDSM). A description of the model with verification results is given in WRINT DWR-134A (Attachment II). The computational grid is shown in Figure 13.
- 2) Montezuma Slough Control Structure Operation. In recent years, the Montezuma Control Structure has been operated as a tidal pump between October and May in all year-types except wet years (40-30-30 year-type classification). Since only critical and below-normal years were modeled (water-years 1987 through 1992), the gates were operated in the model each year between October and May. When the control structure was not operating, all radial gates and flash boards were removed.
- 3) Temporary Delta Barriers. Since 1987, three temporary rock barriers have been deployed in the delta at the Old River head, Old River near DMC, and Middle River near Victoria Island. For planning purposes, a nominal installation and removal schedule representative of the historical pattern was devised. This installation and removal schedule was used identically in the base and plan studies as follows:

	<u>Installed</u>	<u>Removed</u>
Middle River barrier:	May 1	September 30
Old River head barrier	September 1	November 30
	and May 1	May 30
Old River near DMC	May 1	October 1

- 4) Delta Cross-Channel: The draft standard requires that the DCC be closed 45 days between November 1 and January 31, closed continuously between February 1 and May 20, and closed four consecutive days each week excluding weekends between May 21 and June 15. The DWRSIM operation studies model the 45 day November through January requirement by averaging 15 days open and 15 days closed in the delta cross-transfer calculation. Similarly, the May requirement is simulated for 20 days closed and 11 days open. The DWRSIM assumes that the gate is continuously open between May 21 and June 15.

Given the somewhat flexible nature of DCC operation under the draft Plan between November 1st and January 30th, for modeling purposes the DCC was closed between November 1 and November 15, December 1 and December 15, and January 1 and January 15. The DCC was re-opened in the second half of each

month. This nominal operation is somewhat conservative (i.e. it may over-emphasize the water quality impact of the DCC) because the draft Plan requires the DCC to be closed "up to" 45 days. Presumably, the Operations Group will make these decisions on the basis of current water quality conditions and the presence of fish in the Sacramento north of Walnut Grove.

The May 20 through June 15 draft Plan requirement that the DCC can be closed up to four days in a row not including weekends is modeled simply by leaving the DCC closed through May, and opening it thereafter.

5) Clifton Court Forebay operation priority: Clifton Court Forebay is currently operated on a seasonal basis to protect water levels in the south Delta. The priorities used by DWR are summarized in Figure 12. The following priority schedule was used:

Month:	J	F	M	A	M	J	J	A	S	O	N	D
Priority:	4	4	4	3	2	2	3	3	3	3	4	4

6) San Joaquin River Input Salinity: Vernalis is the upstream San Joaquin River boundary condition of the model. As such, the boundary salinity must be provided at that location. Salinity is assumed to be an exponential function of flow by the following equation:

$$\ln ec = 10.0800014 - 0.48230 * \ln (\text{SJR flow in cfs})$$

7) TDS to EC conversion: Output salinity was requested in electrical conductivity units to be consistent with agricultural standards in the draft Plan. The model computes salinity as TDS which therefore must be converted to EC. Location specific conversion equations from DWR [1986] were used for this purpose.

8) Salinity Output: Hydrodynamic inflows are constant within each month. Therefore, salinity approaches a steady-state condition as it is simulated within each month. For output purposes, the average monthly salinity is assumed to be the salinity on the last tidal day of the month.

9) Other Assumptions:

- Use 19-year mean tide at Benicia
- No duck club operation was simulated in Suisun Marsh
- Tom Paine Slough has culvert flow and siphons operating
- Benicia boundary salinity calculated using "Saldif4" program
- Maximum Clifton Court Forebay gate flow is 15,000 cfs
- East-side stream boundary salinity was constant 85 ppm TDS
- Sacramento River salinity at the Sacramento boundary was constant 100 ppm TDS

## Results and Discussion

Time-series monthly average salinity for ten standard locations for water years 1987 through 1992 are shown in Figures 1 through 10 (the same output in tabular form is provided in Table 7 for the base and Table 8 for the draft Plan). Salinity output is shown in step form to emphasize that these are monthly average values resulting from steady, monthly average flow inputs. Half-month steps are shown in November, December, and January when the DCC is closed the first half and open the second half of the month. Each plot also indicates the months, or portion of months that the DCC is closed at the bottom of each plot. DCC closure in the base study only occurs for flood control when Sacramento River flow at Freeport is greater than 25,000 cfs.

Minimum, maximum, and average monthly flows for the same ten stations are presented in Tables 1, 2, and 3 for the base study, and Tables 4, 5, and 6 for the plan study. Sign conventions are relative to flow directions shown on the DWRDSM grid map shown in Figure 13. Again, the plan study shows half-month results for November, December, and January to show the effect DCC operation.

On the basis of the results shown in the plots and tables, several observations can be made:

Under the draft Plan hydrology, salinity at central delta stations Jersey Point, San Andreas, and Prisoners Point increases significantly in the November through January period when the DCC is closed the first half of the month. The increase persists into February when the DCC is closed continuously. The Terminous station shows similar increases but tends to lag by one month. The magnitude of delta outflow in the plan study is only slightly greater than the base in the November through January period (Figure 11A).

Outflow is 15 to 66% greater in the draft Plan over the February through June period (Figure 11B) resulting in generally lower spring and summer salinity at Jersey Point, San Andreas, and Prisoners Point. The increase in delta outflow is attributable mainly to reductions in project export. This lower salinity occurs despite continuous DCC closure between March and June under the draft Plan. Salinity at Terminous remains generally higher in the spring despite higher Plan flows suggesting that the DCC has relatively greater effect there.

Draft Plan agricultural water quality standards are satisfied within the bounds of model accuracy for central and north delta stations requested for analysis by the Board. Standards in the south delta are often exceeded however because DWRSIM was run using a 70 TAF cap on flows released from New Melones Reservoir to the San Joaquin River for water quality purposes. As a result, standard exceedences occur in dry and critical years during the April through August period when the standard is 0.7 mmhos/cm.

Emmaton responds to DCC closure opposite to Jersey Point during the October through December period. When the DCC closes, the water surface elevation at Emmaton increases marginally, the average flow increases 35 to 40% (Table 4), and salinity decreases between 10 and 15% (Figure 1). Jersey Point responds in the opposite direction (Figure 2). In contrast, higher winter and spring inflows cause Emmaton and Jersey Point salinity to respond in concert despite continuous closure of the DCC through June (Figures 1 and 2).

The highest annual salinity peaks at Emmaton under the draft Plan hydrology occur in October when delta outflow is reduced— mainly by reduced Sacramento River inflow— about 15% (Figure 1).

The salinity patterns at San Andreas landing and Prisoners Point tend to follow Jersey Point closely. However, there are greater incremental salinity increases in response to DCC closure (Figures 3 and 4)

Salinity changes in the south delta due to DCC closure are small— generally less than 5% at Buckley Cove (Figure 6), 3% at Brandt Bridge (Figure 9), 2% at Old River Near Tracy (Figure 7), and 2% at Old River at Middle River (Figure 8).

Since salinity is an inverse function of flow at Vernalis, the base versus draft Plan differences in salinity shown in Figure 10 directly reflect differences in flow. For example, November, December, and January flows are 0 to 14% less in the draft Plan resulting in 0 to 7% greater salinity. In general, the draft Plan generates higher flows and lower salinities in October, and April, May and June, while the base generates higher flow and lower salinity in November December and January (Figure 10).

Salinity at Brandt Bridge tends to follow the Vernalis pattern when the flow there is positive and/or when the Old River head barrier is in place in May (Figure 9). Buckley Cove generally has higher salinity in April despite higher San Joaquin River flow (Figure 6). This could reflect the influence of DCC closure. In May, when the Old River head barrier is installed, larger San Joaquin River flows and reduced pumping improve salinity at Brandt Bridge and Buckley Cove under the draft Plan.

Draft Plan salinity at the Old River near Tracy station is generally higher between August and January, and lower between March and July (Figure 7).

## **REFERENCES**

DWR, 1986; Department Memorandum from Kamyar Guivetchi; "Salinity Unit Conversion Equations."

Memo from Tom Howard, State Water Resources Control Board, March 23, 1995.

WRINT DWR 134-A: The Delta Simulation Model DWRDSM: Calibration and Verification; Exhibit for the State Water Resources Control Board, 1992.

Figure 1  
EMMATON

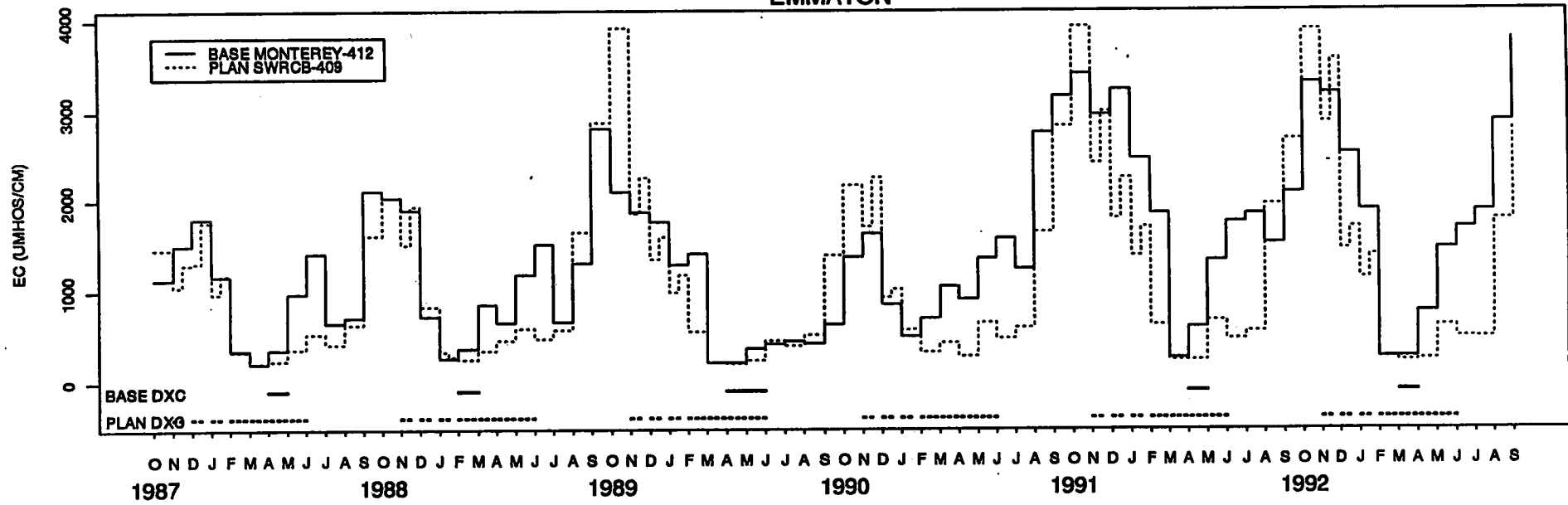


Figure 2  
SJR AT JERSEY POINT

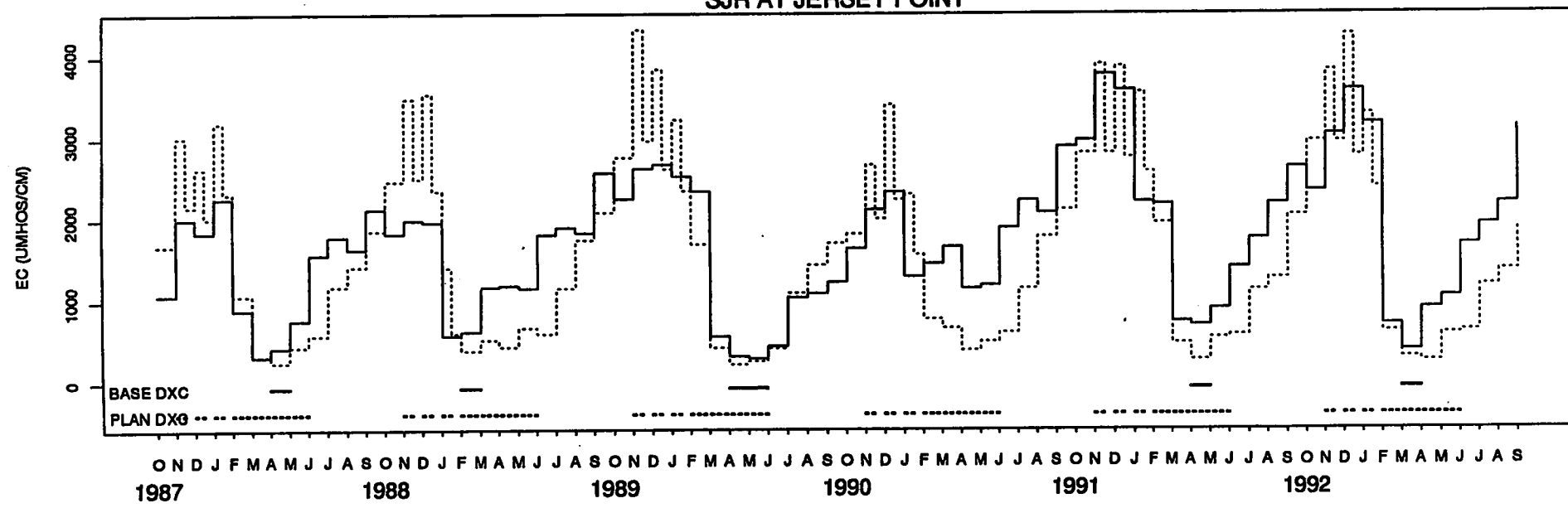


Figure 3  
SJR AT SAN ANDREAS

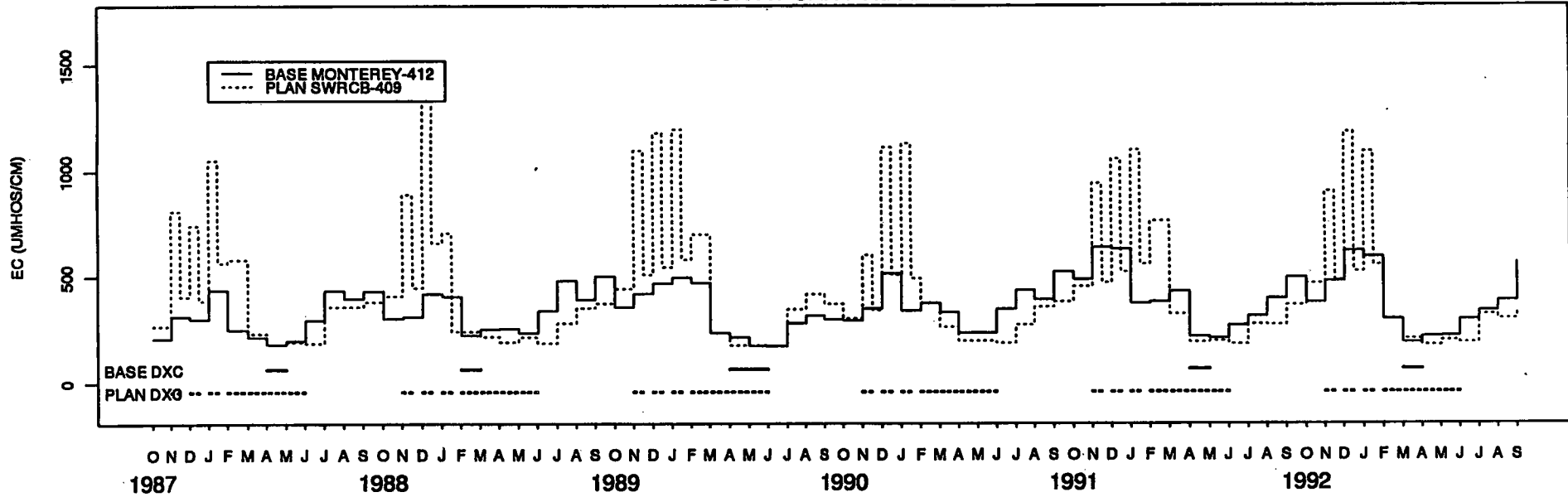


Figure 4  
SJR AT PRISONERS POINT

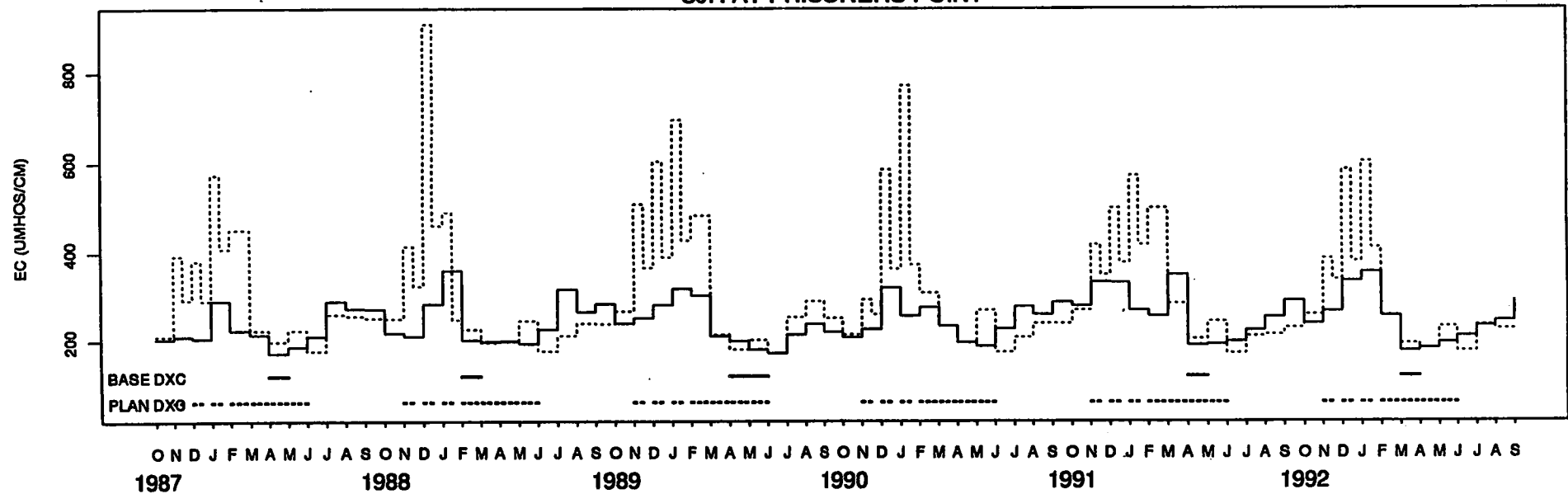




Figure 5  
TERMINOUS

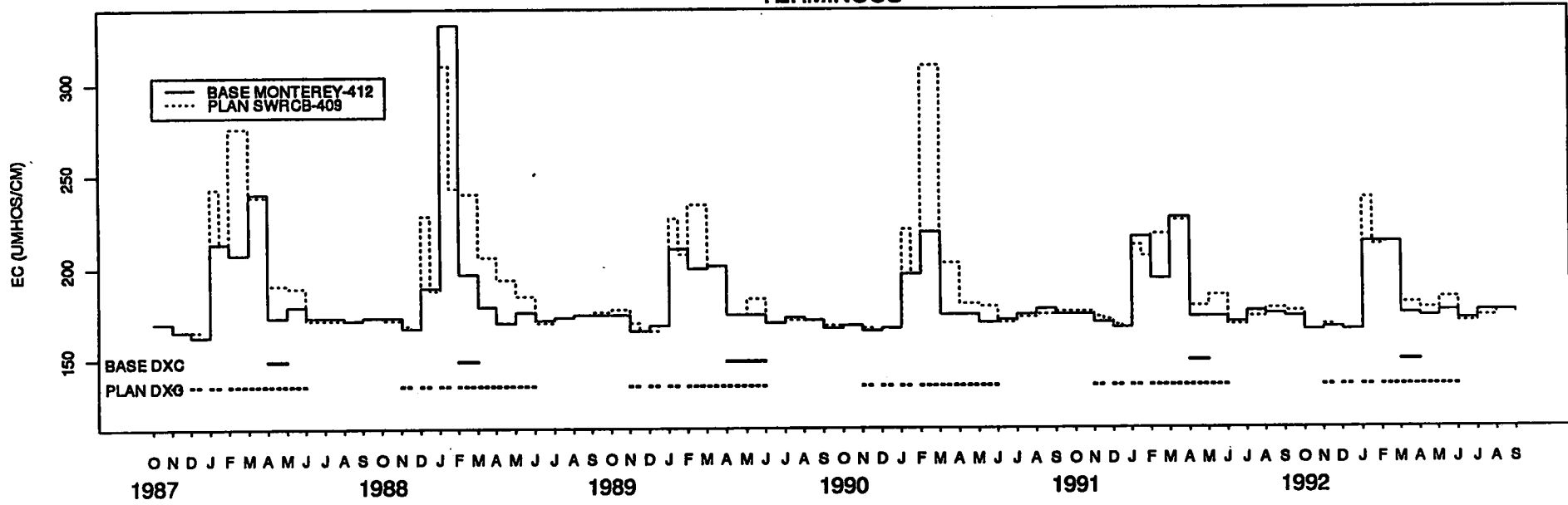


Figure 6  
SJR AT BUCKLEY COVE

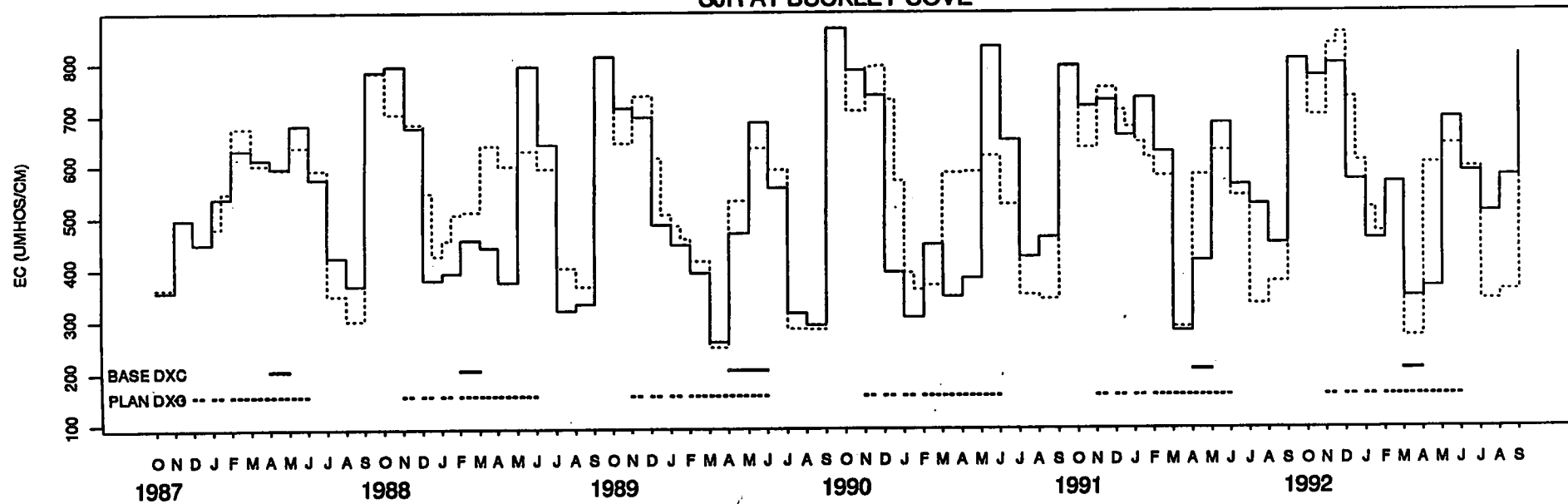


Figure 7  
**OLD RIVER NEAR TRACY**

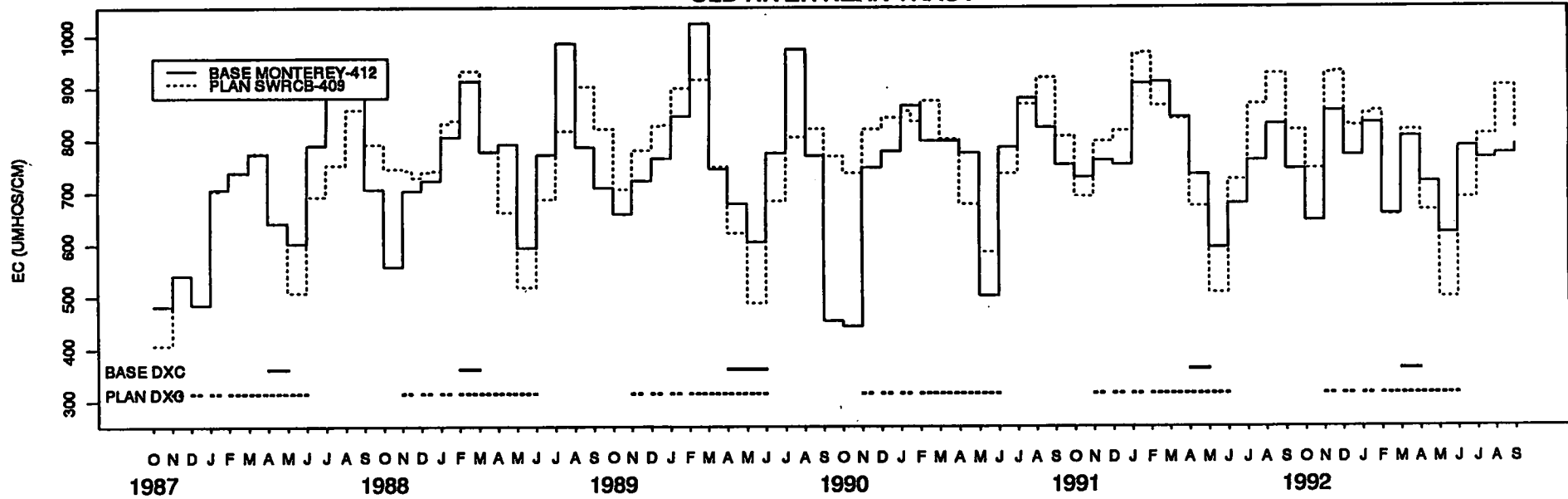


Figure 8  
**OLD RIVER AT MIDDLE RIVER**

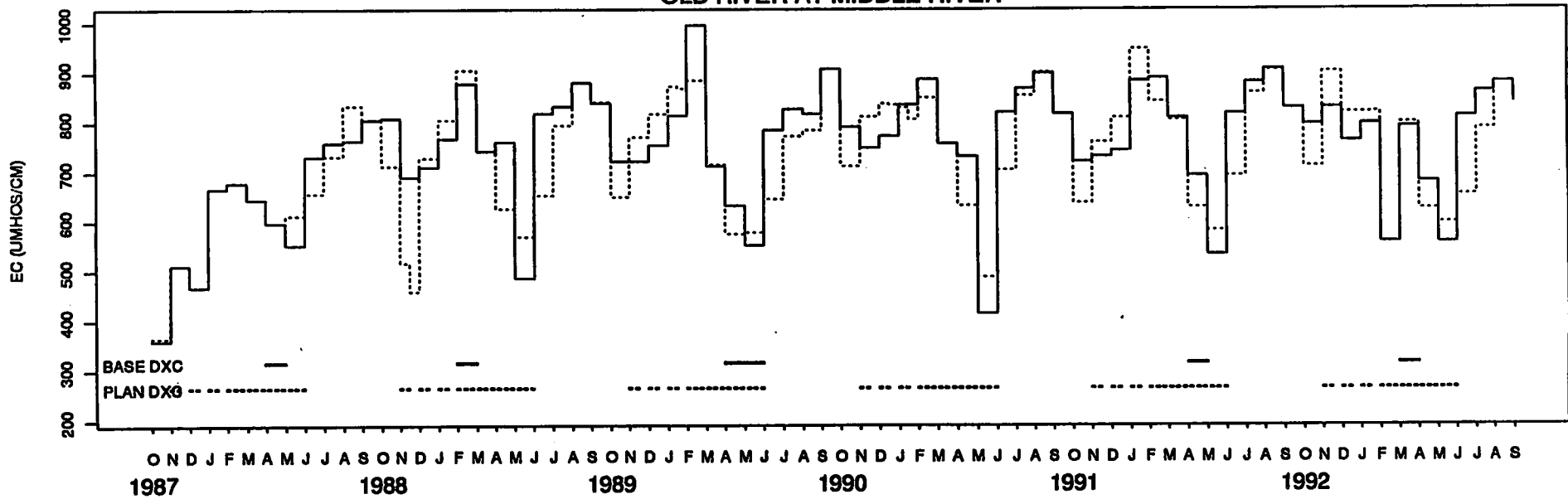


Figure 9  
SJR AT BRANDT BRIDGE

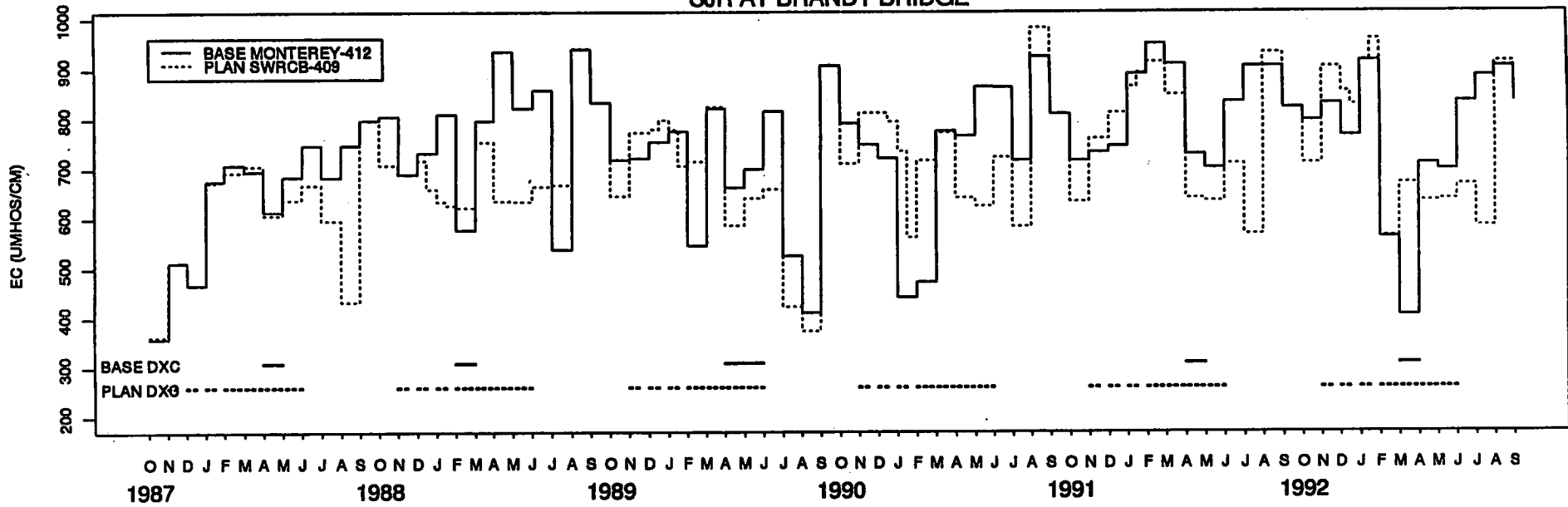


Figure 10  
SJR AT VERNALIS

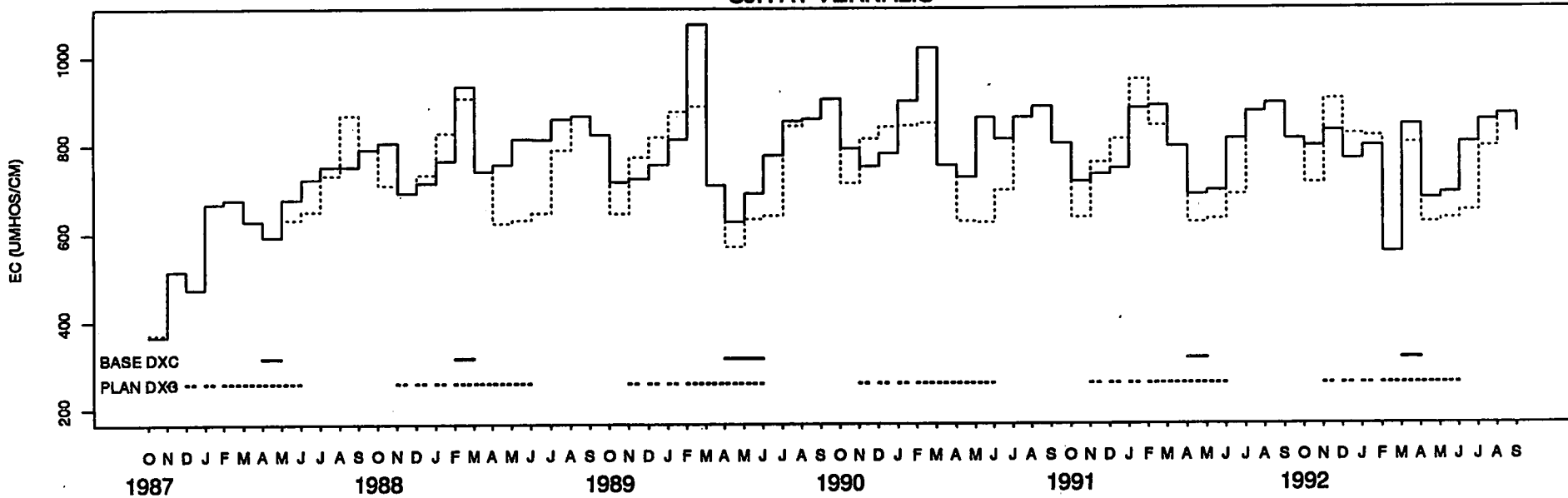


FIGURE 11A  
TOTAL NOVEMBER THROUGH JANUARY DELTA OUTFLOW

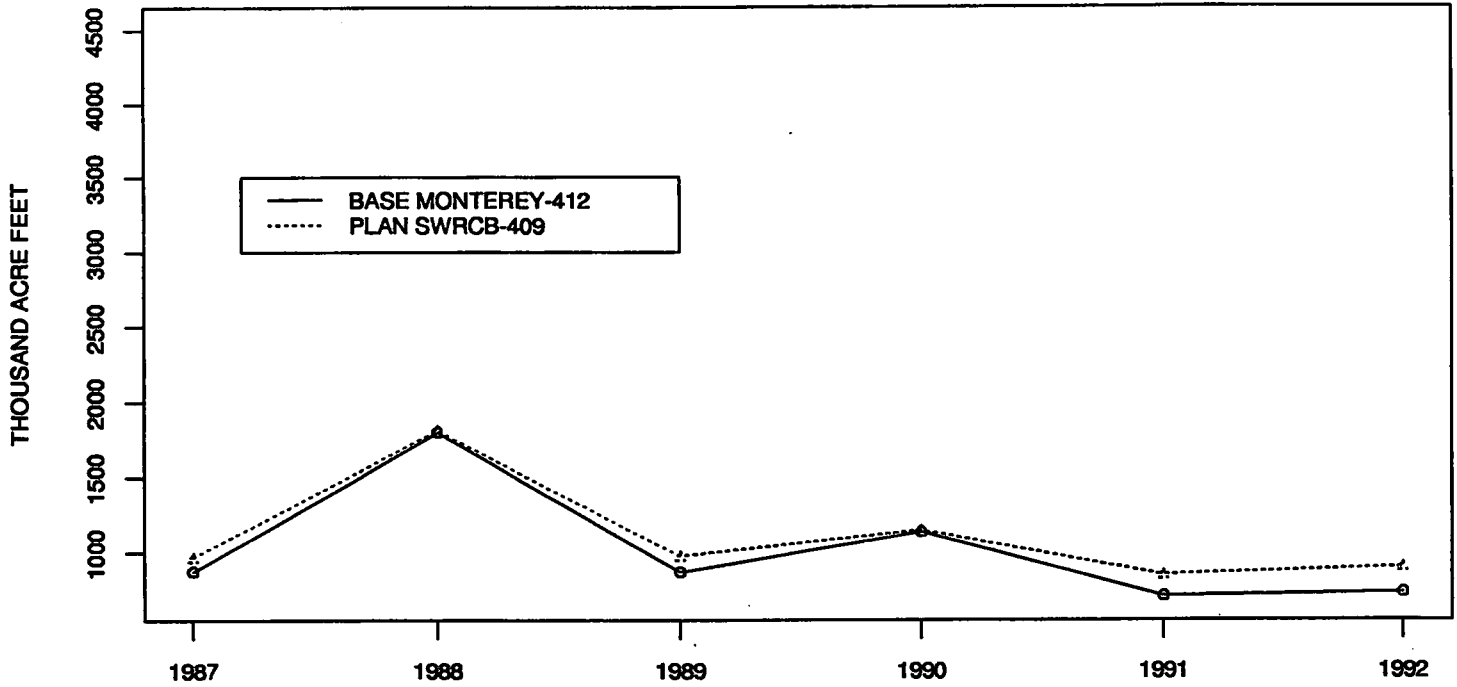
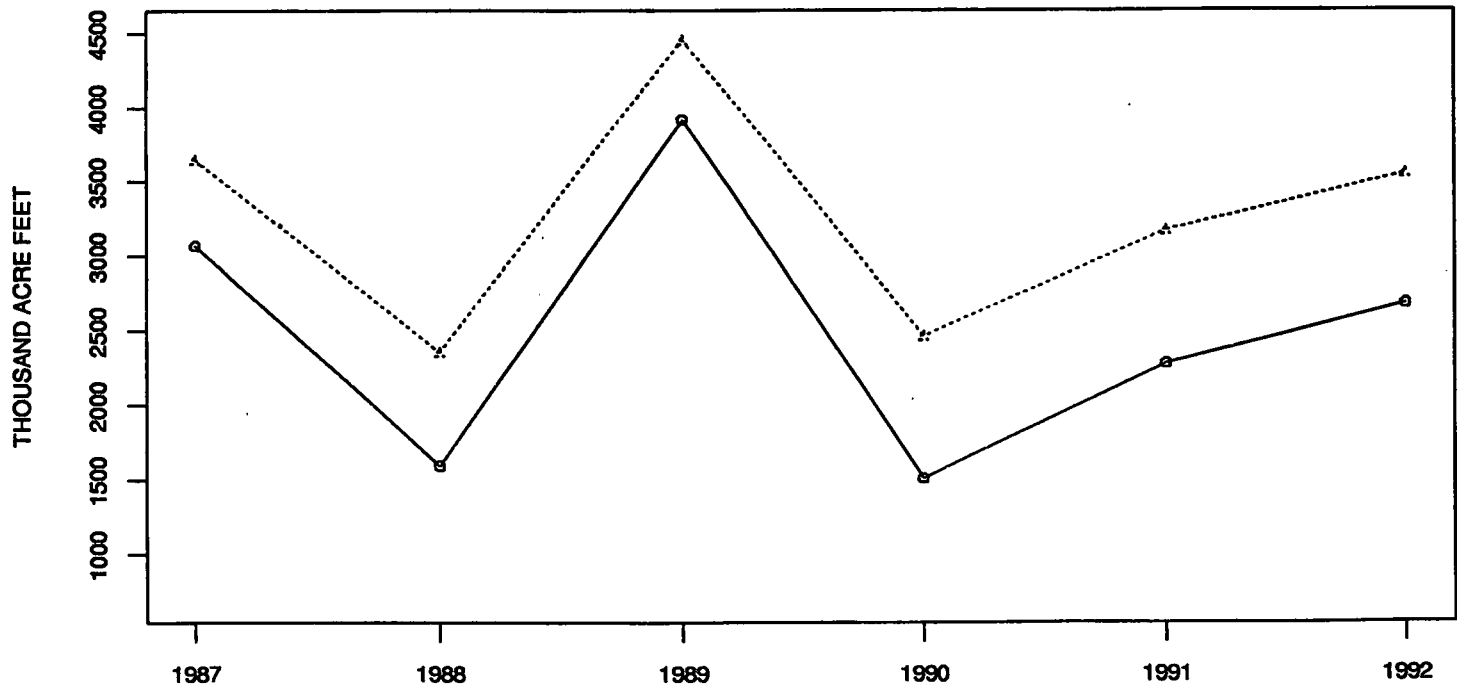
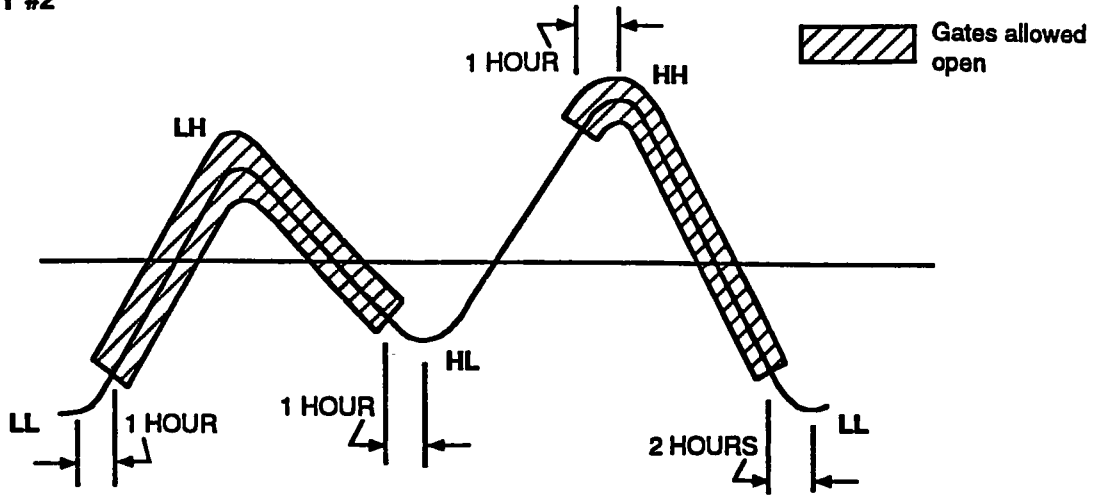


FIGURE 11B  
TOTAL FEBRUARY THROUGH JUNE DELTA OUTFLOW

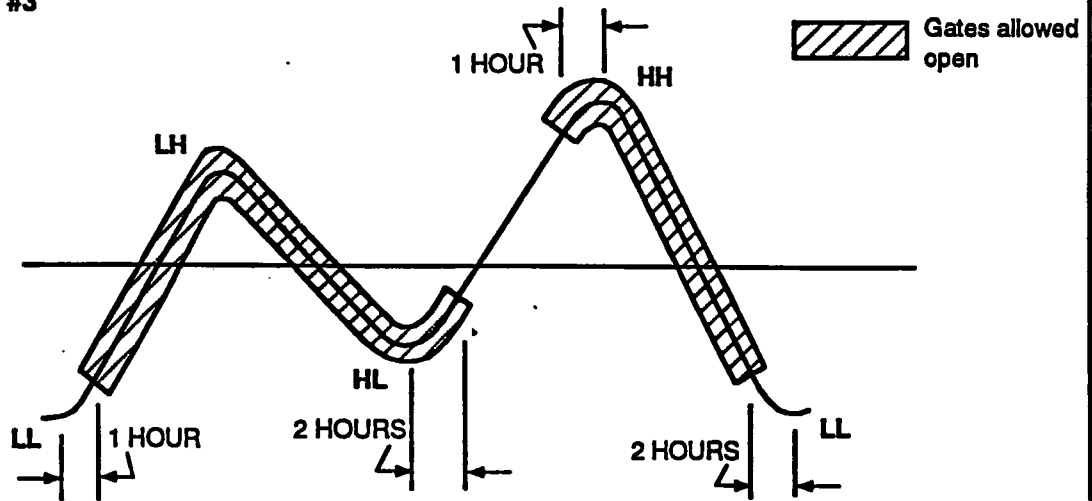


**FIGURE 12**  
**PROPOSED FOREBAY GATE OPERATION PRIORITIES**

**PRIORITY #2**



**PRIORITY #3**

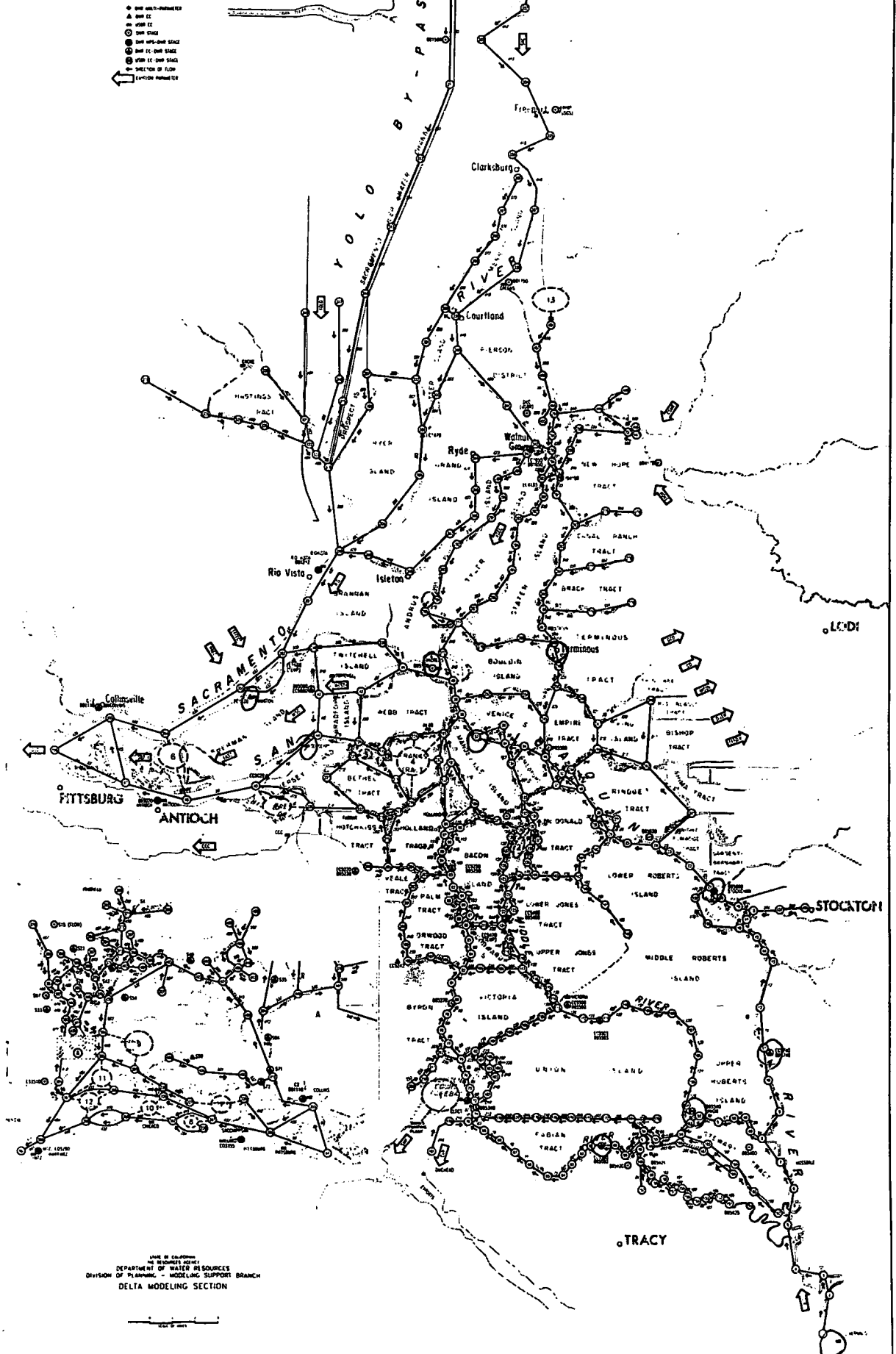


**PRIORITY #4**

Allow flow into forebay any time water level differential allows.  
 Prevent flow from forebay into outside channel.

FIGURE 13

DWRDSM  
DELTA MODEL GRID  
March 1992



STATE OF CALIFORNIA  
 DEPARTMENT OF WATER RESOURCES  
 DIVISION OF PLANNING - MODELING SUPPORT BRANCH  
 DELTA MODELING SECTION

1:50,000

TABLE 1

SWRCB EIR BASE STUDY 1995-MONTEREY-412: \*\*\* AVERAGE MONTHLY FLOW \*\*\*

	EMMATON	JERSEY POINT	SAN ANDREAS	TERMINOUS	PRISONERS POINT	BUCKLEY COVE	BRANDT BRIDGE	OLD R.@ MIDDLE R.	OLD R.@ TRACY	VERNALIS
1987 October	4385.	907.	612.	1265.	-1050.	4249.	4189.	1864.	-85.	6065.
November	4261.	-149.	-378.	1378.	-2303.	1606.	1546.	1331.	178.	2897.
December	3667.	458.	76.	1195.	-1833.	999.	954.	2458.	288.	3436.
January	5390.	-557.	-830.	1591.	-3146.	167.	92.	1564.	195.	1663.
February	9511.	257.	-226.	2121.	-3458.	198.	41.	1612.	197.	1658.
March	21724.	29.	-1140.	1347.	-2944.	366.	215.	1751.	227.	1980.
April	6300.	-178.	-504.	1643.	-3067.	295.	296.	1797.	240.	2152.
May	3905.	667.	295.	1166.	-1684.	1523.	1540.	-8.	-84.	1609.
June	3745.	-43.	-339.	1204.	-2449.	92.	142.	1098.	-16.	1353.
July	7283.	-1405.	-1543.	1788.	-4199.	-134.	-74.	1189.	11.	1233.
August	6386.	-1273.	-1416.	1704.	-3905.	-68.	-32.	1216.	-21.	1274.
September	3063.	-146.	-418.	1091.	-2134.	874.	885.	223.	-105.	1159.
1988 October	3467.	779.	322.	1074.	-1604.	879.	883.	211.	-158.	1120.
November	3691.	486.	88.	1183.	-1853.	894.	860.	680.	102.	1555.
December	7213.	-893.	-1122.	1897.	-3777.	67.	-32.	1473.	178.	1457.
January	18056.	-2052.	-2828.	1145.	-3869.	25.	-95.	1360.	171.	1265.
February	7373.	-1190.	-1400.	1866.	-4043.	-219.	-245.	1060.	141.	826.
March	4840.	-360.	-654.	1440.	-2905.	21.	26.	1291.	175.	1343.
April	6125.	-111.	-447.	1653.	-3059.	31.	-3.	1237.	179.	1280.
May	4008.	535.	159.	1216.	-1912.	1014.	1014.	-6.	-97.	1071.
June	3807.	-99.	-389.	1226.	-2513.	0.	44.	882.	-20.	1034.
July	7473.	-1554.	-1677.	1819.	-4352.	-248.	-188.	965.	8.	895.
August	4242.	-388.	-649.	1326.	-2842.	-28.	7.	827.	-50.	923.
September	2687.	-16.	-325.	996.	-1945.	801.	810.	198.	-114.	1060.
1989 October	3726.	509.	121.	1138.	-1803.	1108.	1120.	285.	-137.	1437.
November	4169.	-47.	-356.	1315.	-2373.	778.	752.	637.	97.	1403.
December	4315.	-231.	-534.	1382.	-2673.	92.	32.	1231.	164.	1279.
January	5229.	-543.	-825.	1538.	-3130.	-46.	-81.	1174.	159.	1099.
February	4658.	-332.	-639.	1444.	-2869.	-108.	-161.	759.	112.	609.
March	28714.	217.	-1176.	1751.	-3637.	179.	-63.	1477.	186.	1454.
April	13961.	-2762.	-3248.	981.	-3946.	227.	167.	1700.	226.	1930.
May	5514.	1421.	908.	1407.	-1628.	1467.	1464.	-8.	-79.	1538.
June	5606.	698.	252.	1463.	-2435.	27.	71.	958.	-13.	1146.
July	7480.	-1531.	-1656.	1823.	-4340.	-240.	-183.	976.	8.	911.
August	8182.	-1684.	-1810.	1944.	-4550.	-225.	-193.	1045.	-27.	939.
September	6086.	-953.	-1144.	1659.	-3492.	665.	653.	194.	-119.	870.
1990 October	4195.	-36.	-338.	1271.	-2342.	892.	901.	236.	-137.	1157.
November	4149.	-17.	-334.	1296.	-2356.	711.	695.	593.	91.	1304.
December	6837.	-1246.	-1427.	1767.	-3943.	-132.	-116.	1291.	161.	1194.
January	8118.	-680.	-1004.	1935.	-3830.	-161.	-217.	1100.	146.	889.
February	6385.	-1125.	-1326.	1724.	-3690.	-201.	-275.	897.	126.	668.
March	4937.	-425.	-697.	1513.	-2989.	22.	-10.	1265.	172.	1289.
April	4888.	612.	176.	1404.	-2234.	149.	116.	1227.	183.	1400.
May	3770.	667.	258.	1177.	-1764.	938.	926.	-3.	-131.	955.
June	3798.	-77.	-371.	1237.	-2512.	-2.	40.	880.	-18.	1033.
July	4940.	-609.	-827.	1429.	-3188.	-119.	-60.	837.	-7.	895.
August	2453.	690.	232.	875.	-1510.	99.	133.	653.	-73.	875.
September	2693.	145.	-186.	978.	-1803.	855.	865.	211.	-113.	1127.
1991 October	2863.	498.	99.	944.	-1517.	1111.	1125.	279.	-144.	1436.
November	3527.	-133.	-427.	1178.	-2245.	738.	744.	617.	96.	1379.
December	3142.	138.	-234.	1077.	-2047.	121.	121.	1170.	156.	1308.
January	3213.	989.	443.	1006.	-1454.	91.	74.	839.	114.	920.
February	3825.	354.	-65.	1226.	-2136.	26.	-6.	907.	123.	913.
March	19185.	-1620.	-2415.	1417.	-3848.	106.	-164.	1284.	166.	1153.
April	4927.	-281.	-563.	1506.	-2882.	150.	110.	1411.	195.	1575.
May	3322.	949.	512.	1062.	-1346.	1476.	1455.	-7.	-98.	1517.
June	3056.	643.	176.	1011.	-1781.	101.	137.	790.	-42.	1035.
July	3330.	388.	-2.	1074.	-2074.	9.	73.	668.	-33.	862.
August	4288.	-257.	-538.	1325.	-2755.	-66.	-29.	800.	-44.	859.
September	3637.	-265.	-516.	1209.	-2391.	813.	825.	214.	-100.	1092.
1992 October	2523.	835.	371.	876.	-1190.	942.	908.	218.	-160.	1144.
November	2978.	351.	-37.	1036.	-1763.	582.	568.	463.	69.	1048.
December	3869.	-272.	-563.	1300.	-2588.	79.	41.	1187.	160.	1244.
January	4491.	-349.	-644.	1453.	-2817.	50.	-38.	1181.	161.	1148.
February	20755.	146.	-972.	1510.	-2846.	797.	400.	2082.	249.	2487.
March	8894.	-211.	-582.	2150.	-3740.	5.	-190.	1205.	156.	1018.
April	4725.	-250.	-535.	1466.	-2805.	150.	135.	1435.	195.	1618.
May	3354.	939.	506.	1046.	-1355.	1455.	1474.	-8.	-95.	1546.
June	3430.	285.	-80.	1133.	-2162.	37.	92.	848.	-21.	1057.
July	3417.	321.	-49.	1102.	-2142.	16.	76.	715.	-30.	909.
August	2526.	628.	184.	903.	-1582.	106.	139.	693.	-72.	921.
September	2300.	265.	-91.	885.	-1584.	807.	813.	195.	-116.	1060.

TABLE 2

SWRCB EIR BASE STUDY 1995-MONTEREY-412: \*\*\* MINIMUM FLOW \*\*\*

	EMMATON	JERSEY POINT	SAN ANDREAS	TERMINOUS	PRISONERS POINT	BUCKLEY COVE	BRANDT BRIDGE	OLD R.@ MIDDLE R.	OLD R.@ TRACY	VERNALIS	
1987	October	-108664.	-119776.	-84129.	-2160.	-51152.	-1166.	3807.	1150.	-534.	6049.
	November	-108640.	-119487.	-84531.	-2141.	-52051.	-3939.	229.	909.	0.	2864.
	December	-109176.	-119008.	-84425.	-2111.	-51518.	-4435.	-871.	2175.	93.	3402.
	January	-107537.	-119892.	-85067.	-2033.	-53233.	-5565.	-1642.	1311.	42.	1604.
	February	-103583.	-120524.	-85432.	-1701.	-54140.	-5659.	-1693.	1399.	47.	1599.
	March	-92738.	-121316.	-88100.	-2880.	-53158.	-5392.	-1551.	1518.	70.	1928.
	April	-106698.	-119933.	-85074.	-2067.	-53417.	-5488.	-1422.	854.	-15.	2081.
	May	-108975.	-119450.	-84546.	-2129.	-51237.	-3821.	14.	-666.	-588.	1529.
	June	-109473.	-119771.	-85039.	-2137.	-52142.	-5841.	-1553.	-195.	-521.	1212.
	July	-106113.	-120935.	-85770.	-2016.	-54308.	-5905.	-1728.	-235.	-426.	1088.
	August	-106986.	-120697.	-85579.	-2035.	-53906.	-5844.	-1698.	-172.	-462.	1133.
	September	-110025.	-119769.	-84967.	-2130.	-51511.	-4582.	-1150.	-495.	-617.	1043.
1988	October	-108946.	-119508.	-84878.	-2111.	-51620.	-4536.	-1149.	-425.	-787.	1002.
	November	-108963.	-119144.	-84659.	-2081.	-51648.	-4483.	-1083.	-1.	-90.	1473.
	December	-105753.	-120832.	-85666.	-1789.	-54047.	-5706.	-1730.	1216.	34.	1392.
	January	-96397.	-122580.	-88923.	-2864.	-53547.	-5647.	-1759.	1004.	28.	1189.
	February	-105499.	-121069.	-85900.	-1871.	-54293.	-5940.	-1885.	406.	14.	707.
	March	-108021.	-119690.	-85065.	-2045.	-52820.	-5777.	-1685.	873.	-3.	1262.
	April	-106846.	-119866.	-85076.	-1964.	-53302.	-5800.	-1674.	-376.	-184.	1119.
	May	-108852.	-119506.	-84700.	-2095.	-51534.	-4483.	-1079.	-672.	-601.	940.
	June	-109424.	-119796.	-85059.	-2124.	-52198.	-5921.	-1636.	-597.	-518.	863.
	July	-105925.	-121062.	-85870.	-1993.	-54447.	-5989.	-1809.	-659.	-422.	718.
	August	-108785.	-120219.	-85341.	-2043.	-52590.	-5911.	-1684.	-544.	-560.	752.
	September	-110172.	-119717.	-84980.	-2147.	-51356.	-4652.	-1217.	-499.	-655.	941.
1989	October	-108828.	-119536.	-84833.	-2117.	-51620.	-4275.	-844.	-368.	-674.	1333.
	November	-108688.	-119435.	-84817.	-2063.	-52094.	-4629.	-1183.	-61.	-97.	1320.
	December	-108545.	-119513.	-84957.	-2005.	-52494.	-5708.	-1680.	722.	-28.	1189.
	January	-107690.	-119770.	-85063.	-2067.	-53149.	-5772.	-1774.	606.	6.	998.
	February	-108224.	-119640.	-85040.	-1996.	-52707.	-5872.	-1840.	-225.	-70.	459.
	March	-86131.	-121993.	-88711.	-2613.	-54138.	-5644.	-1767.	1232.	41.	1389.
	April	-99847.	-122900.	-88935.	-2958.	-53495.	-5439.	-1486.	637.	-34.	1853.
	May	-107452.	-119257.	-84327.	-2039.	-51522.	-3959.	-239.	-669.	-585.	1441.
	June	-107771.	-119606.	-84830.	-2047.	-52484.	-5960.	-1629.	-481.	-516.	981.
	July	-105917.	-121050.	-85859.	-1989.	-54439.	-5984.	-1806.	-644.	-422.	734.
	August	-105263.	-121715.	-86307.	-1832.	-54746.	-6001.	-1811.	-631.	-432.	761.
	September	-107359.	-120784.	-85434.	-1994.	-53385.	-4798.	-1378.	-443.	-539.	745.
1990	October	-108660.	-119812.	-85029.	-2091.	-52097.	-4554.	-1133.	-438.	-628.	1041.
	November	-108688.	-119433.	-84841.	-2084.	-52114.	-4727.	-1238.	-124.	-101.	1216.
	December	-106009.	-120947.	-85825.	-1952.	-54172.	-5867.	-1790.	887.	25.	1111.
	January	-104872.	-120818.	-85707.	-1820.	-54206.	-5913.	-1874.	473.	14.	775.
	February	-106683.	-120403.	-85445.	-1910.	-53710.	-5858.	-1909.	104.	-25.	535.
	March	-107933.	-119666.	-84984.	-2019.	-52959.	-5727.	-1714.	813.	17.	1205.
	April	-108115.	-119191.	-84672.	-2016.	-52388.	-5722.	-1575.	-388.	-214.	1243.
	May	-109077.	-119389.	-84639.	-2092.	-51374.	-4573.	-1174.	-681.	-638.	819.
	June	-109431.	-119778.	-85040.	-2110.	-52193.	-5921.	-1638.	-598.	-516.	862.
	July	-108418.	-120124.	-85268.	-2072.	-52920.	-5960.	-1712.	-772.	-479.	715.
	August	-110236.	-119248.	-84775.	-2200.	-51289.	-5806.	-1596.	-773.	-632.	698.
	September	-110312.	-119535.	-84845.	-2171.	-51191.	-4601.	-1170.	-520.	-640.	1009.
1991	October	-109524.	-119428.	-84835.	-2177.	-51230.	-4236.	-829.	-381.	-708.	1332.
	November	-109273.	-119386.	-84849.	-2144.	-51895.	-4666.	-1188.	-107.	-99.	1294.
	December	-109596.	-119098.	-84773.	-2174.	-51806.	-5696.	-1607.	505.	-47.	1208.
	January	-109581.	-118493.	-84287.	-2223.	-51297.	-5732.	-1669.	-319.	-118.	765.
	February	-109044.	-118994.	-84615.	-2115.	-51973.	-5766.	-1727.	-86.	-76.	769.
	March	-95251.	-122447.	-88730.	-2725.	-53729.	-5616.	-1812.	889.	30.	1070.
	April	-108044.	-119684.	-84930.	-2077.	-53086.	-5606.	-1570.	-114.	-178.	1444.
	May	-109302.	-119274.	-84472.	-2104.	-50900.	-3873.	-218.	-656.	-637.	1423.
	June	-109693.	-119417.	-84872.	-2139.	-51646.	-5808.	-1600.	-562.	-636.	865.
	July	-109411.	-119595.	-84970.	-2162.	-51974.	-5895.	-1641.	-726.	-581.	687.
	August	-109085.	-119766.	-85009.	-2097.	-52417.	-5901.	-1688.	-850.	-515.	675.
	September	-109649.	-119808.	-84970.	-2109.	-51795.	-4651.	-1210.	-507.	-590.	974.
1992	October	-110045.	-118988.	-84580.	-2184.	-50857.	-4463.	-1123.	-501.	-704.	1025.
	November	-109745.	-118934.	-84598.	-2175.	-51428.	-4901.	-1353.	-280.	-130.	946.
	December	-108914.	-119519.	-85011.	-2043.	-52381.	-5730.	-1670.	622.	-32.	1148.
	January	-108390.	-119546.	-84923.	-1978.	-52659.	-5698.	-1739.	613.	7.	1049.
	February	-93982.	-121605.	-87997.	-2708.	-53106.	-4991.	-1406.	1884.	90.	2446.
	March	-104122.	-120692.	-85543.	-1628.	-54318.	-5789.	-1859.	688.	22.	919.
	April	-108241.	-119630.	-84904.	-2095.	-52962.	-5603.	-1547.	-51.	-173.	1493.
	May	-109217.	-119315.	-84508.	-2137.	-50951.	-3896.	-161.	-651.	-640.	1455.
	June	-109513.	-119622.	-84949.	-2139.	-51939.	-5877.	-1615.	-551.	-530.	888.
	July	-109409.	-119630.	-84975.	-2159.	-52000.	-5893.	-1634.	-693.	-569.	735.
	August	-110166.	-119327.	-84825.	-2186.	-51373.	-5801.	-1595.	-715.	-644.	745.
	September	-110668.	-119367.	-84766.	-2201.	-50936.	-4658.	-1217.	-555.	-649.	939.



TABLE 3

SWRCB EIR BASE STUDY 1995-MONTEREY-412: \*\*\* MAXIMUM FLOW \*\*\*

	EMMATON	JERSEY POINT	SAN ANDREAS	TERMINOUS	PRISONERS POINT	BUCKLEY COVE	BRANDT BRIDGE	OLD R.@ MIDDLE R.	OLD R.@ TRACY	VERNALIS	
1987	October	114500.	113528.	76500.	3972.	45268.	9324.	4431.	2174.	940.	6074.
	November	114352.	110857.	74211.	4025.	42775.	7349.	2068.	1675.	346.	2912.
	December	113773.	110963.	74272.	3792.	42714.	6492.	1748.	2770.	464.	3452.
	January	115117.	110515.	73809.	4191.	41809.	5446.	1227.	1855.	345.	1691.
	February	117719.	111247.	74466.	4670.	41589.	5515.	1196.	1831.	346.	1684.
	March	123267.	111322.	74587.	4668.	41197.	5569.	1311.	2002.	370.	2004.
	April	115878.	112176.	75187.	4290.	42955.	5659.	1351.	2107.	436.	2177.
	May	114171.	112721.	75633.	4026.	44109.	6945.	2127.	392.	732.	1631.
	June	113837.	112142.	75046.	4034.	43263.	5308.	1272.	1660.	791.	1393.
	July	116392.	111966.	74932.	4644.	42397.	5163.	1124.	1645.	797.	1269.
	August	115832.	111971.	74922.	4534.	42622.	5222.	1154.	1671.	791.	1310.
	September	113243.	111920.	74897.	3921.	43471.	5852.	1724.	656.	727.	1195.
1988	October	113557.	112209.	75380.	3583.	43665.	5797.	1727.	694.	744.	1157.
	November	113759.	111033.	74292.	3786.	42656.	6087.	1652.	1170.	321.	1585.
	December	116363.	110503.	73840.	4445.	41497.	5391.	1142.	1731.	321.	1485.
	January	121518.	110166.	73606.	4520.	40800.	5208.	1097.	1642.	313.	1297.
	February	116497.	110373.	73704.	4502.	41309.	5109.	1010.	1468.	256.	871.
	March	114719.	110576.	73852.	4077.	41935.	5295.	1186.	1746.	311.	1378.
	April	115739.	112089.	75084.	4305.	42830.	5292.	1168.	1731.	362.	1320.
	May	114220.	112470.	75347.	4044.	43596.	5925.	1837.	392.	728.	1106.
	June	113885.	112113.	75015.	4064.	43213.	5200.	1215.	1539.	741.	1084.
	July	116503.	111896.	74871.	4686.	42287.	5052.	1052.	1420.	742.	941.
	August	114157.	111804.	74791.	4114.	42920.	5167.	1189.	1518.	691.	977.
	September	112860.	111826.	74837.	3791.	43517.	5749.	1685.	645.	724.	1099.
1989	October	113852.	112091.	75146.	3843.	43587.	6171.	1855.	723.	730.	1467.
	November	114201.	110687.	73988.	3952.	42297.	5993.	1589.	1087.	309.	1435.
	December	114270.	110610.	73894.	3984.	42071.	5337.	1193.	1733.	306.	1317.
	January	115012.	110497.	73771.	4172.	41787.	5215.	1121.	1626.	292.	1138.
	February	114553.	110600.	73852.	4072.	41945.	5116.	1079.	1494.	249.	673.
	March	127066.	111568.	74699.	5076.	40811.	5372.	1130.	1723.	316.	1484.
	April	119669.	111058.	74407.	4393.	41734.	5450.	1257.	1973.	412.	1956.
	May	115376.	113200.	75999.	4217.	43988.	6779.	2093.	393.	741.	1562.
	June	115217.	112663.	75458.	4267.	43198.	5249.	1235.	1582.	767.	1193.
	July	116506.	111910.	74885.	4688.	42293.	5059.	1056.	1426.	744.	957.
	August	116839.	112024.	75017.	4787.	42332.	5078.	1047.	1483.	740.	984.
	September	115597.	112256.	75170.	4483.	43012.	5680.	1602.	725.	751.	913.
1990	October	114284.	111990.	75013.	4025.	43336.	5895.	1730.	664.	727.	1193.
	November	114185.	110710.	74001.	3939.	42305.	5903.	1559.	1055.	308.	1338.
	December	116165.	110268.	73627.	4417.	41364.	5202.	1088.	1618.	298.	1228.
	January	116933.	110656.	73922.	4547.	41390.	5156.	1030.	1496.	267.	932.
	February	115777.	110285.	73599.	4335.	41515.	5075.	996.	1430.	229.	722.
	March	114800.	110530.	73821.	4126.	41862.	5289.	1165.	1703.	303.	1325.
	April	114726.	112280.	75251.	4039.	43277.	5384.	1249.	1805.	370.	1441.
	May	114004.	112502.	75369.	3993.	43672.	5825.	1787.	391.	729.	993.
	June	113881.	112130.	75031.	4071.	43213.	5196.	1212.	1537.	742.	1082.
	July	114771.	112073.	74979.	4287.	42924.	5149.	1147.	1459.	745.	947.
	August	112595.	112146.	75135.	3570.	43696.	5206.	1283.	1524.	709.	939.
	September	112877.	111996.	74957.	3802.	43654.	5802.	1715.	651.	740.	1164.
1991	October	113074.	111962.	75064.	3635.	43789.	6156.	1857.	721.	742.	1466.
	November	113707.	110599.	73921.	3838.	42396.	5930.	1585.	1080.	311.	1411.
	December	113303.	110725.	74004.	3703.	42464.	5326.	1254.	1767.	302.	1349.
	January	113280.	111131.	74327.	3625.	42733.	5232.	1245.	1632.	291.	979.
	February	113860.	110842.	74073.	3843.	42320.	5206.	1185.	1610.	273.	967.
	March	121994.	110511.	73964.	4686.	40899.	5291.	1054.	1584.	287.	1187.
	April	114844.	112100.	75124.	4146.	43118.	5411.	1236.	1835.	389.	1609.
	May	113587.	112609.	75545.	3858.	44128.	6754.	2080.	444.	732.	1542.
	June	113116.	112182.	75167.	3666.	43493.	5202.	1283.	1584.	744.	1091.
	July	113428.	112049.	75035.	3805.	43269.	5139.	1236.	1507.	724.	924.
	August	114235.	112233.	75107.	4178.	43217.	5178.	1171.	1452.	730.	914.
	September	113727.	112018.	74966.	4055.	43386.	5808.	1691.	640.	736.	1130.
1992	October	112709.	112208.	75204.	3598.	44030.	5852.	1740.	655.	772.	1181.
	November	113167.	110803.	74077.	3669.	42634.	5666.	1499.	970.	305.	1090.
	December	113929.	110587.	73879.	3912.	42147.	5310.	1198.	1733.	300.	1284.
	January	114423.	110555.	73829.	4059.	41981.	5285.	1150.	1662.	298.	1188.
	February	122828.	111498.	74803.	4694.	41516.	6018.	1421.	2240.	415.	2506.
	March	117387.	110973.	74232.	4670.	41459.	5310.	1047.	1546.	286.	1056.
	April	114689.	112087.	75112.	4116.	43158.	5419.	1253.	1858.	391.	1651.
	May	113630.	112580.	75538.	3852.	44128.	6779.	2090.	466.	732.	1569.
	June	113527.	112102.	75039.	3922.	43301.	5195.	1245.	1564.	750.	1108.
	July	113511.	112060.	75025.	3865.	43256.	5164.	1236.	1518.	729.	968.
	August	112666.	112132.	75139.	3575.	43657.	5210.	1287.	1545.	714.	984.
	September	112485.	112025.	74969.	3714.	43818.	5733.	1689.	635.	753.	1099.

TABLE 4

SWRCB EIR PLAN STUDY 1995-SWRCB-409: \*\*\* AVERAGE MONTHLY FLOW \*\*\*

	EMMATON	JERSEY POINT	SAN ANDREAS	TERMINOUS	PRISONERS POINT	BUCKLEY COVE	BRANDT BRIDGE	OLD R.@ MIDDLE R.	OLD R.@ TRACY	VERNALIS
1987 October	4192.	198.	27.	1291.	-1497.	4108.	4046.	1797.	136.	5856.
November 1-15	6720.	-1913.	-2206.	708.	-2527.	1614.	1556.	1321.	176.	2897.
November 16-30	4867.	144.	-142.	1456.	-2264.	1605.	1545.	1333.	179.	2897.
December 1-15	5245.	-1074.	-1488.	599.	-1977.	1026.	977.	2450.	287.	3436.
December 15-31	3687.	529.	134.	1192.	-1789.	1003.	957.	2454.	288.	3436.
January 1-15	7459.	-2554.	-2868.	758.	-3306.	183.	107.	1548.	193.	1663.
January 15-31	5452.	-325.	-638.	1583.	-3004.	178.	103.	1553.	196.	1663.
February	12421.	-1848.	-2451.	997.	-3331.	242.	85.	1568.	193.	1658.
March	21796.	-872.	-1898.	1373.	-3511.	324.	173.	1793.	225.	1980.
April	8301.	997.	102.	598.	-1056.	494.	495.	1599.	229.	2152.
May	6518.	320.	-326.	510.	-1024.	1780.	1798.	-8.	80.	1867.
June	5153.	512.	109.	1390.	-2412.	179.	230.	1378.	184.	1720.
July	8710.	-2435.	-2431.	1999.	-5119.	-208.	-148.	1343.	181.	1314.
August	6519.	-1505.	-1618.	1738.	-4107.	-209.	-173.	1003.	143.	920.
September	3590.	-231.	-489.	1205.	-2364.	869.	879.	228.	76.	1159.
1988 October	3796.	-56.	-336.	1206.	-2195.	1121.	1132.	301.	48.	1459.
November 1-15	5524.	-1228.	-1637.	593.	-2121.	903.	870.	670.	101.	1555.
November 16-30	3942.	524.	119.	1229.	-1902.	891.	856.	684.	103.	1555.
December 1-15	9636.	-3895.	-4056.	962.	-4409.	16.	-83.	1443.	170.	1376.
December 15-31	7279.	-1274.	-1441.	1930.	-4049.	13.	-86.	1446.	173.	1376.
January 1-15	17787.	-2621.	-3297.	1151.	-4210.	-69.	-189.	1261.	158.	1072.
January 15-31	14505.	1028.	277.	2502.	-3692.	-72.	-193.	1264.	162.	1072.
February	10816.	-858.	-1602.	751.	-2545.	-25.	-51.	919.	122.	879.
March	7113.	-202.	-881.	577.	-1748.	163.	167.	1149.	159.	1343.
April	5480.	1160.	360.	520.	-686.	483.	449.	1436.	207.	1931.
May	5372.	536.	-99.	472.	-770.	1819.	-6.	1821.	71.	1878.
June	5649.	697.	254.	1456.	-2394.	187.	230.	1396.	185.	1735.
July	6397.	-1050.	-1224.	1659.	-3800.	-145.	-85.	1072.	171.	1105.
August	3410.	-111.	-425.	1163.	-2429.	15.	45.	793.	142.	923.
September	2370.	620.	191.	857.	-1365.	801.	814.	194.	72.	1060.
1989 October	2303.	672.	256.	794.	-1117.	1385.	1399.	361.	55.	1792.
November 1-15	5450.	-1086.	-1525.	577.	-2052.	698.	672.	532.	78.	1219.
November 16-30	3890.	647.	210.	1207.	-1832.	686.	660.	545.	80.	1219.
December 1-15	6416.	-1780.	-2160.	691.	-2755.	62.	1.	1068.	145.	1085.
December 15-31	4653.	177.	-203.	1408.	-2496.	61.	0.	1069.	146.	1085.
January 1-15	7525.	-2568.	-2897.	713.	-3342.	-77.	-112.	1044.	144.	938.
January 15-31	5473.	-290.	-622.	1557.	-3029.	-79.	-114.	1046.	146.	938.
February	8462.	-1351.	-1906.	731.	-2677.	5.	-47.	950.	135.	914.
March	27065.	-462.	-1688.	1702.	-3891.	157.	-85.	1499.	185.	1454.
April	14856.	1160.	18.	907.	-1547.	571.	511.	1774.	250.	2347.
May	8765.	367.	-375.	628.	-1238.	1790.	1787.	-8.	84.	1861.
June	5106.	590.	180.	1393.	-2342.	206.	251.	1413.	190.	1780.
July	8913.	-2611.	-2586.	2034.	-5293.	-340.	-283.	1108.	167.	944.
August	7805.	-2499.	-2475.	1946.	-5009.	-287.	-255.	1106.	144.	939.
September	3891.	-319.	-583.	1273.	-2528.	675.	663.	184.	46.	870.
1990 October	3214.	586.	185.	1021.	-1552.	1125.	1133.	294.	40.	1448.
November 1-15	4508.	-407.	-928.	480.	-1508.	646.	630.	459.	65.	1104.
November 16-30	3187.	1056.	538.	1006.	-1331.	636.	620.	468.	66.	1104.
December 1-15	8133.	-2610.	-2951.	656.	-3368.	-89.	-73.	1070.	143.	1016.
December 15-31	5909.	-142.	-492.	1569.	-3024.	-90.	-74.	1072.	145.	1016.
January 1-15	10579.	-4058.	-4276.	878.	-4535.	-152.	-209.	1220.	153.	1018.
January 15-31	7987.	-1178.	-1415.	1949.	-4127.	-154.	-211.	1223.	156.	1018.
February	10443.	-483.	-1250.	824.	-2301.	54.	-20.	965.	134.	991.
March	6563.	-52.	-718.	625.	-1641.	189.	157.	1098.	155.	1289.
April	8110.	1028.	148.	648.	-1063.	439.	407.	1453.	213.	1917.
May	4477.	984.	305.	434.	-375.	1890.	1878.	-3.	46.	1907.
June	5758.	561.	125.	1497.	-2568.	93.	135.	1219.	180.	1467.
July	6109.	-926.	-1115.	1613.	-3667.	-185.	-125.	902.	164.	895.
August	3490.	-178.	-483.	1181.	-2506.	-12.	20.	767.	139.	875.
September	2411.	590.	174.	864.	-1371.	856.	866.	210.	71.	1127.
1991 October	2310.	642.	229.	783.	-1111.	1431.	1447.	376.	56.	1855.
November 1-15	4345.	-434.	-946.	445.	-1469.	729.	734.	526.	77.	1279.
November 16-30	3039.	1014.	504.	965.	-1294.	718.	723.	537.	79.	1279.
December 1-15	5219.	-1111.	-1569.	524.	-2143.	106.	106.	974.	130.	1098.
December 15-31	3682.	595.	135.	1144.	-1922.	106.	106.	975.	130.	1098.
January 1-15	6000.	-1587.	-2012.	589.	-2554.	-17.	-34.	817.	118.	791.
January 15-31	4284.	317.	-111.	1287.	-2300.	-17.	-33.	817.	118.	791.
February	8234.	-1216.	-1783.	694.	-2555.	40.	8.	1000.	140.	1021.
March	19835.	-1754.	-2547.	1445.	-3988.	89.	-181.	1300.	166.	1153.
April	8871.	1127.	197.	687.	-1091.	446.	406.	1464.	212.	1925.
May	4414.	568.	-34.	468.	-672.	1830.	1810.	-7.	76.	1872.
June	5679.	731.	246.	1462.	-2422.	123.	162.	1248.	179.	1519.
July	6406.	-1057.	-1234.	1658.	-3819.	-215.	-152.	894.	164.	862.
August	2532.	868.	373.	875.	-1409.	83.	115.	659.	133.	859.
September	2538.	473.	75.	908.	-1522.	823.	837.	203.	74.	1092.
1992 October	2434.	479.	93.	888.	-1357.	1175.	1142.	291.	39.	1451.
November 1-15	3761.	-163.	-702.	435.	-1281.	529.	515.	350.	48.	882.
November 16-30	2638.	1081.	547.	878.	-1135.	523.	509.	357.	48.	882.
December 1-15	6402.	-1568.	-1983.	652.	-2600.	61.	24.	1027.	141.	1067.
December 15-31	4621.	411.	-7.	1376.	-2337.	61.	23.	1028.	142.	1067.
January 1-15	6630.	-2004.	-2365.	747.	-2941.	48.	-39.	1118.	154.	1084.
January 15-31	4830.	-4.	-364.	1483.	-2676.	46.	-41.	1120.	156.	1084.
February	20662.	-285.	-1329.	1519.	-3105.	776.	378.	2103.	248.	2487.
March	12585.	-428.	-1243.	1093.	-2598.	176.	-19.	1147.	154.	1131.

TABLE 5

SWRCB EIR PLAN STUDY 1995-SWRCB-409: \*\*\* MINIMUM FLOW \*\*\*

	EMMATON	JERSEY POINT	SAN ANDREAS	TERMINOUS	PRISONERS POINT	BUCKLEY COVE	BRANDT BRIDGE	OLD R.@ MIDDLE R.	OLD R.@ TRACY	VERNALIS
1987 October	-108857.	-120317.	-84536.	-2237.	-51495.	-1280.	3651.	1066.	-327.	5840.
November 1-15	-106175.	-120859.	-86745.	-3210.	-51329.	-3898.	313.	905.	1.	2867.
November16-30	-108075.	-119404.	-84443.	-2120.	-52149.	-3951.	217.	906.	0.	2864.
December 1-15	-107643.	-120159.	-86360.	-3097.	-50762.	-4284.	-812.	2171.	96.	3403.
December15-31	-109160.	-118970.	-84397.	-2112.	-51483.	-4436.	-867.	2166.	92.	3402.
January 1-15	-105451.	-121248.	-87372.	-3159.	-52292.	-5394.	-1588.	1297.	30.	1606.
January 15-31	-107497.	-119677.	-84926.	-2053.	-53114.	-5563.	-1635.	1288.	28.	1603.
February	-101197.	-121639.	-87838.	-3032.	-52776.	-5411.	-1620.	1324.	48.	1600.
March	-92614.	-122346.	-88822.	-2773.	-53625.	-5425.	-1571.	1577.	74.	1931.
April	-104744.	-119473.	-86022.	-3150.	-50726.	-5303.	-1223.	530.	-122.	2069.
May	-106441.	-119954.	-85934.	-3189.	-49884.	-3628.	683.	-681.	-393.	1818.
June	-108322.	-119506.	-84732.	-2111.	-52303.	-5804.	-1473.	313.	-276.	1618.
July	-104761.	-122370.	-86860.	-1964.	-55335.	-5989.	-1762.	-109.	-188.	1185.
August	-106867.	-120846.	-85679.	-2027.	-54072.	-5945.	-1798.	-632.	-197.	741.
September	-109508.	-119897.	-85008.	-2097.	-51809.	-4586.	-1156.	-427.	-350.	1044.
1988 October	-109069.	-119716.	-84924.	-2118.	-51817.	-4258.	-823.	-347.	-393.	1356.
November 1-15	-107228.	-120396.	-86668.	-3077.	-50956.	-4349.	-1039.	-15.	-90.	1477.
November16-30	-108764.	-119146.	-84638.	-2071.	-51730.	-4497.	-1086.	-3.	-90.	1474.
December 1-15	-103489.	-123028.	-88696.	-2920.	-53399.	-5560.	-1713.	1177.	40.	1313.
December15-31	-105686.	-121226.	-85956.	-1783.	-54325.	-5744.	-1766.	1155.	38.	1308.
January 1-15	-96631.	-123030.	-89258.	-2843.	-53829.	-5704.	-1820.	790.	30.	982.
January 15-31	-99395.	-120591.	-85760.	-1478.	-54821.	-5948.	-1879.	752.	27.	975.
February	-102607.	-120541.	-86979.	-3204.	-52161.	-5630.	-1746.	-130.	-92.	733.
March	-105752.	-119843.	-86368.	-3149.	-51046.	-5601.	-1550.	443.	-47.	1242.
April	-107363.	-118969.	-85346.	-3146.	-50216.	-5302.	-1271.	187.	-174.	1828.
May	-107559.	-119673.	-85680.	-3188.	-49593.	-3599.	734.	-691.	-409.	1831.
June	-107869.	-119460.	-84671.	-2085.	-52360.	-5815.	-1474.	340.	-271.	1634.
July	-106978.	-120616.	-85573.	-1964.	-53676.	-5972.	-1737.	-386.	-204.	945.
August	-109381.	-120011.	-85248.	-2084.	-52264.	-5852.	-1680.	-516.	-495.	752.
September	-110472.	-119160.	-84616.	-2218.	-50839.	-4643.	-1215.	-512.	-441.	940.
1989 October	-110267.	-119069.	-84553.	-2257.	-50624.	-3975.	-241.	-302.	-451.	1714.
November 1-15	-107423.	-120148.	-86498.	-3112.	-50901.	-4616.	-1232.	-212.	-121.	1127.
November16-30	-108947.	-118909.	-84478.	-2116.	-51656.	-4776.	-1274.	-202.	-121.	1125.
December 1-15	-106417.	-120753.	-87058.	-3018.	-51671.	-5633.	-1672.	379.	-37.	975.
December15-31	-108197.	-119378.	-84865.	-1990.	-52466.	-5776.	-1713.	342.	-38.	969.
January 1-15	-105365.	-121264.	-87458.	-3125.	-52271.	-5657.	-1759.	349.	3.	822.
January 15-31	-107457.	-119675.	-85000.	-2019.	-53069.	-5830.	-1805.	313.	2.	816.
February	-104565.	-120757.	-87118.	-3035.	-51793.	-5704.	-1724.	109.	-44.	783.
March	-87687.	-122449.	-89009.	-2617.	-54277.	-5645.	-1773.	1257.	47.	1391.
April	-99225.	-120104.	-86896.	-2997.	-51564.	-5249.	-1221.	810.	-69.	2275.
May	-104442.	-120236.	-86211.	-3142.	-50231.	-3614.	651.	-676.	-380.	1811.
June	-108366.	-119455.	-84679.	-2100.	-52235.	-5777.	-1455.	388.	-275.	1683.
July	-104565.	-122493.	-86980.	-1944.	-55491.	-6083.	-1855.	-619.	-174.	770.
August	-105585.	-122269.	-86735.	-1956.	-55096.	-6029.	-1839.	-626.	-192.	763.
September	-109501.	-119731.	-84898.	-2091.	-51925.	-4800.	-1353.	-476.	-381.	747.
1990 October	-109725.	-119090.	-84509.	-2226.	-51153.	-4217.	-827.	-408.	-443.	1343.
November 1-15	-108124.	-119745.	-86231.	-3138.	-50594.	-4697.	-1290.	-236.	-124.	1000.
November16-30	-109293.	-118674.	-84421.	-2170.	-51266.	-4832.	-1325.	-227.	-123.	998.
December 1-15	-104783.	-121437.	-87660.	-3105.	-52308.	-5714.	-1727.	419.	-17.	907.
December15-31	-106997.	-119723.	-85057.	-2022.	-53136.	-5899.	-1774.	380.	-21.	900.
January 1-15	-102642.	-123254.	-89020.	-2975.	-53568.	-5689.	-1806.	736.	30.	928.
January 15-31	-104990.	-121305.	-86065.	-1832.	-54478.	-5899.	-1860.	703.	28.	921.
February	-102983.	-120357.	-86846.	-3002.	-51646.	-5689.	-1711.	108.	-57.	863.
March	-106261.	-119673.	-86198.	-3101.	-50920.	-5573.	-1559.	321.	-47.	1180.
April	-104926.	-119401.	-85953.	-3108.	-50729.	-5377.	-1304.	216.	-165.	1815.
May	-108467.	-119309.	-85357.	-3192.	-49227.	-3536.	843.	-702.	-444.	1863.
June	-107464.	-119808.	-84955.	-2015.	-52622.	-5858.	-1582.	181.	-309.	1351.
July	-107260.	-120554.	-85558.	-1984.	-53466.	-6033.	-1767.	-613.	-209.	721.
August	-109291.	-120005.	-85236.	-2083.	-52288.	-5871.	-1692.	-562.	-445.	702.
September	-110604.	-119104.	-84546.	-2234.	-50766.	-4588.	-1169.	-523.	-410.	1008.
1991 October	-110282.	-119084.	-84561.	-2268.	-50603.	-3935.	-112.	-284.	-449.	1784.
November 1-15	-108232.	-119795.	-86266.	-3155.	-50564.	-4563.	-1192.	-158.	-111.	1182.
November16-30	-109374.	-118733.	-84473.	-2194.	-51227.	-4694.	-1227.	-147.	-110.	1180.
December 1-15	-107275.	-120400.	-86824.	-3094.	-51315.	-5606.	-1591.	-77.	-48.	967.
December15-31	-108730.	-119189.	-84841.	-2106.	-52032.	-5734.	-1627.	-126.	-60.	961.
January 1-15	-106729.	-120646.	-87019.	-3085.	-51547.	-5705.	-1710.	-163.	-55.	647.
January 15-31	-108443.	-119306.	-84883.	-2077.	-52306.	-5848.	-1747.	-199.	-65.	643.
February	-104707.	-120719.	-87113.	-3048.	-51743.	-5693.	-1678.	203.	-38.	898.
March	-94637.	-122688.	-88939.	-2708.	-53918.	-5628.	-1823.	898.	36.	1071.
April	-104242.	-119474.	-86029.	-3096.	-50828.	-5384.	-1307.	232.	-165.	1823.
May	-108517.	-119534.	-85545.	-3164.	-49442.	-3591.	714.	-690.	-408.	1825.
June	-107701.	-119586.	-84821.	-2037.	-52440.	-5845.	-1552.	158.	-289.	1403.
July	-106967.	-120643.	-85612.	-1965.	-53657.	-6039.	-1784.	-655.	-201.	685.
August	-110235.	-119155.	-84704.	-2208.	-51278.	-5811.	-1621.	-778.	-561.	681.
September	-110362.	-119271.	-84676.	-2206.	-50975.	-4619.	-1195.	-497.	-417.	973.
1992 October	-110321.	-119103.	-84597.	-2200.	-50821.	-4158.	-805.	-407.	-454.	1347.
November 1-15	-108861.	-119476.	-86022.	-3153.	-50420.	-4883.	-1397.	-335.	-139.	766.
November16-30	-109765.	-118532.	-84381.	-2207.	-51012.	-4989.	-1427.	-327.	-138.	764.
December 1-15	-106343.	-120690.	-87033.	-3040.	-51614.	-5644.	-1657.	269.	-35.	950.
December15-31	-108123.	-119303.	-84829.	-2013.	-52408.	-5789.	-1697.	231.	-36.	944.
January 1-15	-106230.	-120825.	-87067.	-3013.	-51809.	-5592.	-1705.	508.	-13.	981.
January 15-31	-108077.	-119413.	-84830.	-1963.	-52590.	-5740.	-1747.	471.	-17.	975.
February	-94068.	-122004.	-88288.	-2692.	-53347.	-5004.	-1422.	1899.	97.	2446.
March	-101100.	-120613.	-87050.	-2898.	-52223.	-5574.	-1716.	504.	-5.	1026.

April	-104903.	-119325.	-85888.	-3116.	-50665.	-5377.	-1290.	227.	-170.	1833.
May	-107984.	-119722.	-85719.	-3189.	-49610.	-3637.	685.	-686.	-401.	1821.
June	-107894.	-119510.	-84710.	-2078.	-52412.	-5834.	-1482.	325.	-264.	1623.
July	-105909.	-121295.	-85981.	-1973.	-54529.	-5959.	-1781.	-438.	-182.	924.
August	-109920.	-119403.	-84856.	-2166.	-51601.	-5824.	-1633.	-664.	-499.	745.
September	-110684.	-118987.	-84477.	-2240.	-50642.	-4648.	-1217.	-543.	-423.	939.

TABLE 6

SWRCB EIR PLAN STUDY 1995-SWRCB-409: \*\*\* MAXIMUM FLOW \*\*\*

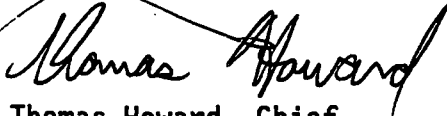
	EMMÁTON	JERSEY POINT	SAN ANDREAS	TERMINOUS	PRISONERS POINT	BUCKLEY COVE	BRANDT BRIDGE	OLD R.@ MIDDLE R.	OLD R.@ TRACY	VERNALIS	
1987	October	114376.	113219.	76266.	4003.	45086.	9213.	4293.	2102.	943.	5865.
	November 1-15	116654.	109761.	73420.	4091.	41612.	7211.	2059.	1663.	340.	2911.
	November 16-30	114811.	111042.	74360.	4090.	42770.	7360.	2069.	1677.	347.	2912.
	December 1-15	115709.	109975.	73606.	3902.	41603.	6425.	1742.	2765.	462.	3452.
	December 15-31	113785.	111001.	74304.	3787.	42737.	6497.	1750.	2771.	465.	3452.
	January 1-15	116960.	109242.	72873.	4121.	40737.	5333.	1223.	1850.	340.	1690.
	January 15-31	115166.	110631.	73903.	4180.	41870.	5457.	1237.	1863.	346.	1691.
	February	119174.	109983.	73501.	4332.	40865.	5374.	1217.	1847.	340.	1684.
	March	123248.	110908.	74265.	4701.	41005.	5546.	1282.	1977.	366.	2003.
	April	117460.	112245.	75363.	3932.	42803.	5744.	1465.	2137.	404.	2181.
	May	116679.	112314.	75391.	4075.	43352.	7089.	2286.	405.	779.	1885.
	June	114956.	112673.	75459.	4216.	43346.	5474.	1325.	1833.	891.	1752.
	July	117055.	111827.	74909.	4873.	42127.	5118.	1064.	1815.	827.	1347.
	August	115928.	111840.	74811.	4586.	42476.	5083.	1062.	1466.	747.	965.
	September	113683.	111828.	74828.	4027.	43256.	5870.	1720.	673.	732.	1195.
1988	October	113986.	111931.	74987.	3970.	43463.	6231.	1858.	729.	752.	1488.
	November 1-15	115877.	109945.	73526.	3909.	41631.	5996.	1640.	1152.	314.	1584.
	November 16-30	113970.	111050.	74303.	3834.	42604.	6092.	1650.	1168.	321.	1585.
	December 1-15	117919.	108760.	72525.	4312.	40322.	5191.	1095.	1666.	305.	1404.
	December 15-31	116391.	110318.	73695.	4483.	41372.	5344.	1110.	1681.	311.	1405.
	January 1-15	121373.	109858.	73363.	4534.	40644.	5119.	1040.	1543.	289.	1107.
	January 15-31	120072.	111871.	74981.	5109.	41345.	5215.	1057.	1562.	294.	1109.
	February	118539.	110238.	73654.	4098.	41060.	5039.	1146.	1512.	265.	932.
	March	116781.	110486.	73915.	3867.	42159.	5258.	1277.	1776.	298.	1385.
	April	115833.	112167.	75348.	3813.	43014.	5669.	1441.	2045.	387.	1964.
	May	115956.	112356.	75439.	4010.	43505.	7098.	2302.	433.	781.	1895.
	June	115323.	112828.	75587.	4275.	43366.	5488.	1326.	1841.	894.	1767.
	July	115830.	111899.	74854.	4511.	42516.	5153.	1123.	1557.	784.	1147.
	August	113450.	111824.	74946.	3758.	43133.	5124.	1231.	1598.	739.	983.
	September	112495.	112051.	75018.	3648.	43828.	5722.	1690.	647.	785.	1099.
1989	October	112545.	112135.	75206.	3564.	44313.	6728.	2008.	793.	798.	1815.
	November 1-15	115832.	109914.	73473.	3900.	41575.	5727.	1537.	1013.	304.	1255.
	November 16-30	113931.	111006.	74244.	3822.	42541.	5824.	1548.	1029.	311.	1256.
	December 1-15	116387.	109640.	73218.	4022.	41000.	5160.	1162.	1665.	278.	1129.
	December 15-31	114505.	110876.	74107.	3993.	42157.	5284.	1178.	1681.	281.	1131.
	January 1-15	116980.	109224.	72815.	4098.	40681.	5043.	1090.	1562.	269.	982.
	January 15-31	115185.	110643.	73883.	4186.	41824.	5178.	1105.	1578.	272.	984.
	February	117441.	109946.	73427.	4079.	41025.	5096.	1140.	1601.	261.	965.
	March	126125.	111225.	74456.	5017.	40758.	5361.	1117.	1712.	312.	1483.
	April	120159.	112892.	75899.	4251.	42810.	5853.	1481.	2226.	432.	2373.
	May	117838.	112528.	75555.	4208.	43260.	7123.	2280.	390.	777.	1879.
	June	114916.	112713.	75501.	4210.	43397.	5505.	1337.	1859.	902.	1811.
	July	117148.	111748.	74844.	4921.	42009.	4988.	976.	1589.	766.	986.
	August	116618.	111718.	74793.	4801.	42210.	5037.	998.	1568.	755.	982.
	September	113926.	112061.	74984.	4123.	43329.	5654.	1604.	606.	760.	913.
1990	October	113473.	112312.	75289.	3804.	43924.	6180.	1862.	712.	806.	1477.
	November 1-15	115088.	110438.	73948.	3743.	42654.	5613.	1522.	1006.	302.	1145.
	November 16-30	113260.	111343.	74558.	3583.	42984.	5702.	1534.	1022.	307.	1146.
	December 1-15	117241.	109229.	72826.	4040.	40678.	5049.	1114.	1603.	271.	1059.
	December 15-31	115523.	110737.	73978.	4205.	41810.	5193.	1131.	1620.	274.	1061.
	January 1-15	118295.	108724.	72435.	4279.	40294.	5015.	1017.	1507.	279.	1053.
	January 15-31	116826.	110415.	73751.	4562.	41287.	5181.	1032.	1524.	283.	1055.
	February	118488.	110461.	73840.	4152.	41236.	5132.	1162.	1622.	275.	1041.
	March	116487.	110563.	74006.	3905.	42282.	5264.	1273.	1757.	302.	1332.
	April	117379.	112233.	75360.	3972.	42768.	5635.	1416.	2032.	392.	1950.
	May	115230.	112552.	75621.	3937.	43762.	7132.	2345.	470.	787.	1924.
	June	115285.	112398.	75272.	4263.	43018.	5331.	1268.	1751.	834.	1503.
	July	115611.	111853.	74810.	4462.	42530.	5108.	1101.	1488.	747.	945.
	August	113535.	111726.	74798.	3870.	43036.	5118.	1208.	1565.	730.	934.
	September	112564.	112145.	75064.	3698.	43893.	5786.	1718.	653.	794.	1164.
1991	October	112541.	112146.	75216.	3563.	44384.	6844.	2034.	806.	800.	1877.
	November 1-15	114966.	110480.	74000.	3697.	42761.	5742.	1576.	1071.	311.	1315.
	November 16-30	113139.	111367.	74602.	3541.	43088.	5826.	1587.	1086.	316.	1316.
	December 1-15	115615.	110199.	73719.	3792.	42251.	5211.	1240.	1743.	296.	1150.
	December 15-31	113689.	111273.	74484.	3702.	42678.	5316.	1258.	1760.	303.	1151.
	January 1-15	116142.	109777.	73302.	3919.	41337.	5048.	1148.	1594.	263.	851.
	January 15-31	114213.	110979.	74180.	3903.	42305.	5167.	1165.	1610.	270.	852.
	February	117320.	110046.	73523.	4026.	41270.	5129.	1174.	1660.	273.	1069.
	March	122293.	110450.	73915.	4717.	40835.	5283.	1048.	1578.	285.	1187.
	April	117732.	112349.	75453.	4012.	42763.	5644.	1416.	2037.	392.	1957.
	May	115212.	112336.	75444.	3979.	43591.	7108.	2293.	454.	785.	1890.
	June	115223.	112573.	75376.	4248.	43160.	5368.	1287.	1767.	852.	1555.
	July	115827.	111853.	74809.	4516.	42469.	5087.	1082.	1467.	744.	911.
	August	112620.	112310.	75381.	3428.	43788.	5158.	1294.	1572.	760.	927.
	September	112682.	112014.	74981.	3712.	43741.	5756.	1701.	654.	779.	1130.
1992	October	112691.	112075.	75097.	3655.	44033.	6225.	1866.	721.	797.	1481.
	November 1-15	114411.	110586.	74096.	3674.	42912.	5451.	1470.	939.	277.	931.
	November 16-30	112712.	111332.	74558.	3453.	43198.	5542.	1481.	954.	278.	932.
	December 1-15	116368.	109794.	73348.	3974.	41320.	5147.	1179.	1679.	275.	1114.
	December 15-31	114476.	111042.	74252.	3956.	42262.	5271.	1196.	1695.	278.	1115.
	January 1-15	116527.	109500.	73086.	4096.	40895.	5154.	1136.	1636.	286.	1126.
	January 15-31	114663.	110758.	73996.	4077.	42042.	5280.	1151.	1651.	290.	1127.
	February	122764.	111275.	74632.	4705.	41414.	5998.	1410.	2232.	411.	2506.
	March	119305.	110701.	74090.	4345.	41175.	5259.	1163.	1659.	290.	1172.

April	117345.	112321.	75440.	3965.	42824.	5642.	1429.	2044.	389.	1968.
May	115639.	112233.	75343.	3992.	43482.	7072.	2284.	444.	782.	1886.
June	115299.	112782.	75548.	4287.	43327.	5465.	1318.	1834.	896.	1756.
July	116511.	111853.	74855.	4699.	42282.	5087.	1068.	1576.	785.	1126.
August	112949.	112071.	75103.	3637.	43493.	5165.	1267.	1589.	759.	983.
September	112398.	112186.	75102.	3648.	43978.	5718.	1692.	640.	802.	1099.

**Memorandum**

To : Francis Chung, Chief  
Delta Modeling Section  
Department of Water Resources  
1416 Ninth Street  
Sacramento, California 95814

Date: MAR 23 1995



Thomas Howard, Chief  
Bay-Delta Unit

From : STATE WATER RESOURCES CONTROL BOARD  
901 P Street Sacramento, CA 95814  
Mail Code G-8

Subject: REQUEST FOR DWRDSM STUDIES

The purpose of this memorandum is to request the Department of Water Resources' (DWR) assistance in estimating water quality conditions in the Delta under the standards of the December 1994 draft Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (draft Plan).

On February 23, 1995, the State Water Resources Control Board conducted a hearing to solicit comments on the draft Plan and accompanying environmental report. Among the comments received from hearing participants are concerns regarding: (1) the potential impacts on water quality in the central Delta due to the Delta Cross Channel gate closure and increased San Joaquin River flow standards in the draft Plan; and (2) the water quality needs for irrigation and leaching in months not covered by the agricultural standards in the draft Plan.

Consequently, we are requesting that studies be conducted using the DWR Delta Simulation Model (DWRDSM) to estimate year-round water quality conditions in the Delta. A base case study and a draft Plan study should be conducted using outputs from DWRSIM studies 1995c6b-MONTERY-412 and 1995c6b-SWRCB-409m, respectively. These DWRSIM studies were conducted earlier by the DWR to estimate water supply impacts of the draft Plan. As necessary, assumptions used to model the base case and draft Plan DWRSIM operations should be used for the DWRDSM studies. Please include a discussion of these and other DWRDSM major assumptions and operational criteria, along with a brief model description, when transmitting the results of the studies.

For the base case and draft Plan DWRDSM studies, we are specifically interested in obtaining average monthly salinity (as electrical conductivity in millimhos per centimeter) and maximum, minimum, and average monthly flow (in cubic feet per second) for water years 1987 through 1992 at the following locations:

- (1) Sacramento River at Emmaton;
- (2) San Joaquin River at Jersey Point;
- (3) San Joaquin River at San Andreas Landing;
- (4) South Fork of the Mokelumne River at Terminous;

- (5) San Joaquin River at Prisoners Point;
- (6) San Joaquin River at Buckley Cove.
- (7) San Joaquin River at Brandt Bridge site;
- (8) Old River near Middle River;
- (9) Old River near Tracy Road Bridge; and
- (10) San Joaquin River at Vernalis;

Please provide the flow outputs in tabular forms, and the salinity outputs in both tabular and graphical forms. Tabular outputs should be in ASCII or other Lotus 1-2-3 compatible formats. We would appreciate receiving the requested information as soon as possible. Your staff has indicated that this would be no later than April 28, 1995.

Thank you for your consideration of this request. Please contact me at (916) 657-1873 if you have any questions.



WRINT DWR-134A

ATTACHMENT 2

WRINT DWR-134A

The Delta Simulation Model DWRDSM  
Calibration and Verification

WRINT DWR-134B

Description of the DWR MDO Program

## The Delta Simulation Model DWRDSM

### Introduction

The objective of this exhibit is two-fold:

1. Present the latest version of the DWR Delta Simulation Model (DWRDSM). DWRDSM is a variant of the Fischer Delta Model version 7E (FDM) which incorporates significant enhancements to create an improved tool for analysis of structural and operational impacts on Delta hydrodynamics and water quality. A brief discussion of the major enhancements is included.
2. Present results of DWRDSM calibration and verification against Delta stage, flow and salinity data. These results are described in Appendix I, II and III as part of this exhibit.

Since the 1987 Water Rights Hearings when DWR presented the FDM as a modeling tool for analysis of impacts, DWR has engaged in an extensive effort to enhance the flexibility of the FDM so that analysis of complex and specific operational and structural modifications of the Delta could be appropriately modeled. Enhancements include improvements to simulation of agricultural drainage quality, improved description of Delta geometry, accurate simulation of gate structures, and mass tracking. The basic mathematical formulation of the FDM is unchanged. Calibration and verification of the DWRDSM have been incrementally improved as new data has become available and automatic calibration techniques have been developed.

### 1. DWRDSM Enhancements

#### Agricultural Diversion and Drainage Modeling Enhancements

A significant enhancement to the FDM incorporated in the DWRDSM is the capability to dynamically simulate agricultural drainage quality. Field experience shows that agricultural drainage concentrations and time of peak concentration change significantly from one year to the next. Given the magnitude of Delta island drainage flows, an approach which captured the overall physics of salt exchange between irrigated land and Delta channels was required.

The mathematical approach to dynamic island drainage quality simulation considers actual irrigation water quantity and quality, soil moisture content, salt concentration, soil leaching efficiency, surface runoff, and soil type. A conceptual model of the dynamic salt balance process is shown in Figure 1. This enhancement is an improvement over the predetermined agricultural diversion and drainage used in the FDM. Details of the computational approach may be found in the Twelfth Annual Report to the State Water Resources Control Board, "Methodology for flow and Salinity Estimates in the Sacramento-San Joaquin Delta and San Francisco Bay," April 1991.

The agricultural drainage model was calibrated and verified against drainage quality field data for Grand Island using a leaching efficiency factor and a drainage activity factor. Data for water years 1985 and 1986 was used for calibration purposes, while data for water years 1987 and 1988 was used for model verification. The result of both calibration and verification are shown in Figure 2.

### **Expanded Description of Delta Diversion and Drainage Locations**

A related enhancement which is critical to accurate agricultural drainage quality modeling was refinement of the mathematical description of Delta diversion and drainage locations. There are over 1,600 agricultural diversion points in the Delta. The FDM simulates these diversion points with only twelve aggregated model diversion points (Figure 3). This capability has been enhanced in DWRDSM by expanding to 253 diversion locations (Figure 4a). Similarly, 370 actual Delta island drainage locations are simulated by 23 locations in the FDM and is enhanced to 197 locations in the DWRDSM model (Figure 4b). The importance of this effort was to more realistically distribute the effects of local salt loads and flow due to agricultural drainage.

### **Enhancements To The Mathematical Description of Delta Geometry**

Accurate simulation of Delta hydrodynamics and water quality require adequate mathematical descriptions of channel cross-section geometry. The DWRDSM model is applied principally for the purpose of comparing alternative design, location, or operation of proposed Delta improvements. Errors in the basic description of Delta geometry render inferences about the impact of proposed Delta facilities suspect. For example, investigations into the hydrodynamic and water quality impact of channel enlargements for improved conveyance rely on accurate base channel geometry descriptions. If base conditions are grossly inadequate or erroneous, there is little basis on which to provide meaningful impact assessments of proposed alternatives.

The limited resolution of the FDM geometry proved inadequate for the scale of impact analysis of interest to DWR planners. The geometric description of 1000 miles of Delta channels was therefore improved from 134 channels of uniform geometry in the FDM (Figure 3) to 496 channels in the DWRDSM (Figure 4c).

### **Enhancements For Simulation Of Gate Structures**

The DWRDSM includes several enhancements that allow accurate modeling of existing and planned hydraulic structures in the Delta.

#### **1. Suisun Marsh Salinity Control Gates**

A gate was implemented in the DWRDSM to simulate the action of the Suisun Marsh Salinity Control Gates. Gate operation can be implemented according to hydraulic head gradient and velocity criteria, or it can be operated according to a set time schedule. The model also simulates the twenty minute opening and closing sequence of the prototype gate.

#### **2. Clifton Court Forebay Gates**

The FDM did not provide for simulation of a forebay gate at Clifton Court which in the prototype is opened generally on the ebb tide and closed on the flood. Accurate simulation of south Delta area water levels depend on forebay gate simulation. Additionally, the capability of simulating more than one Clifton Court Forebay (CCFB) gate in alternative locations has been added for future planning studies.

### 3. Automatic Adjustment of SWP Pumping Based On Minimum Water Levels in Clifton Court Forebay

Export rates from Banks Pumping Plant are constrained by minimum water levels in CCFB. This constraint will be approached when the SWP expands pumping capacity to 10,300 cfs. A routine was added to determine the total monthly volume of pumping with varying tides (spring and neap) or hydrology. As critical water levels are approached in CCFB, the DWRDSM begins an automatic iterative pumping reduction routine to maintain forebay water levels above the minimum.

### 4. Combined Weir-Pipe Hydraulic Structures

Existing and planned channel gate structures often have combination weir and culvert flow capability. The DWRDSM was enhanced to allow water to flow through both weirs and pipes. When water levels at the upstream of the combined structure drop below the crest of the weir, water flows solely through the pipes. Provisions were made to simulate open channel flow or submerged flow in all cases.

### 5. Weirs With Double Size Openings

Some Delta channel gates are designed to create a pool of water behind the gate for irrigation purposes when the flow reverses direction. Such a gate is proposed for Grant Line Canal where landward flow will pass through a 268 foot wide weir which reduces to 80 feet when the flow reverses to the seaward direction. The DWRDSM has been enhanced to read two different weir widths, one for each flow direction.

### Tracer Modeling

A new system has been developed to track and account for all conservative constituent mass entering and leaving the Delta. Typically, transported materials are reported in concentration units which are appropriate when sources of solute are continuously available at the boundaries of the model (e.g. ocean or land derived salt). However, if the transport and fate of finite quantities of material which arrive in the Delta only infrequently and only for short durations are of interest, then it is useful to track the material in mass units. This is the case in modeling transport of fish eggs and larvae. It is now possible to inject a known number of particles (tracer) into any Delta location, and track the time fate of particles as they disperse in the Delta and move through one of several Delta sinks. At any time after the simulation begins, we track the percentage of the initial tracer release entrained in project pumping plants, Delta islands, out of the Delta into Suisun Bay, and remaining in Delta channels. This capability has been successfully applied to analysis of south Delta barrier impacts on Striped Bass egg and larvae transport. Figure 5 shows a typical time series result for a tracer injection on the Sacramento River at I street. Additional work is underway to develop a particle tracking capability which will account for variable settling, transverse shear, and mortality of biological constituents.

2. CALIBRATION AND VERIFICATION OF DWRDSM

1990 Automatic Calibration of DWRDSM

A parameter estimation program based on a Newton gradient algorithm has been used for automatic calibration of DWRDSM. Model coefficients, Manning's n and dispersion coefficients, are systematically adjusted to minimize the sum of the squared differences between DWRDSM stage, and salinity, and actual stage and salinity. The procedure is extremely computer intensive since the model must be run once for each degree of freedom in the coefficient matrix.

DWRDSM was calibrated using field hydrodynamic and water quality data for selected months in 1988. Several verifications were made on months in 1988 and 1989. All calibration and verification periods are shown in Table 1. A complete record of this effort is reported in the Twelfth Annual Progress Report to the SWRCB, "Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin delta and Suisun Marsh," June, 1991.

1992 Calibration and Verification

A new calibration and verification is made when there are source code changes, if new data becomes available for comparison, or if improvement is needed for specific Delta locations. New flow data became available in late 1991. This provided an opportunity not only to incorporate this data, but to improve model predictions at important Delta locations.

Calibration Procedure

An iterative, stepwise calibration procedure was followed:

1. Steady-state runs were made using a dry year July hydrology and the previously calibrated and verified geometry. This provided the base condition for comparison with improved calibrations.
2. Changes were made to the base condition Manning's n or dispersion coefficients and a steady state simulation was performed using the same dry year July hydrology. Fifteen minute flow values were compared between the base and the modified version at various locations. This process may continue for several iterations until a satisfactory result is generated.
3. Daily average flow values for the intermediate calibration were compared at Middle River, Old River, Georgiana Slough, and the Cross Channel. Flow-splits were compared with field data for adequacy. If flow-splits were not adequate, then procedure 2 was repeated.
4. If flow-splits compared well to field data, a three year historical simulation was made. Table 2 lists the sources of all input data and assumptions. Three year historical simulations have been made using monthly average flow data for 1976-1978 and 1983-1985. Salinity output is plotted against observed USBR data (converted EC to TDS). Flow-split plots were

made using the regression equations developed in DAYFLOW. If the results were not considered adequate, the calibration coefficients are changed and the process was repeated.

#### Verification Process and Results

1. A one month verification run using the actual tide for May 1988 and actual Cross Channel and Clifton Court Forebay gate operation was also made. Prototype flow data is from USGS ADCP flow measurements made in 1988 and 1989. Results of this effort are organized as follows:

Appendix I: May 1988 Water Surface Stage Verification  
Appendix II: May 1988 Flow Verification

Each Appendix begins with a location map which indicates the location of the referenced stations that follow.

2. When the results of the three year run are deemed satisfactory, a 24 year historical simulation is performed. Table 2 provides a complete listing of input data and assumptions used for the 24 year verification. Flow-split and salinity plots were made and compared with observed data. Appendix III exhibits the results of the 24-year salinity verification. Appendix III begins with a location map which indicates the referenced stations that follow.

#### DWRDSM Verification Via Flow-Split Analysis

Data for Delta channel flows is difficult and expensive to collect. As a result, there is little flow data available. Of the data that exists, some is of very high quality, while some must be considered anecdotal. An efficient way to take advantage of limited flow data is to focus on the distribution of Delta flows. The distribution concept is useful because it provides understanding of the complex nature of delta flows and the resulting distribution of salinity.

The approach was to focus on three important flow-split locations in the Delta:

1. Delta Cross-Transfer Flow - determined in several field studies to be as follows:

Cross Transfer Q (both gates open)	$Q = 0.293 * \text{Sac } Q + 2090 \text{ cfs}$
Cross-Channel Q (both gates open)	$Q = 0.190 * \text{Sac } Q + 1205 \text{ cfs}$
Georgiana Slough (both gates open)	$Q = 0.103 * \text{Sac } Q + 885 \text{ cfs}$
Georgiana Slough (both gates closed)	$Q = 0.133 * \text{Sac } Q + 829 \text{ cfs}$

2. North Fork vs South Fork Mokelumne River - determined by field studies reported in DWR Bulletin 76. Based on these studies, the target net flow relation is 80% North Fork, 20% South Fork.

3. Old River vs Middle River - measured at USGS AVM sites at Bacon Island. Based on this data, the target net flow relation is 50% Old River, 50% Middle River adjacent to Bacon Island.

The locations of Delta flow split analysis sites is shown in Figure 6. Six steady-state DWRDSM and FDM model runs were made using a wide range of Delta

inflows, channel depletions and export amounts. Results of the analysis follow:

1. Delta Cross-Transfer Flow

Figure 7 shows the monthly average flow from DAYFLOW data verification of DWRDSM. The model tracks all four empirical relations well.

2. North Fork vs South Fork Mokelumne River

Figure 8 shows the Bulletin 76 80%-20% flow split. The DWRDSM result indicates that there is a fairly robust relationship over a range of hydrologies.

3. Old River vs Middle River

New data at the USGS AVM sites adjacent to Bacon Island have recently become available. On four occasions in 1988 and 1989 the USGS employed their hull-mounted acoustic doppler current profiler (ADCP) capability to obtain data with which to calibrate their permanent AVM's. This data represents an effectively simultaneous measurement of flows at the Old and Middle River AVM sites. The DWR used the DAYFLOW hydrology for each of the four occasions to run the DWRDSM model for verification against these data. The hydrologies are shown in Table 3 and the results of the verification are shown in Figure 9. Net flow results for the 50% Old River, 50% Middle River flow-split are shown in Figure 10.

Figure 1  
**SALT MASS BALANCE FOR  
 TYPICAL DELTA ISLAND**

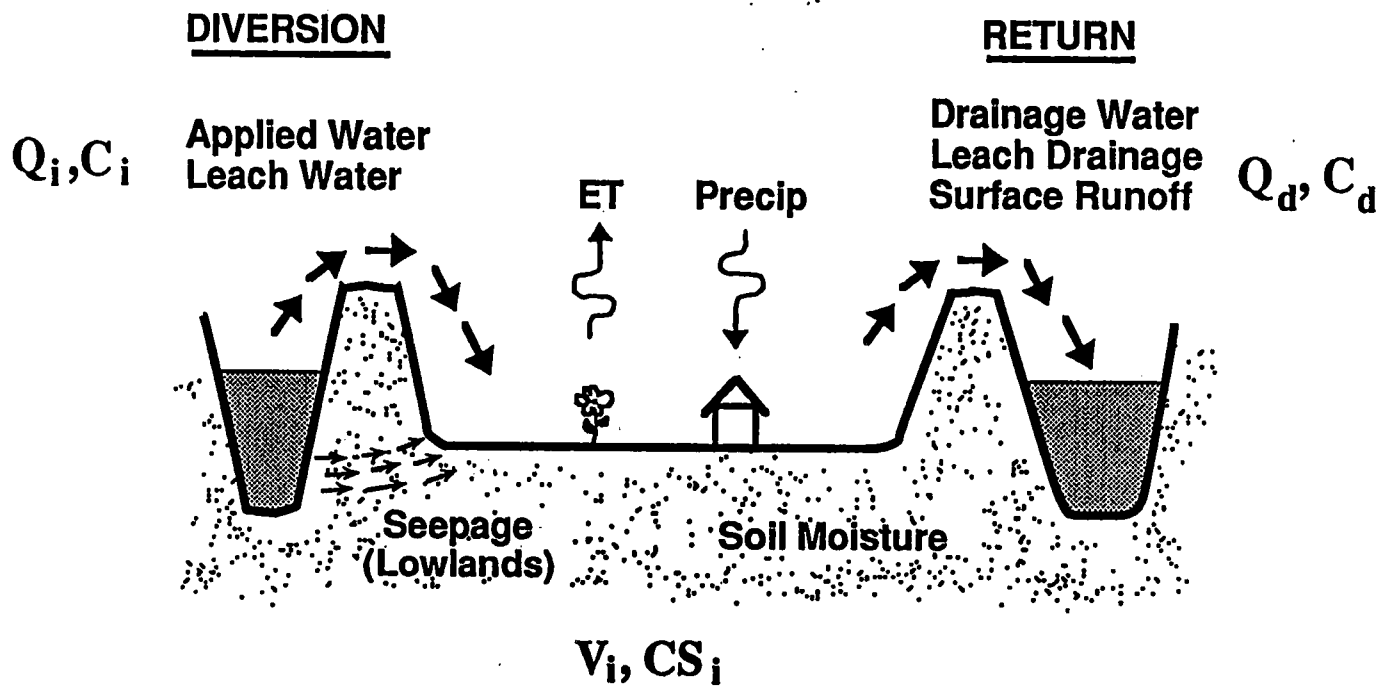
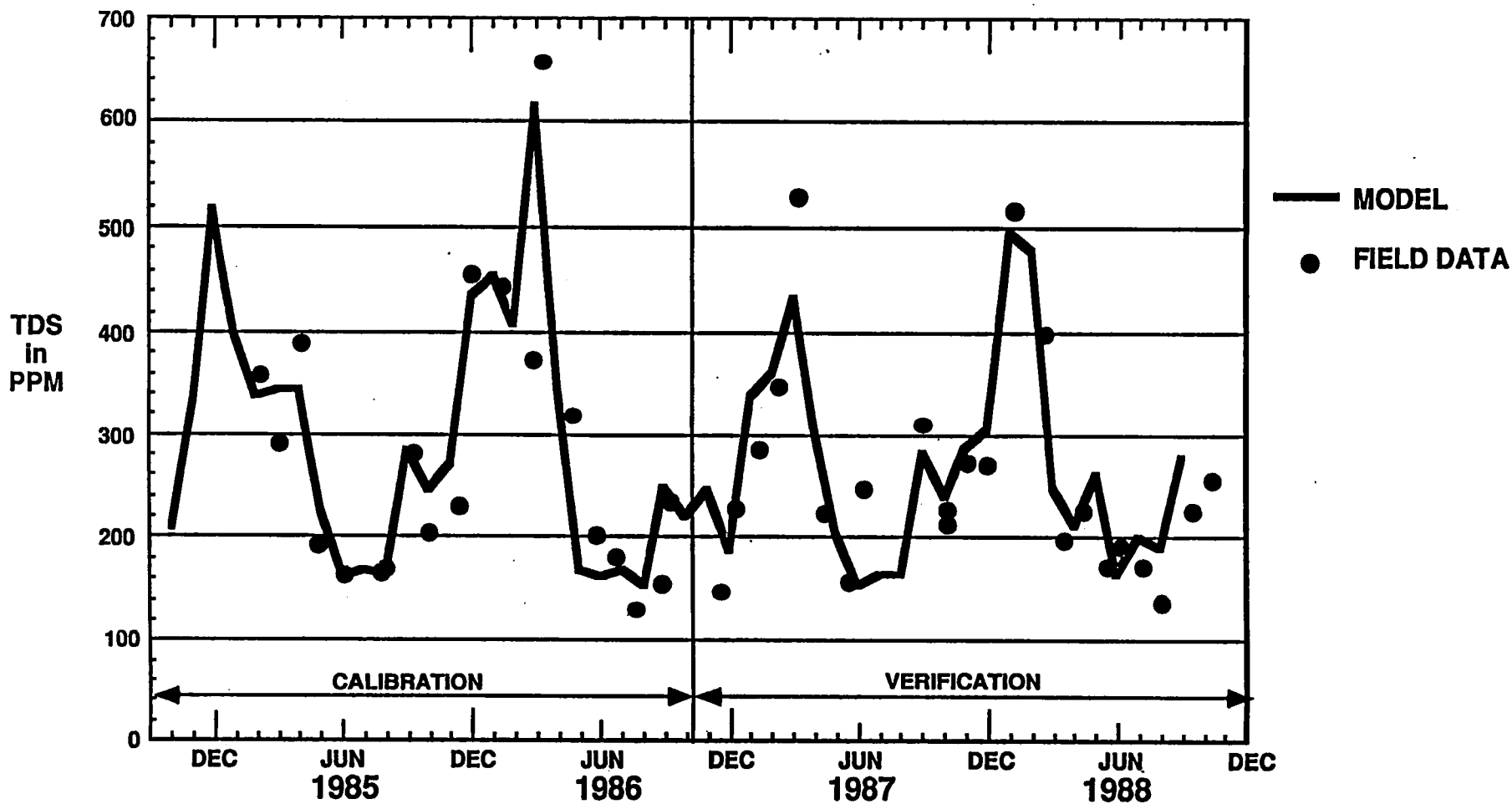


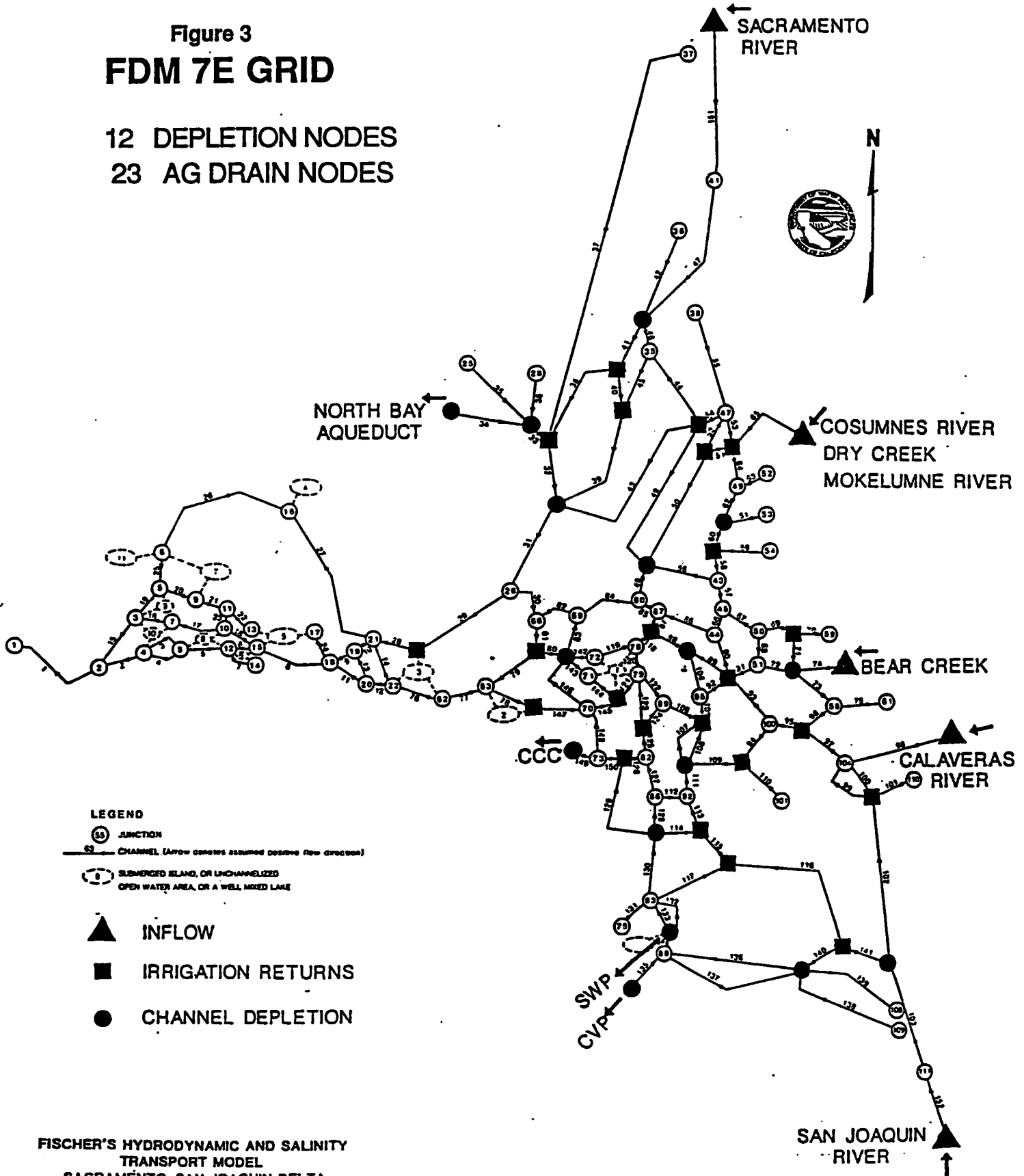


Figure 2  
**CALIBRATION AND VERIFICATION**  
of  
**AGRICULTURAL DRAIN MODEL FOR GRAND ISLAND**



**Figure 3**  
**FDM 7E GRID**

12 DEPLETION NODES  
23 AG DRAIN NODES



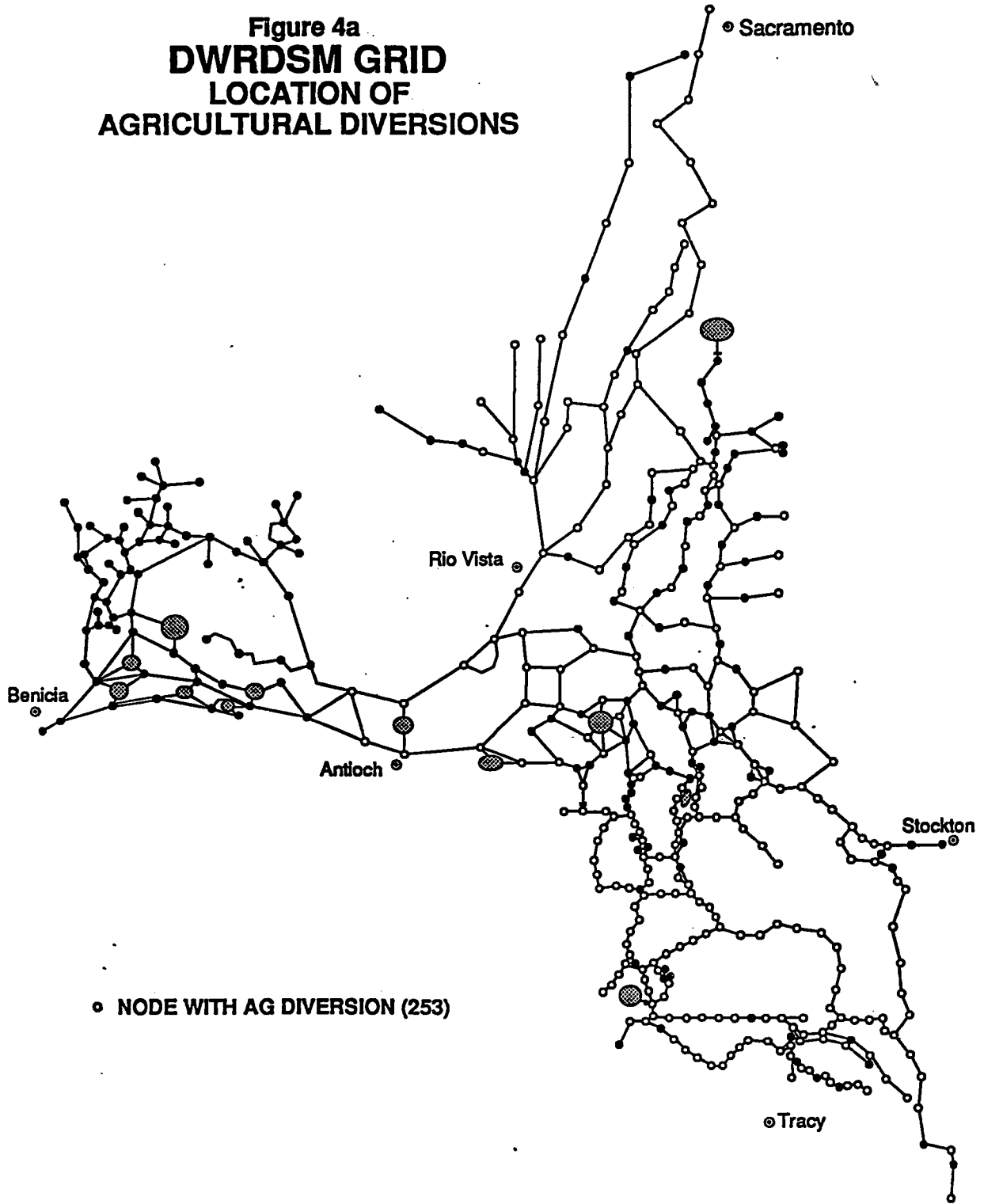
**LEGEND**

- ⑤⑤ JUNCTION
- ⑤⑤— CHANNEL (Arrow denotes assumed positive flow direction)
- ⊖ SUBMERGED ISLAND, OR UNCHANNELIZED OPEN WATER AREA, OR A WELL MIXED LAKE
- ▲ INFLOW
- IRRIGATION RETURNS
- CHANNEL DEPLETION

FISCHER'S HYDRODYNAMIC AND SALINITY  
TRANSPORT MODEL  
SACRAMENTO-SAN JOAQUIN DELTA

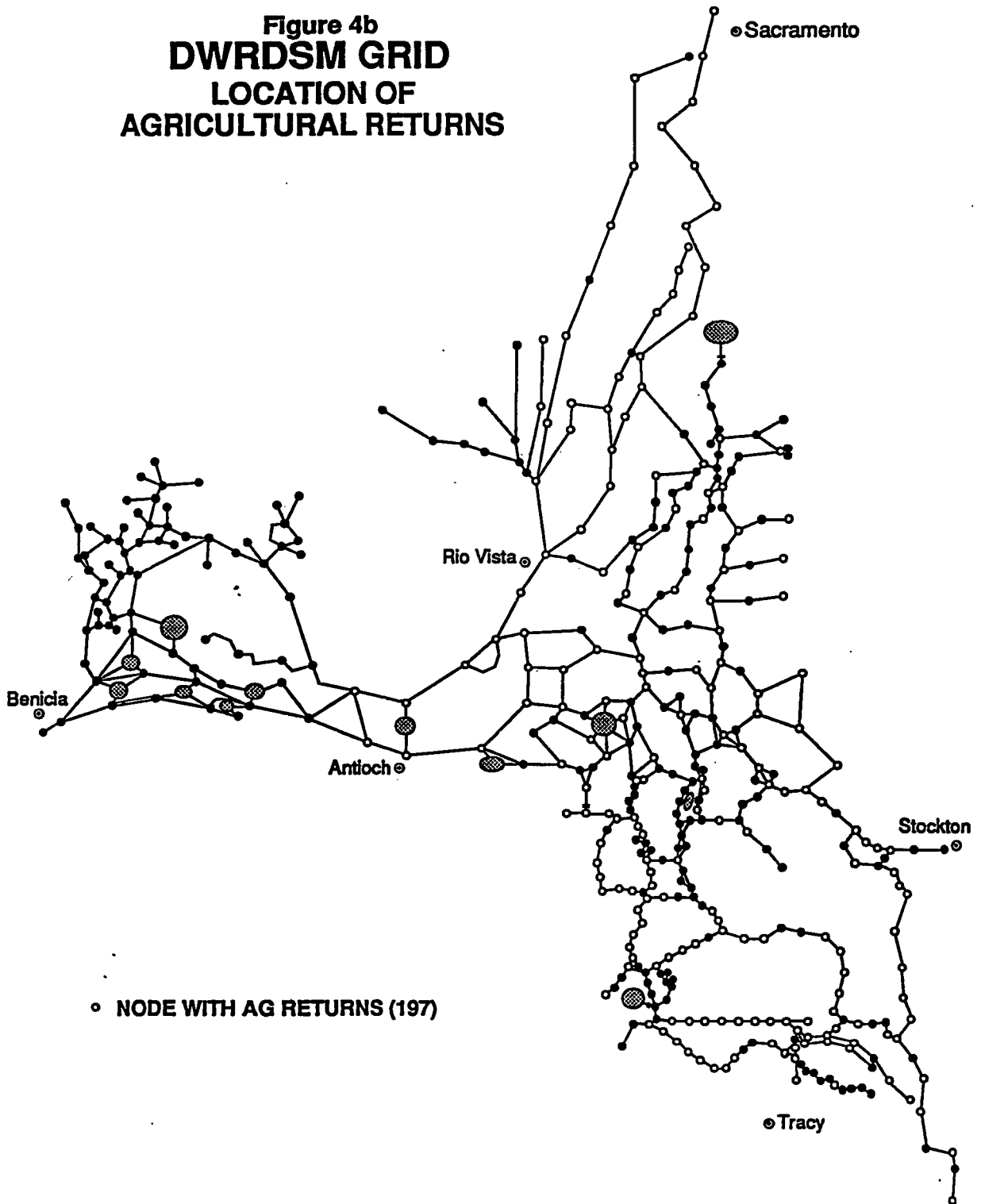


**Figure 4a**  
**DWRDSM GRID**  
**LOCATION OF**  
**AGRICULTURAL DIVERSIONS**



◉ NODE WITH AG DIVERSION (253)

**Figure 4b**  
**DWRDSM GRID**  
**LOCATION OF**  
**AGRICULTURAL RETURNS**



**Figure 4c**  
**DWRDSM**  
**DELTA MODEL GRID**

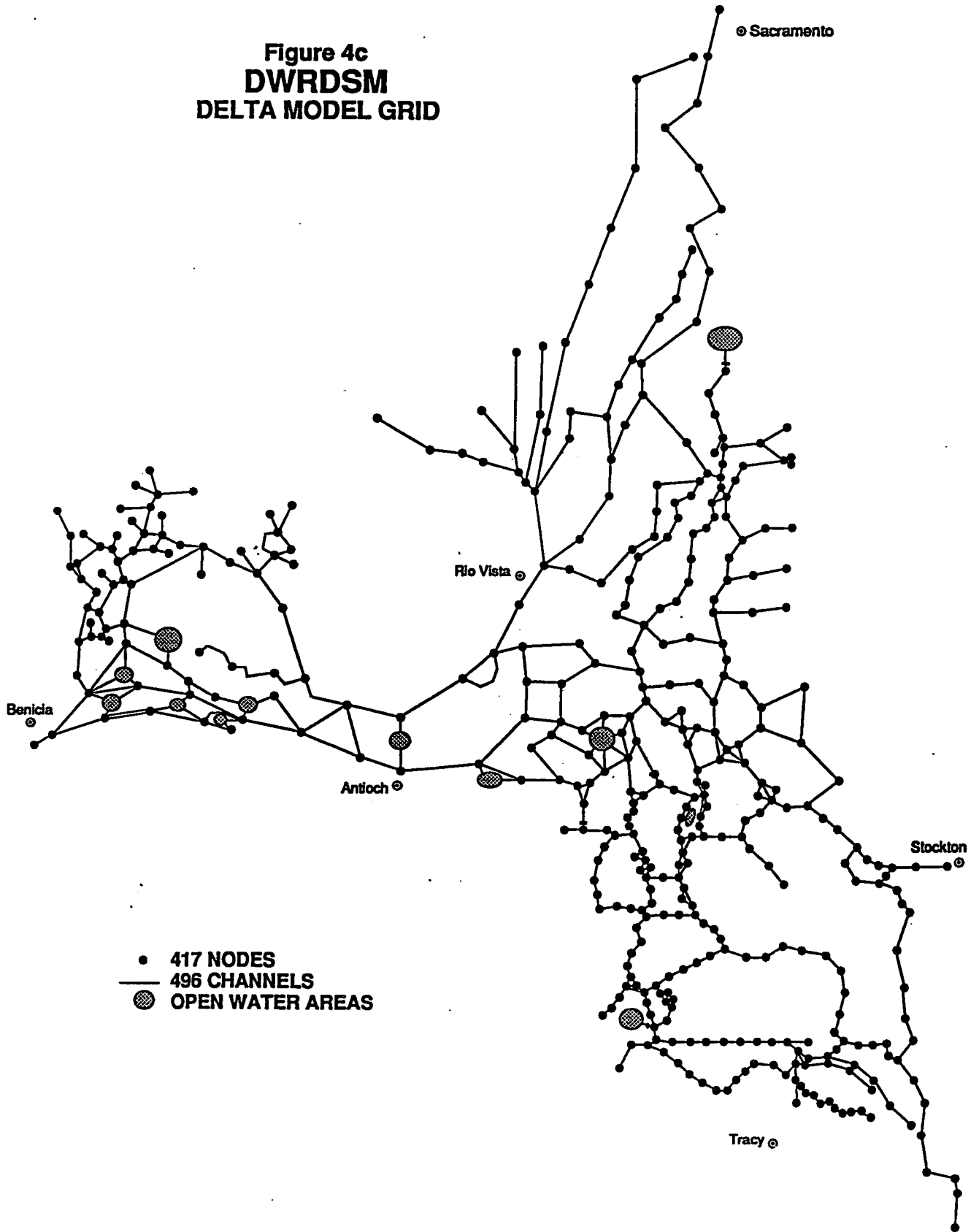


Figure 5  
**TIME FATE OF TRACER MASS  
SACRAMENTO RIVER @ 1 ST TRACER RELEASE**

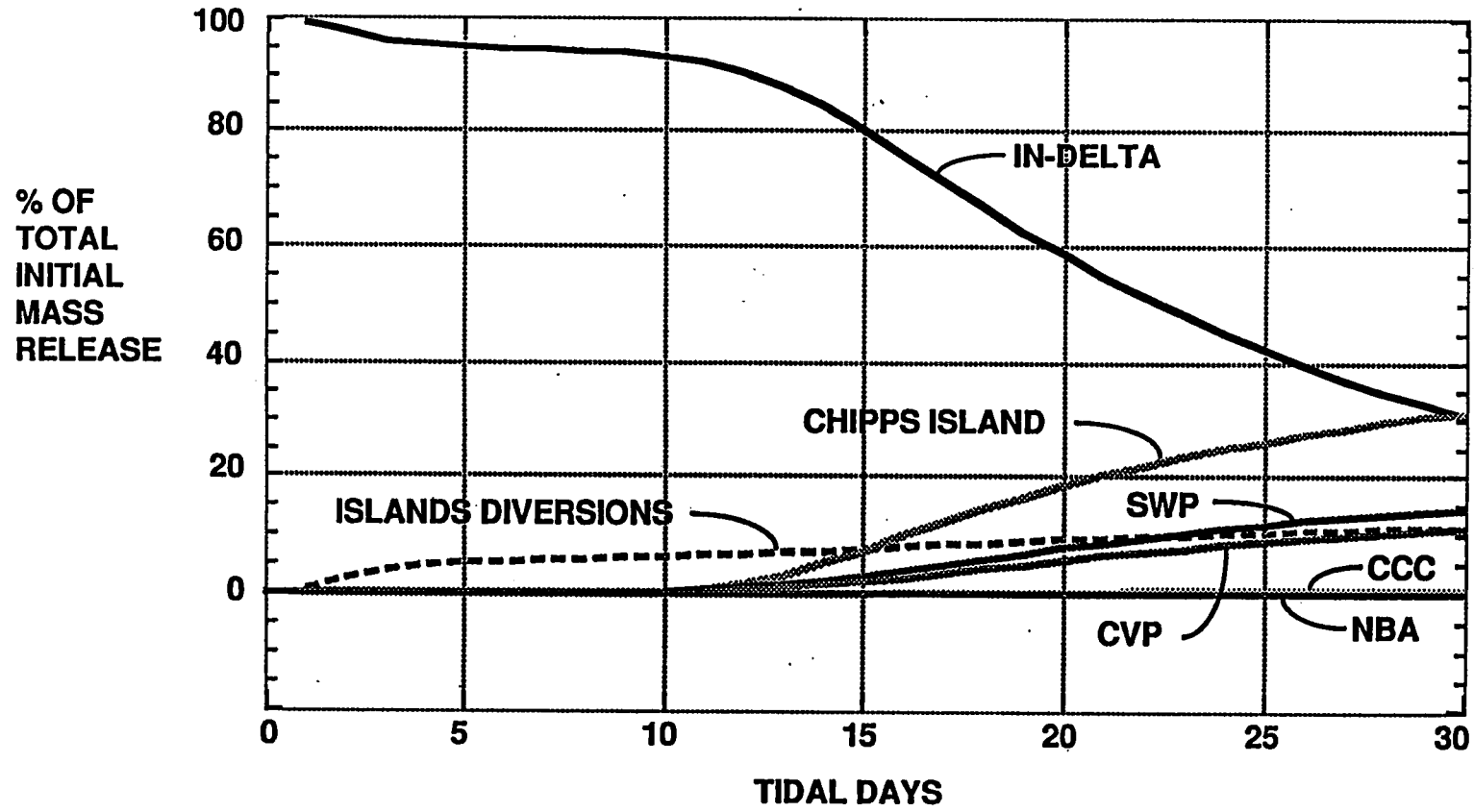


Figure 6  
**LOCATION OF  
DELTA FLOW SPLIT ANALYSIS SITES**

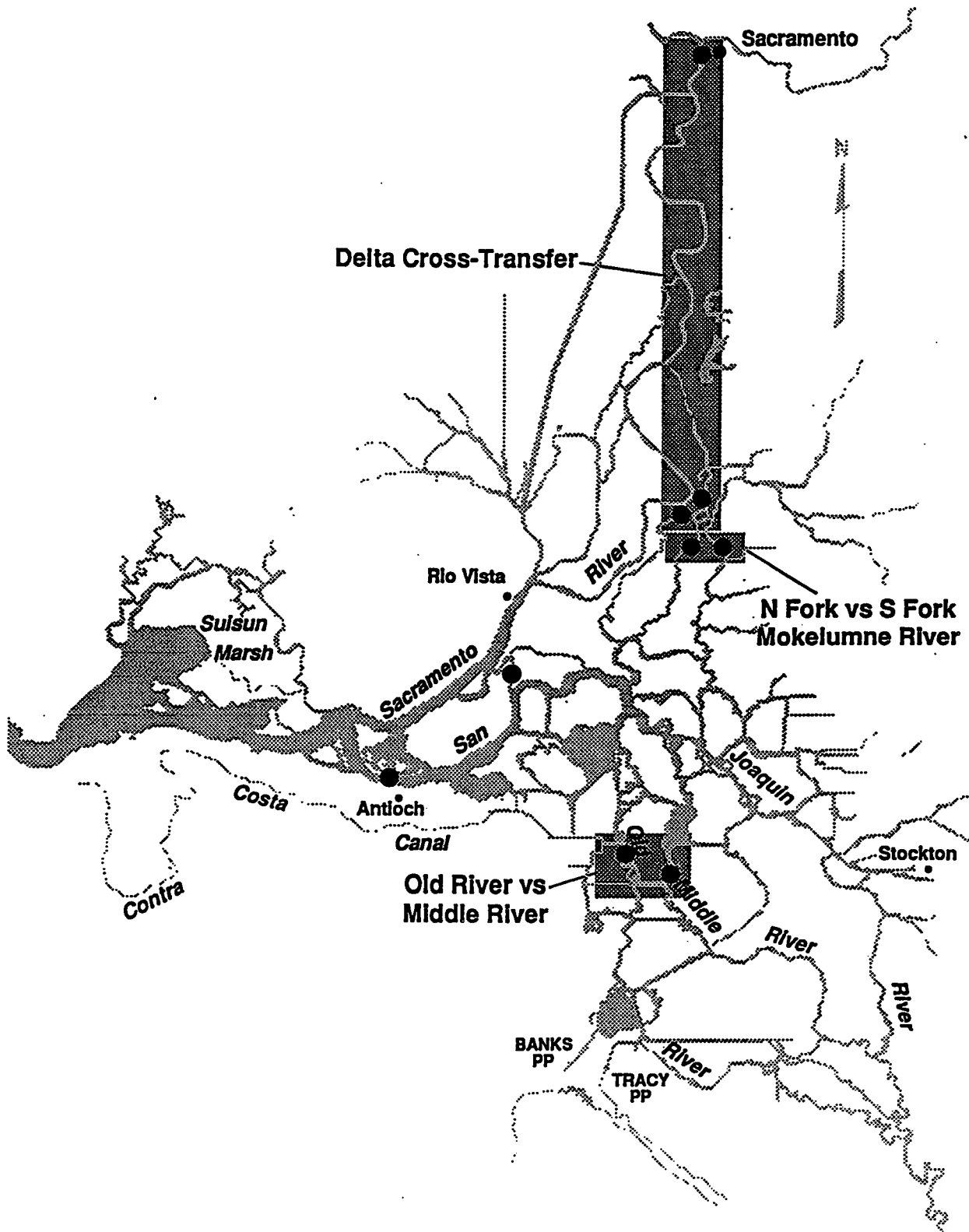


Figure 7

Flow Split between Sacramento, Cross Channel and Georgiana Slough - June 1992 Verification

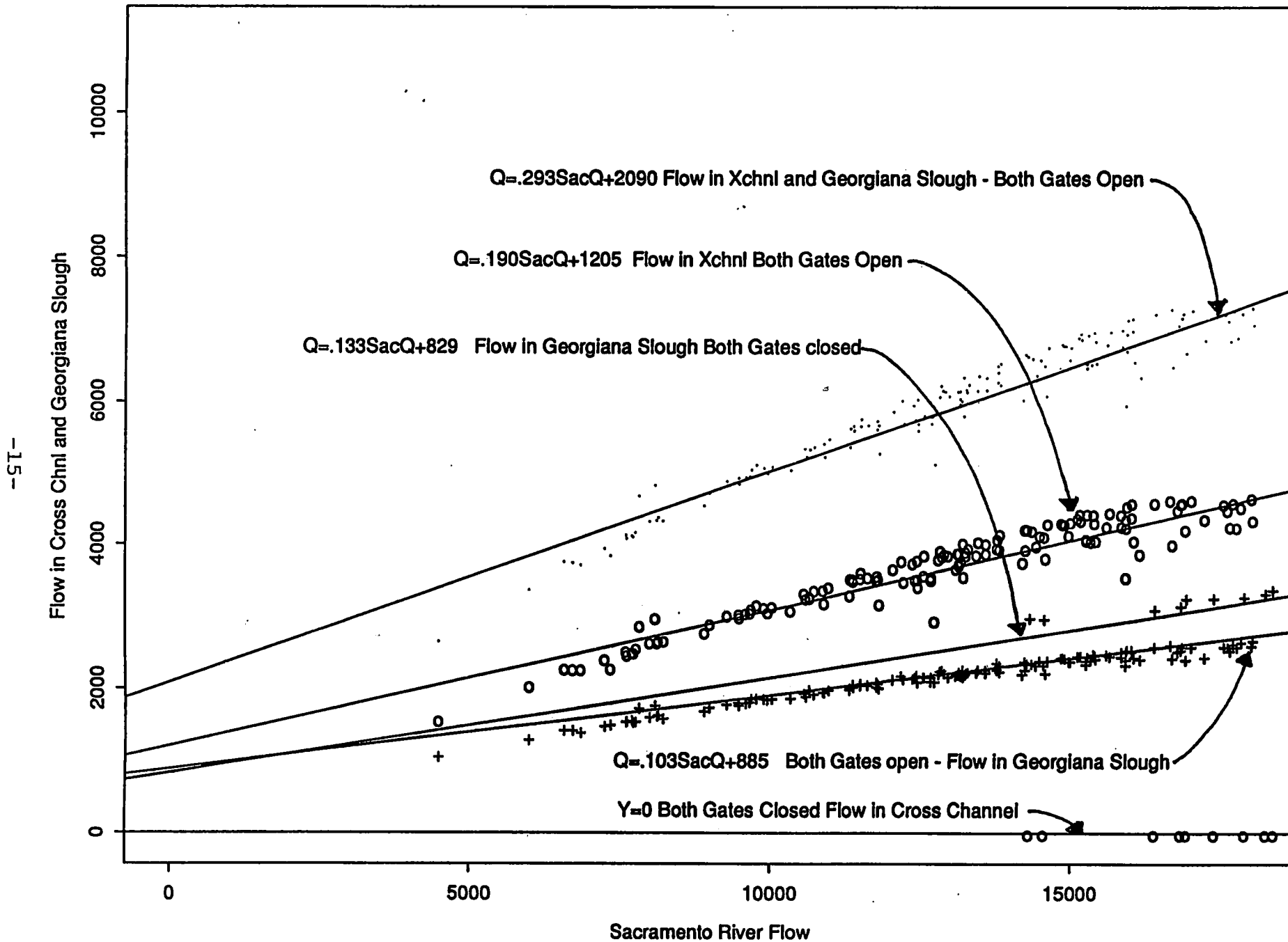
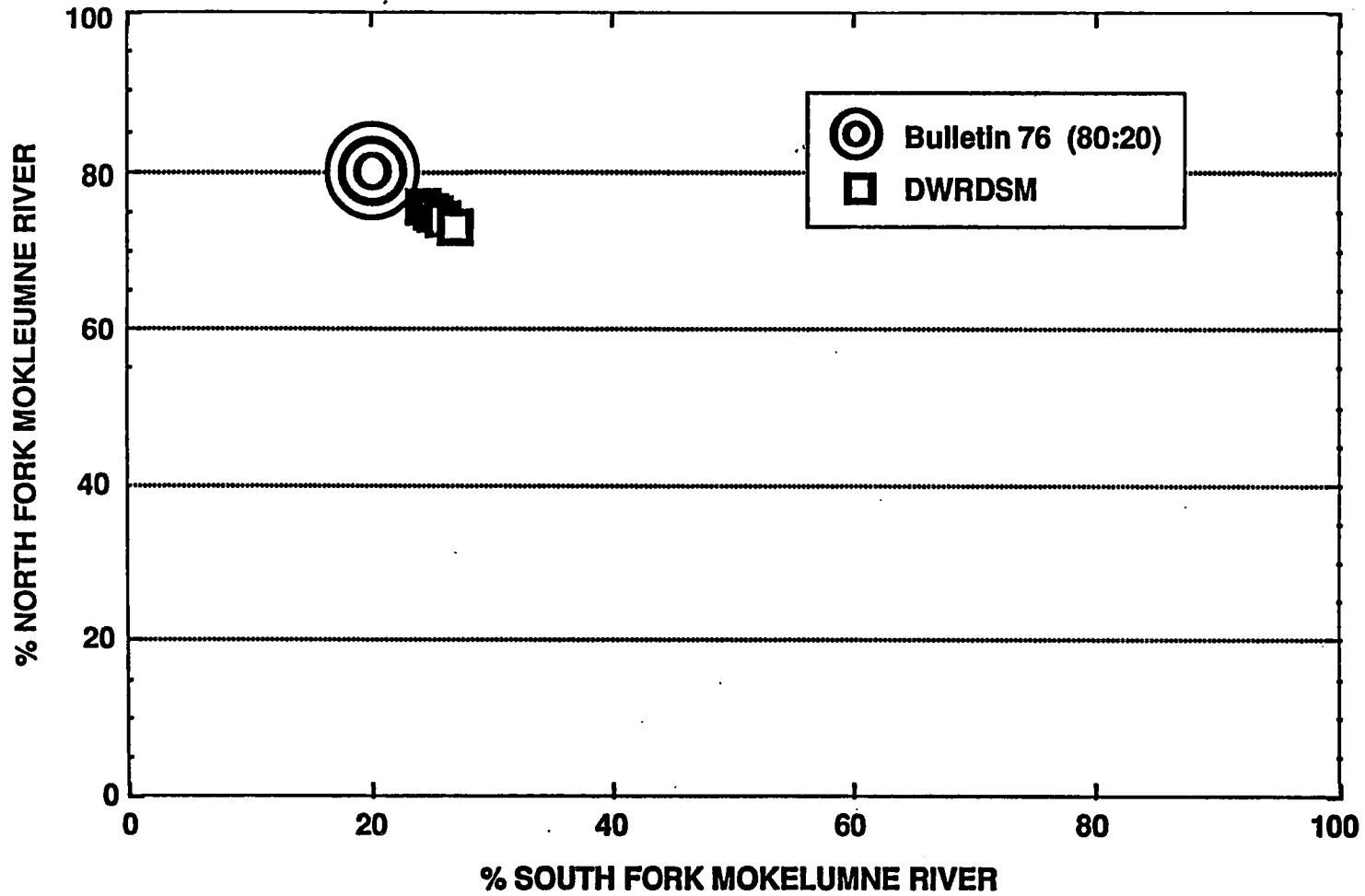




Figure 8  
NORTH FORK VS SOUTH FORK MOKELUMNE RIVER  
FLOW SPLIT IN CFS



**Figure 9**  
**OLD RIVER VS MIDDLE RIVER FLOW**  
**USGS ADCP MOVING BOAT SYSTEM AND**  
**DWRDSM SIMULATION (19-YEAR MEAN TIDE)**

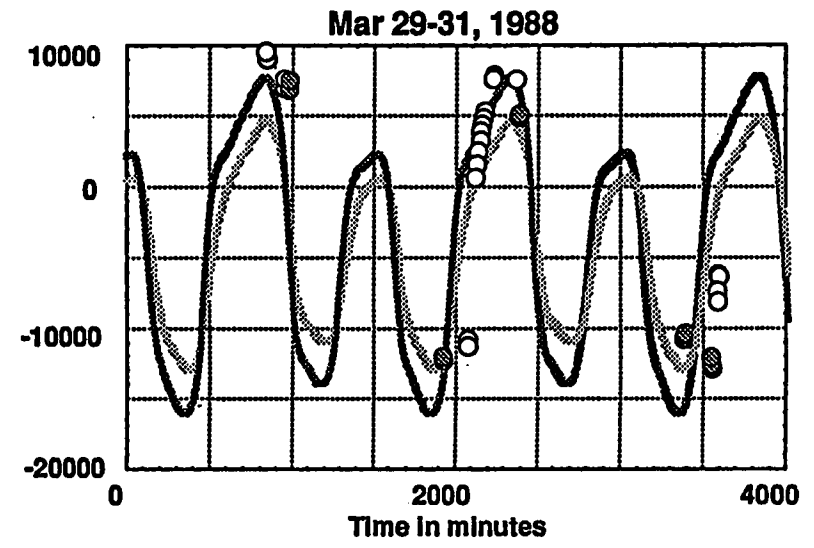
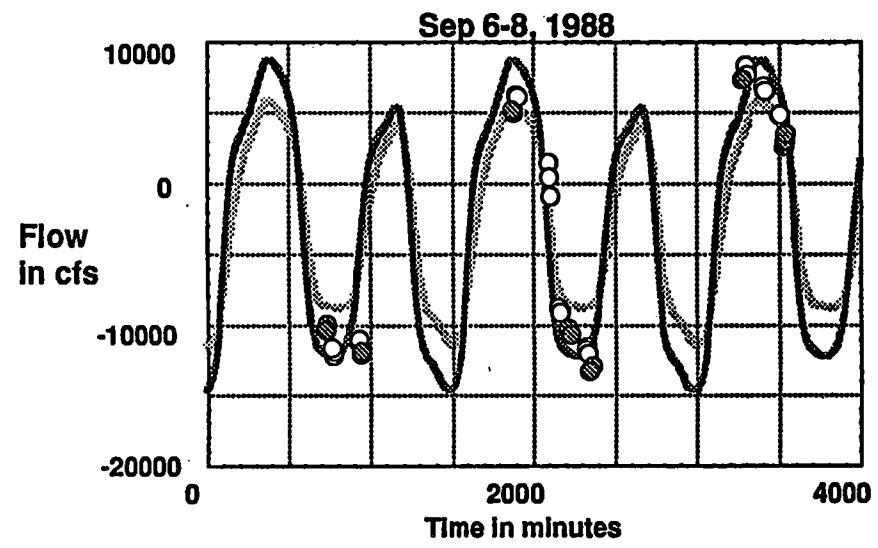
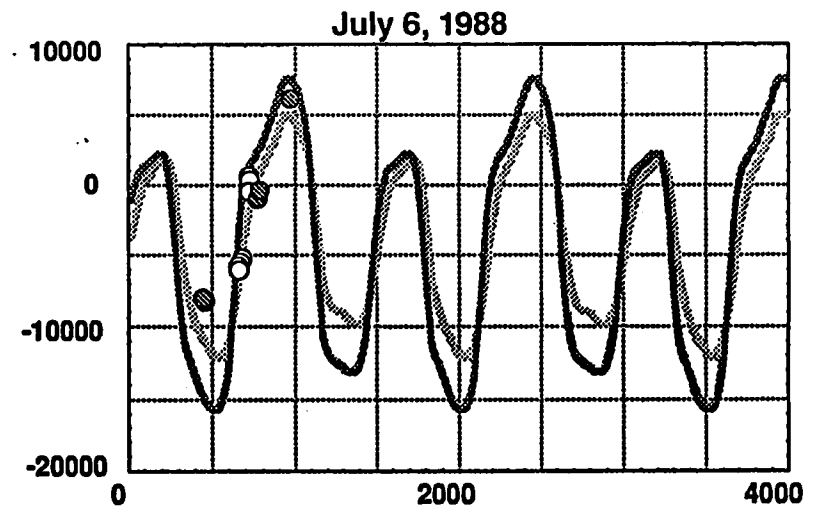
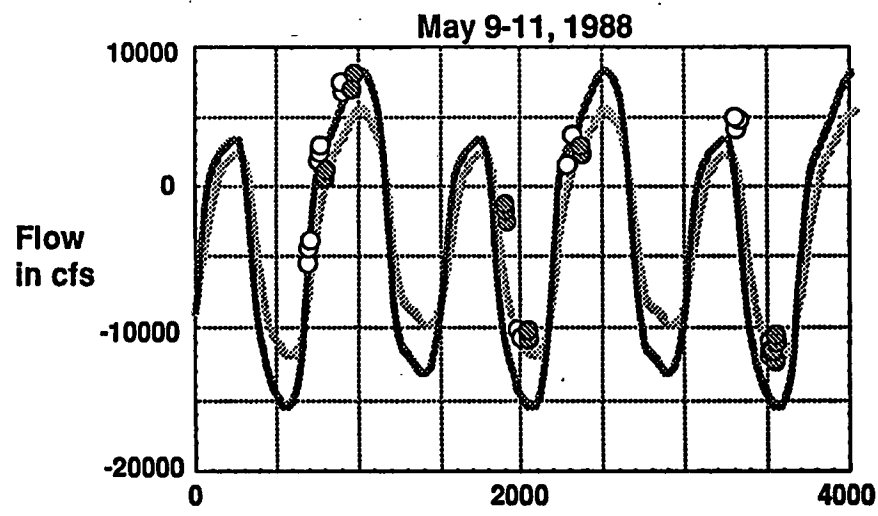
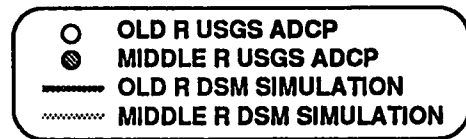
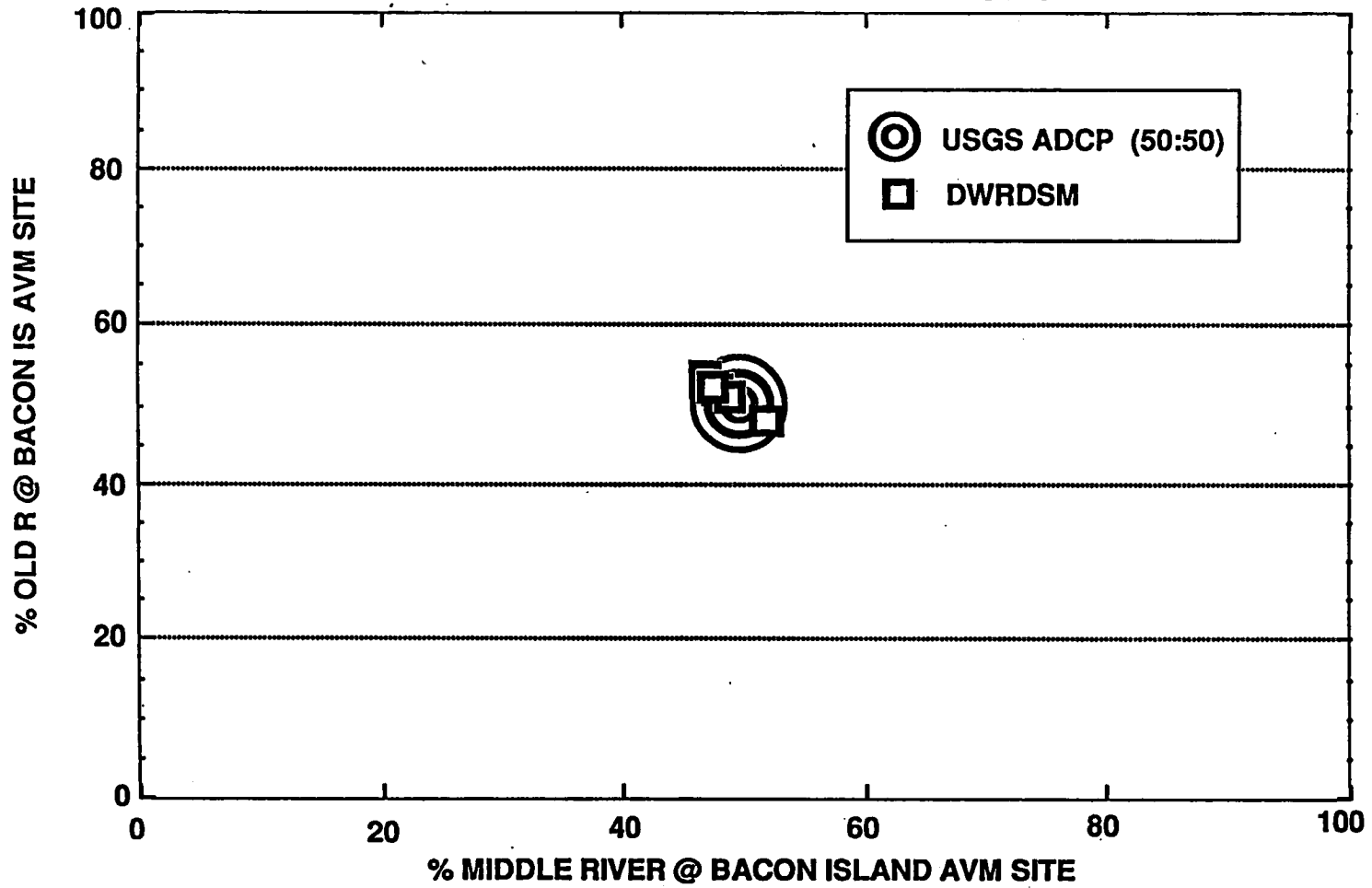


Figure 10  
OLD RIVER VS MIDDLE RIVER  
RESIDUAL FLOW SPLIT IN CFS



**Table 1**

**Calibration and Verification Periods  
Hydrodynamics**

<b>Period</b>	<b>Description</b>
May 1988	Delta and Suisun Marsh stage calibration Delta stage, flow, and velocity verification
December 1988	Delta and Suisun Marsh stage verification Suisun Marsh Salinity Control Gate stage, flow, and velocity verification Montezuma-Nurse Slough flow verification
February 1989	Delta and Suisun Marsh stage verification SMSCG stage, flow, and velocity verification Montezuma-Cutoff Slough flow verification
April 1989	Delta and Suisun Marsh stage verification SMSCG stage, flow, and velocity verification Montezuma-Hunters Cut flow verification
December 1989	Delta and Suisun Marsh stage verification SMSCG calibration

**Quality**

<b>Period</b>	<b>Description</b>
January-April 1988	Delta and Suisun Marsh warmup
May-August 1988	Delta and Suisun Marsh calibration
September-October 1988	Delta and Suisun Marsh verification, SMSCG not operating
November-December 1988	Delta and Suisun Marsh verification, SMSCG operating

**Table 2 - Input For Long Term Historical Verification**

**Salinities (TDS):**

	<b>DWRDSM Input Data</b>
<b>Seaward Boundary</b>	Saldif generated or Observed Data (EC to TDS converted)
<b>Sacramento</b>	100 ppm TDS or observed data (EC to TDS converted)
<b>Yolo</b>	100 ppm TDS
<b>Eastside</b>	85 ppm TDS
<b>SJR (Irrigation Season)</b> <b>(Non Irrigation Season)</b>	$\ln(\text{ec})=10.080014-0.48230*\log(Q)$ , $\text{tds}(\text{ppm})=0.583793*\text{ec}-2.67$ or observed data (EC to TDS converted) same equations as above or observed data
<b>Agricultural Returns</b>	Return Quality is a function of diversion and soil salinity.

**Hydrodynamics:**

	<b>DWRDSM Input Data</b>
<b>Seaward Boundary</b>	19 year mean tide
<b>Rimflows</b>	Use daily flows from Dayflow and convert them to monthly average flows for DWRSAL input and "tidal" monthly average flows for DWRFLO input. Separate flows of Eastside streams on a percentage basis.
<b>Exports</b>	CCFB gate is always open. "Tidal" monthly average pumping is used
<b>Consumptive Use</b>	Values calculated using variable evapotranspiration and critical and non critical land use for 142 areas.

**Geometry:**

	<b>DWRDSM Input Data</b>
<b>Delta Cross Channel</b>	Close gates when DOI is > 12000 cfs. Close gates when Sacramento flow > 27,000 cfs. (Handled in DWRFLO input file.)
<b>Barriers</b>	Currently incorporates 20 different barrier configurations
<b>Floods</b>	Simulates the 1972 and 1983 summer flooding.

**Table 3**  
**USGS ADCP MOVING BOAT SYSTEM FLOW DATA**  
**AVERAGE HYDROLOGIES FROM DAYFLOW**

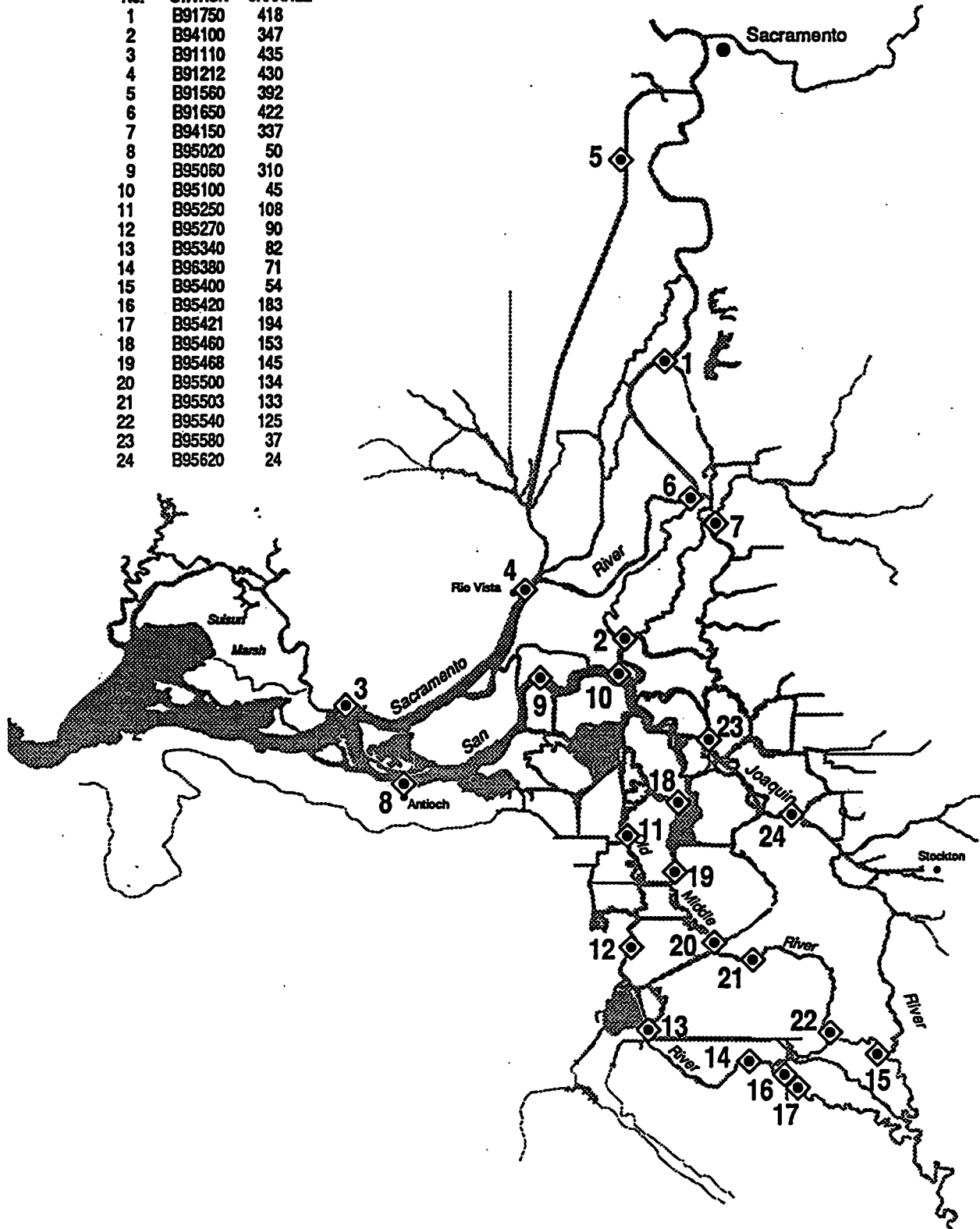
	May 9-11 1988	July 6 1988	Sep 6-8 1988	Mar 29-31 1989
<b>Sacramento</b>	<b>14933</b>	<b>14200</b>	<b>12367</b>	<b>55367</b>
<b>San Joaquin</b>	<b>2040</b>	<b>1470</b>	<b>1553</b>	<b>2110</b>
<b>SWP</b>	<b>5109</b>	<b>4223</b>	<b>3053</b>	<b>6053</b>
<b>CVP</b>	<b>3155</b>	<b>4722</b>	<b>4579</b>	<b>4032</b>
<b>Delta CU</b>	<b>211</b>	<b>4400</b>	<b>2950</b>	<b>711</b>
<b>Net Delta Outflow</b>	<b>8211</b>	<b>2290</b>	<b>3252</b>	<b>48100</b>

APPENDIX I

MAY 1988 STAGE VERIFICATION PLOTS

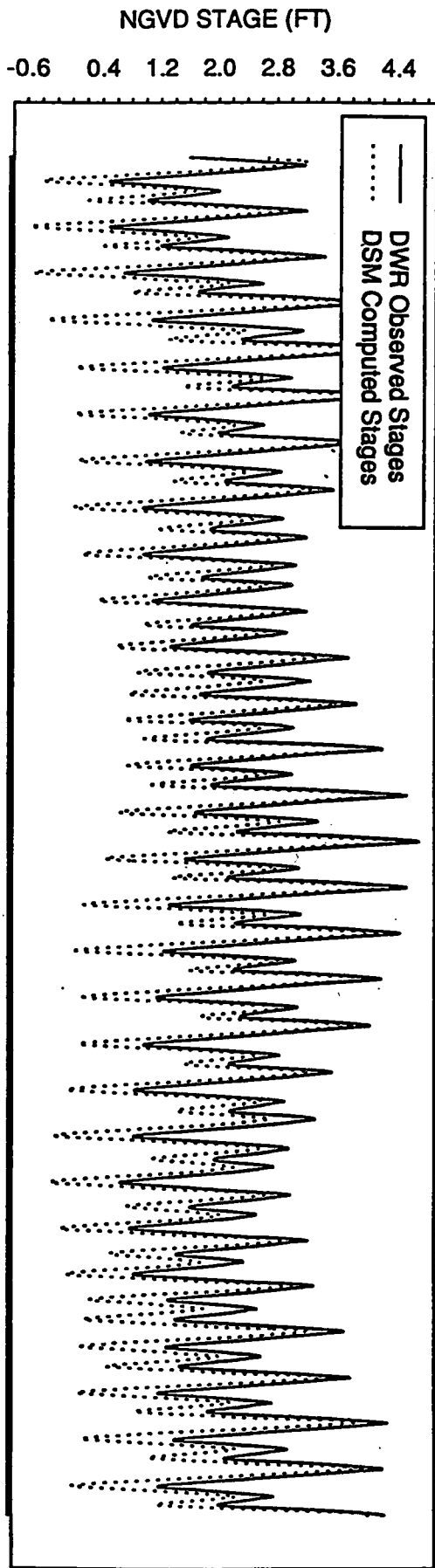
# LOCATION MAP DWR STAGE STATIONS

NO.	STATION	CHANNEL
1	B91750	418
2	B94100	347
3	B91110	435
4	B91212	430
5	B91560	392
6	B91650	422
7	B94150	337
8	B95020	50
9	B95060	310
10	B95100	45
11	B95250	108
12	B95270	90
13	B95340	82
14	B96380	71
15	B95400	54
16	B95420	183
17	B95421	194
18	B95460	153
19	B95468	145
20	B95500	134
21	B95503	133
22	B95540	125
23	B95580	37
24	B95620	24

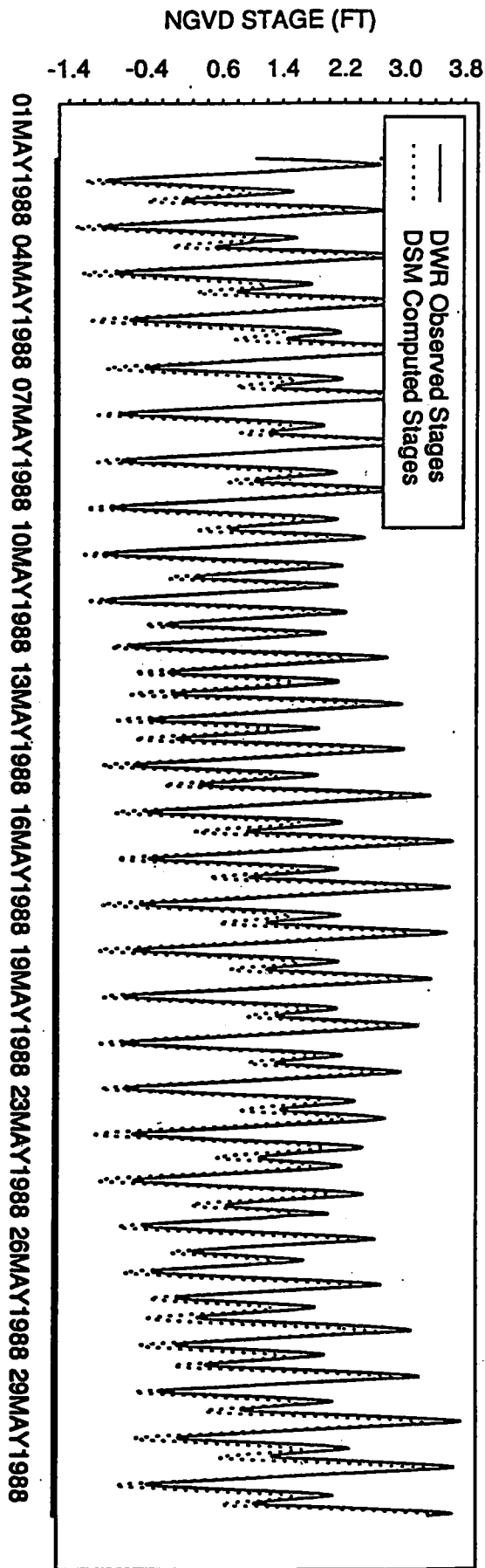




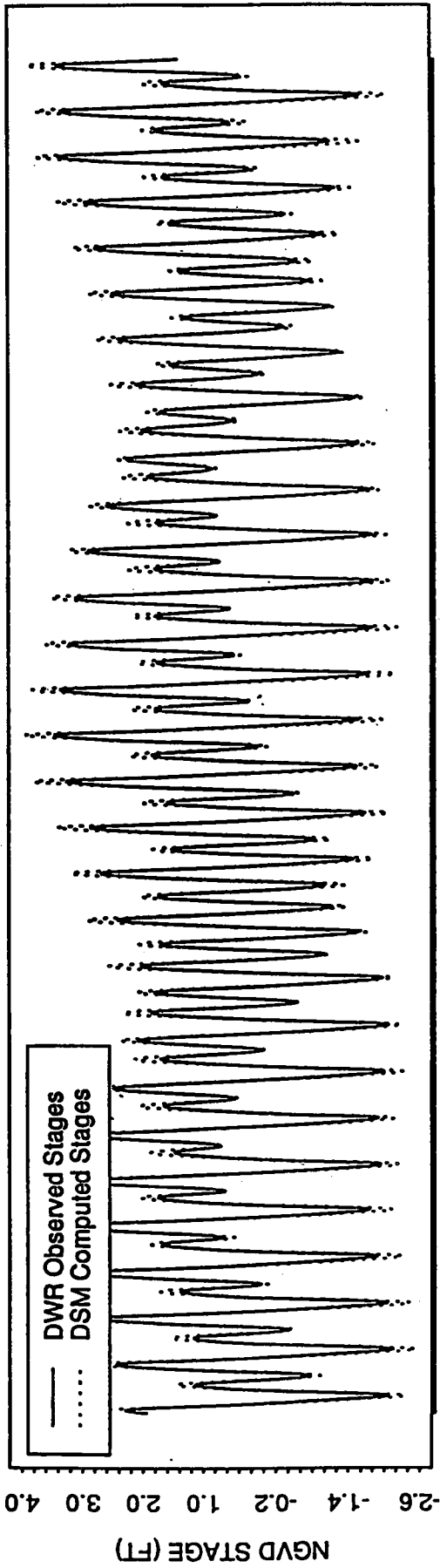
Stage Verification at B91750 (Chnl 418)  
STATION NO. 1



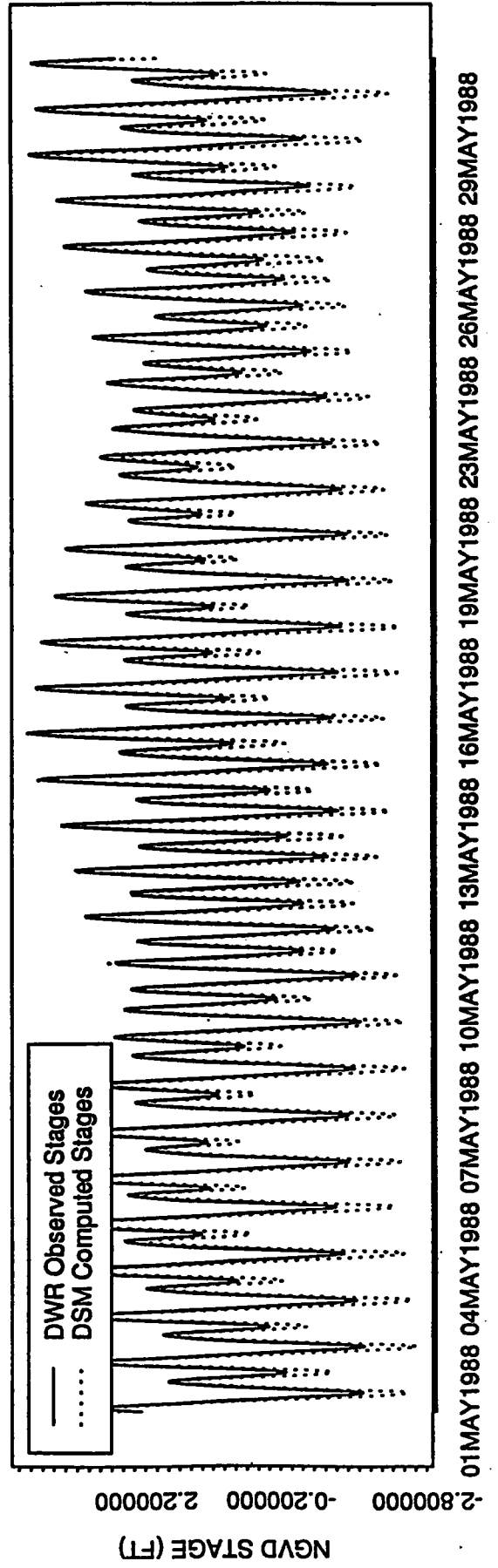
Stage Verification at B94100 (Chnl 347)  
STATION NO. 2



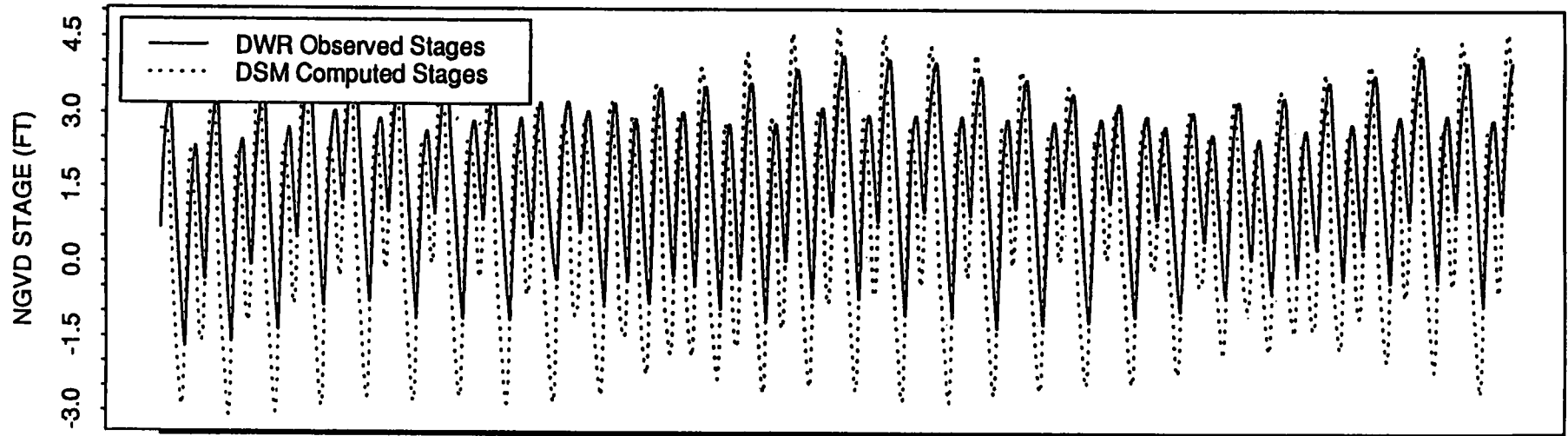
Stage Verification at B91110 (Chnl 435)  
STATION NO. 3



Stage Verification at B91212 (Chnl 430)  
STATION NO. 4



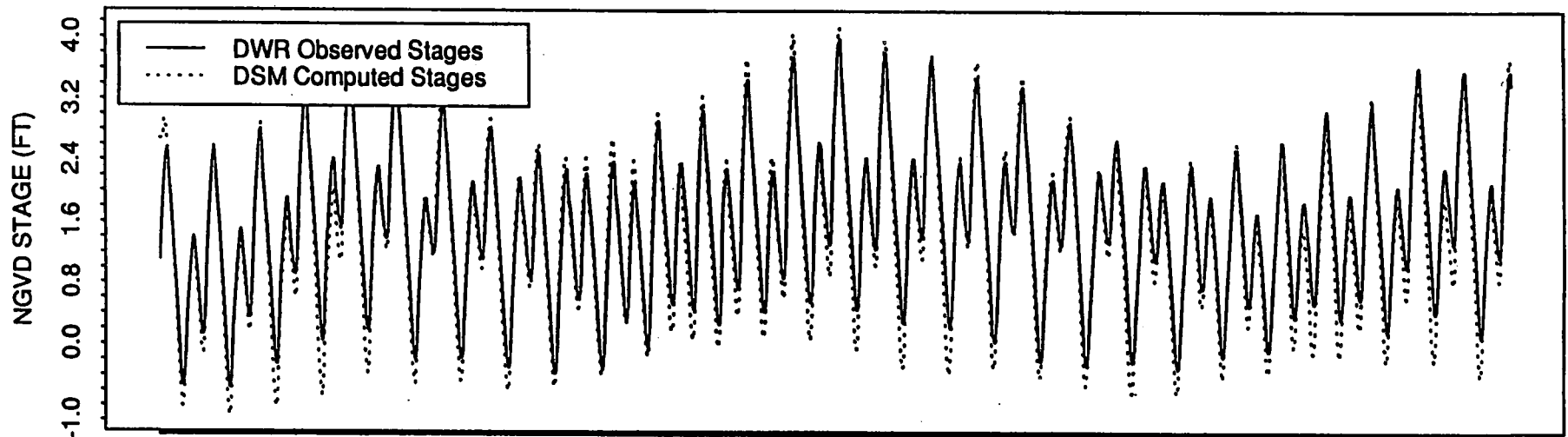
### Stage Verification at B91560 (Chnl 392) STATION NO. 5



01MAY1988 04MAY1988 07MAY1988 10MAY1988 13MAY1988 16MAY1988 19MAY1988 23MAY1988 26MAY1988 29MAY1988

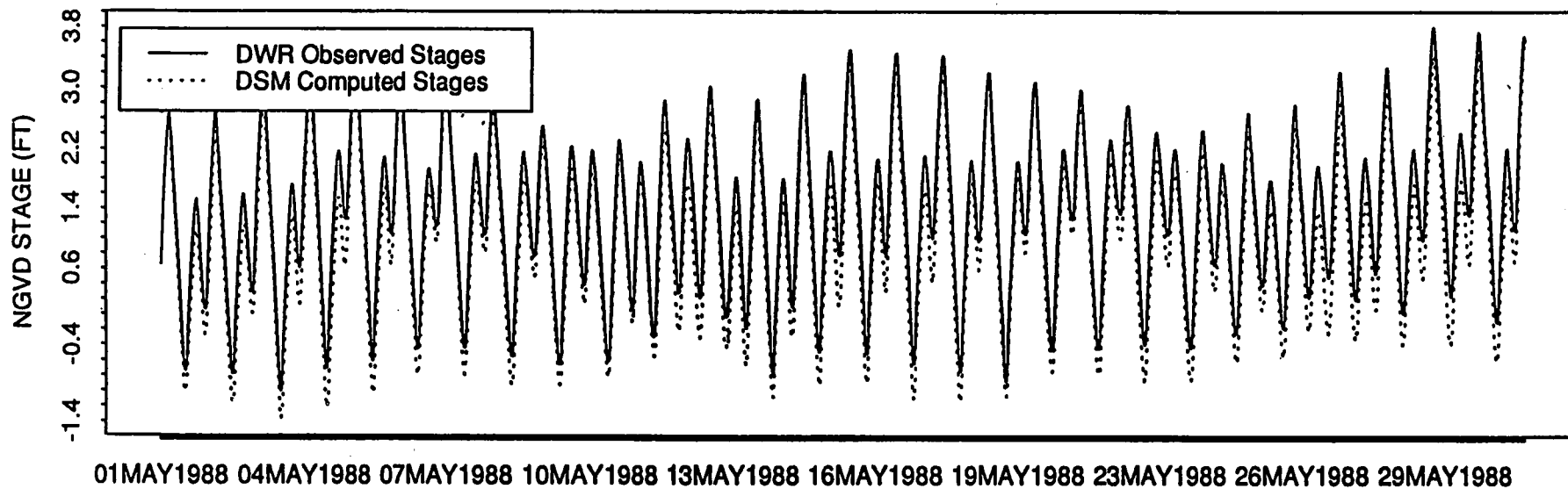
AI-4

### Stage Verification at B91650 (Chnl 422) STATION NO. 6

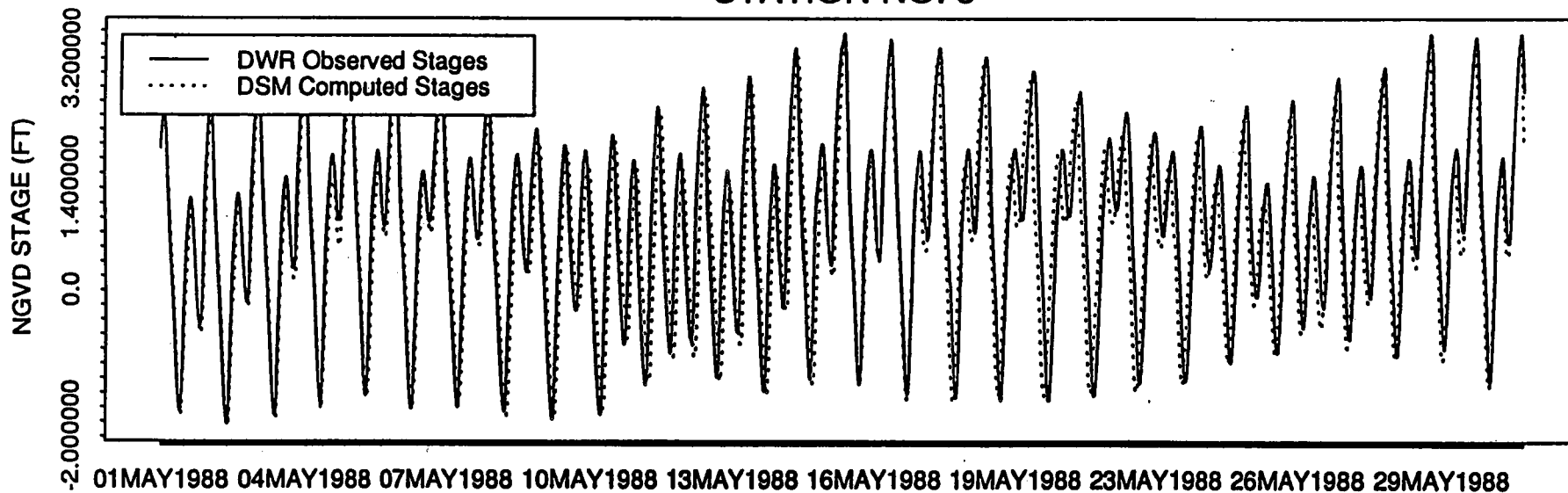


01MAY1988 04MAY1988 07MAY1988 10MAY1988 13MAY1988 16MAY1988 19MAY1988 23MAY1988 26MAY1988 29MAY1988

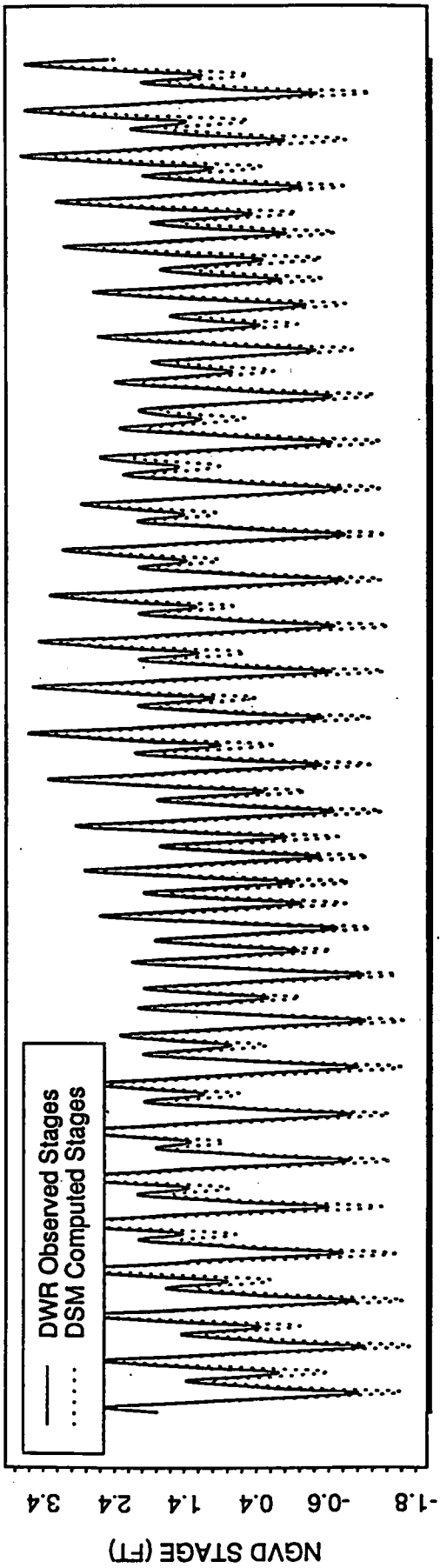
### Stage Verification at B94150 (Chnl 337) STATION NO. 7



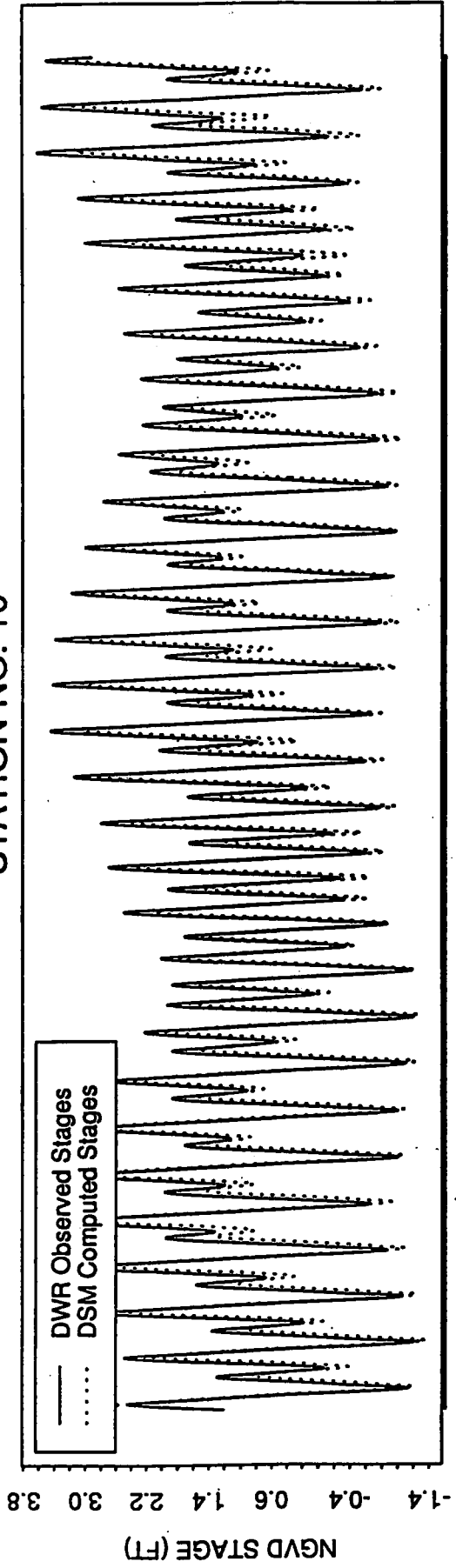
### Stage Verification at B95020 (Chnl 50) STATION NO. 8



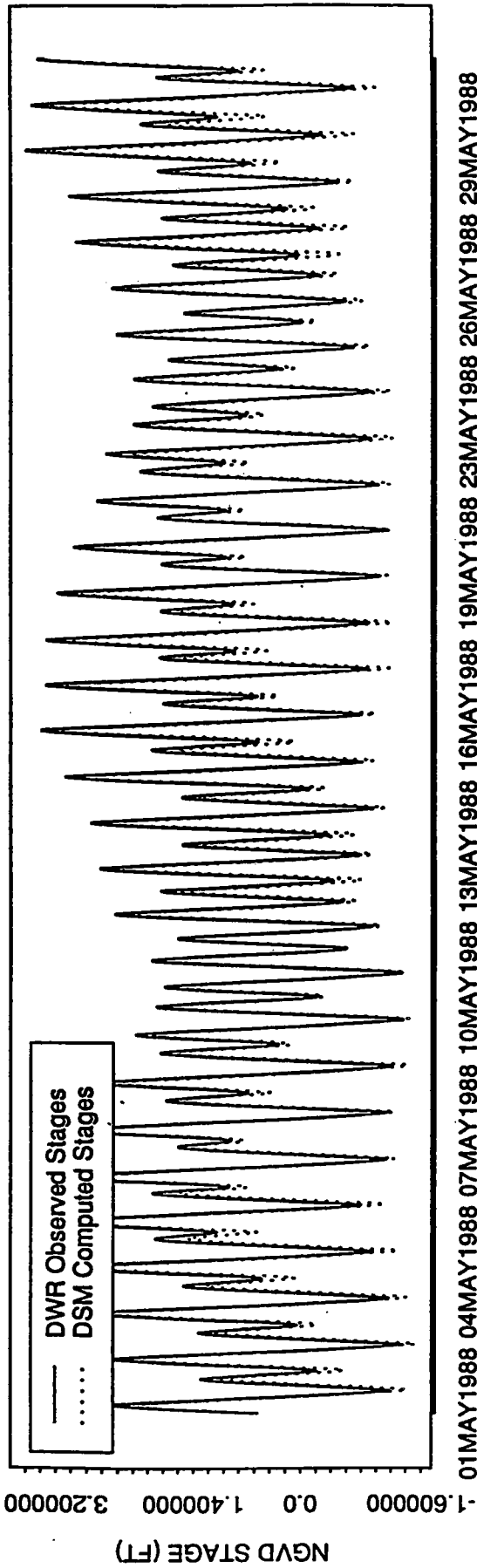
Stage Verification at B95060 (Chnl 310)  
STATION NO. 9



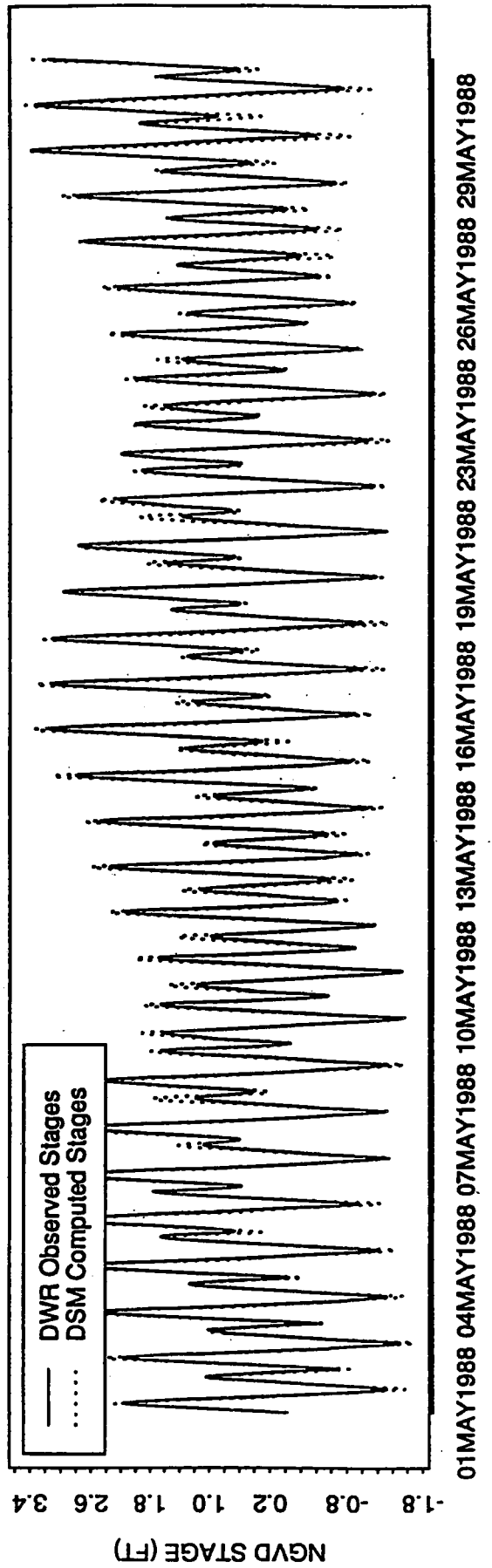
Stage Verification at B95100 (Chnl 45)  
STATION NO. 10



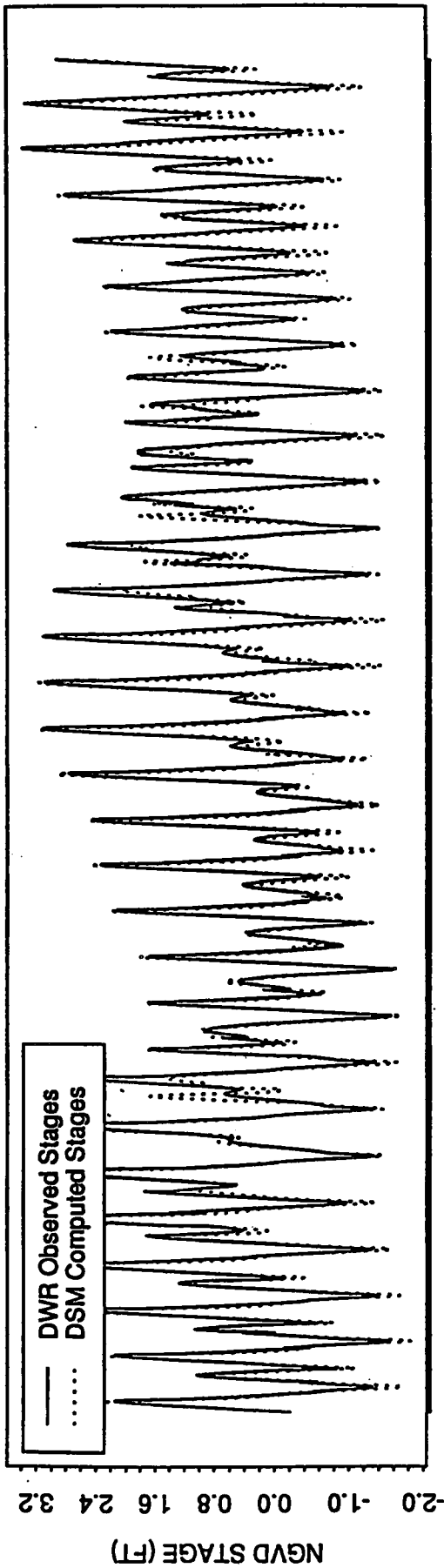
Stage Verification at B95250 (Chnl 108)  
STATION NO. 11



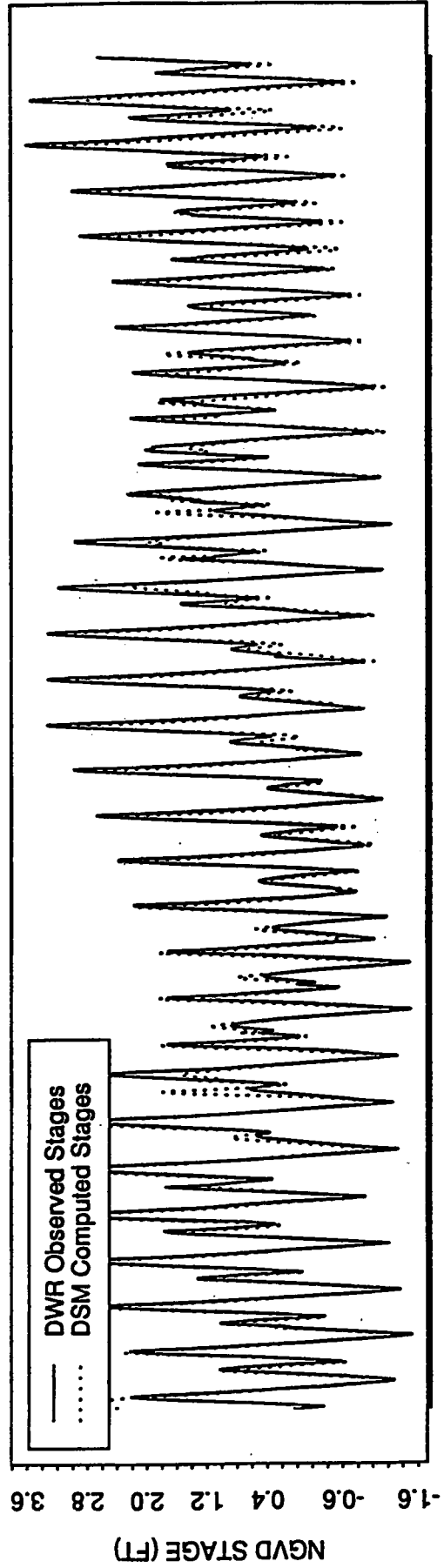
Stage Verification at B95270 (Chnl 90)  
STATION NO. 12



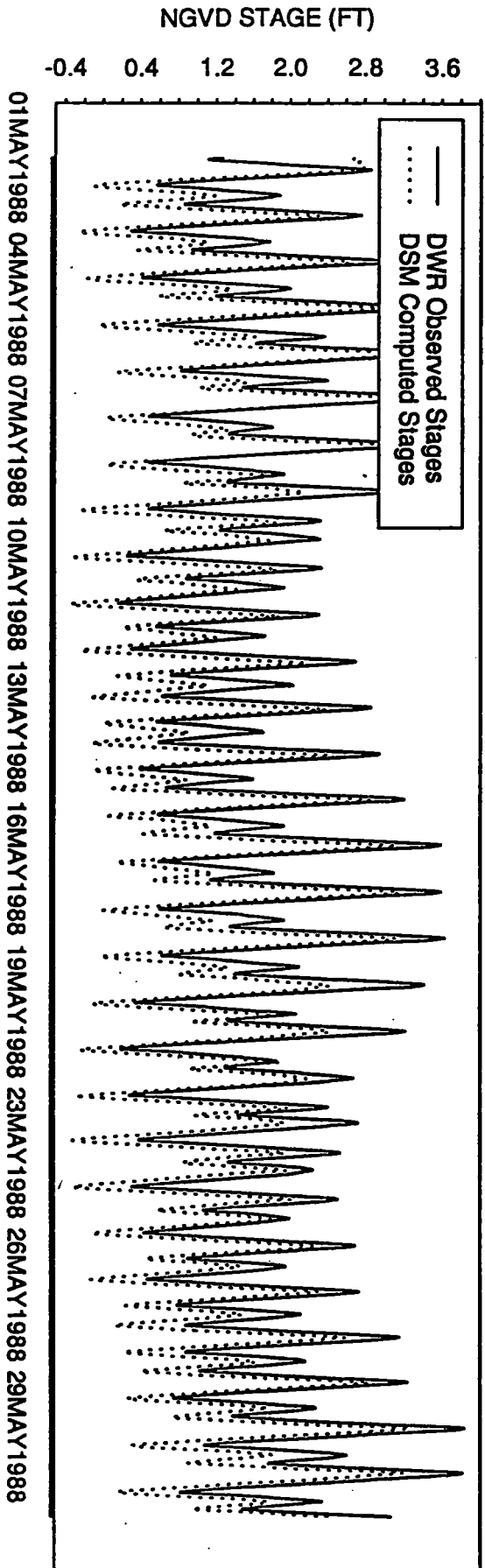
Stage Verification at B95340 (Chnl 82)  
STATION NO. 13



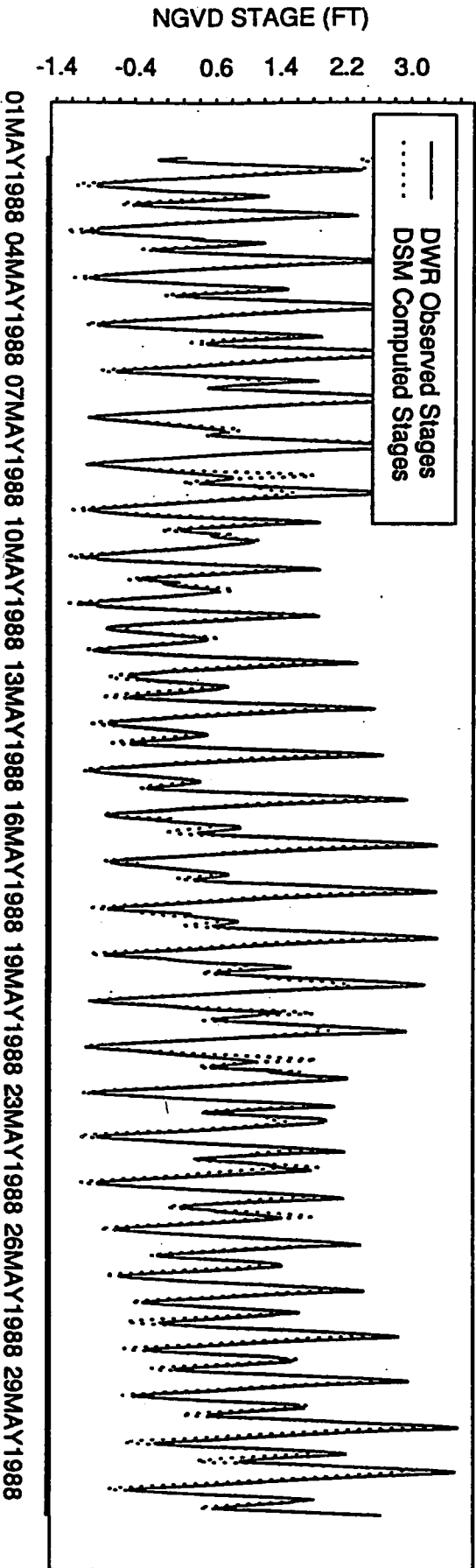
Stage Verification at B95380 (Chnl 71)  
STATION NO. 14



Stage Verification at B95400 (Chnl 54)  
STATION NO. 15

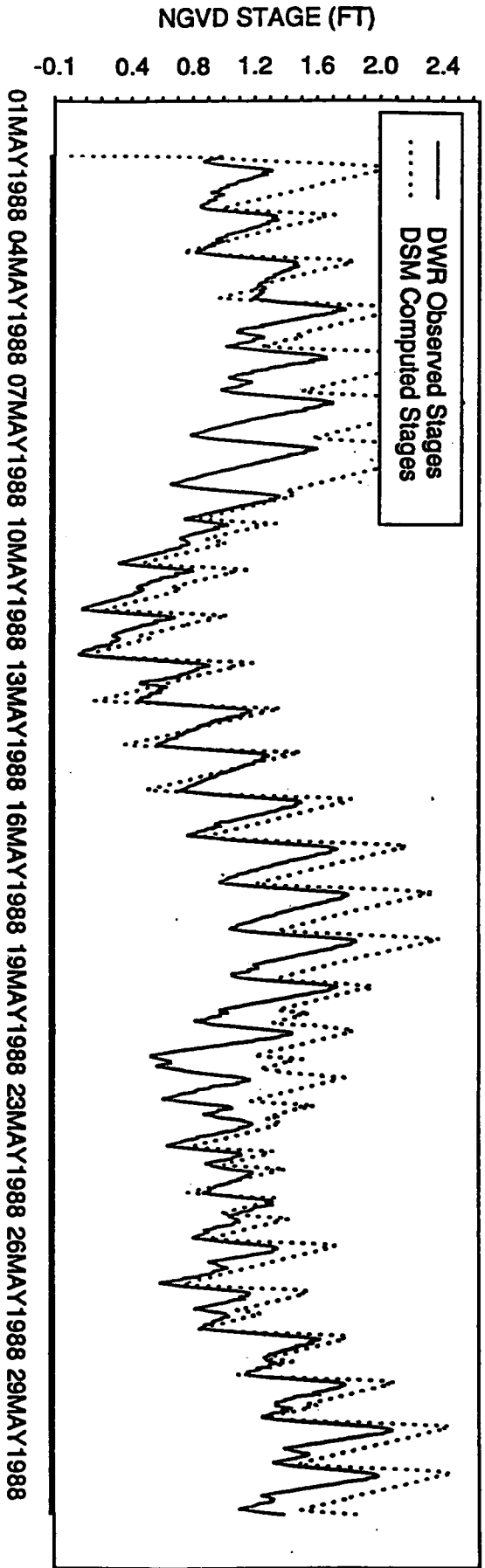


Stage Verification at B95420 (Chnl 183)  
STATION NO. 16

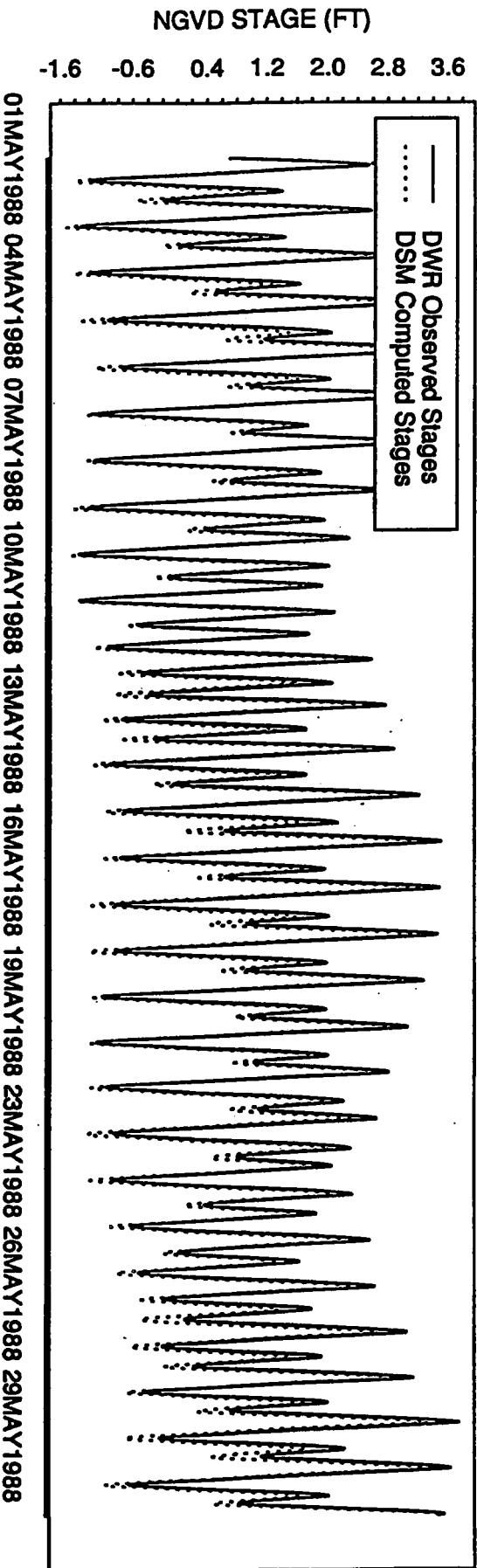




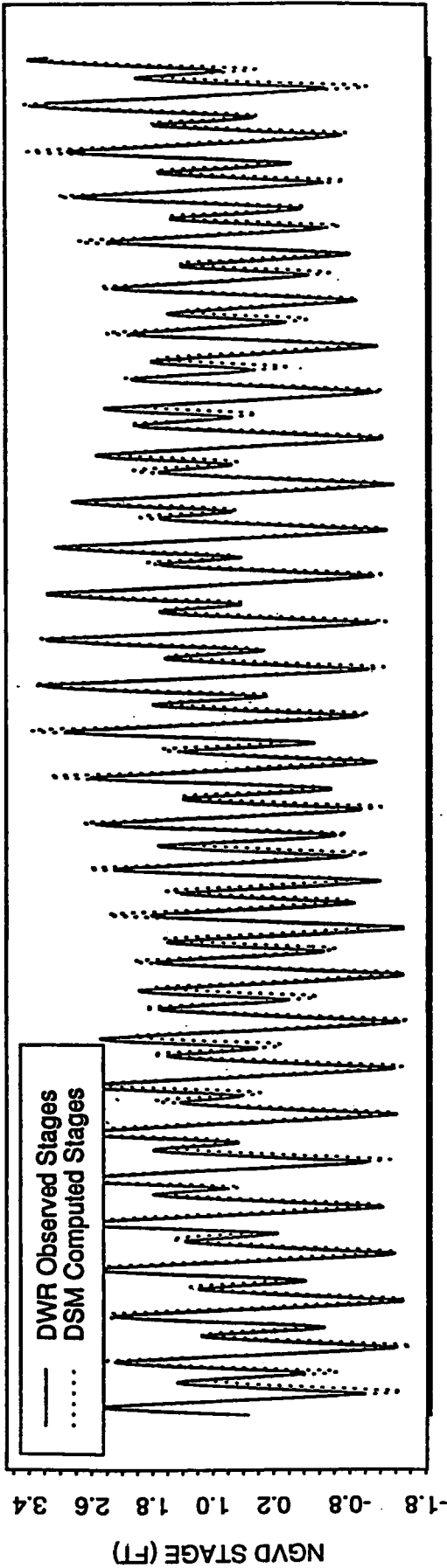
Stage Verification at B95421 (Chnl 194)  
STATION NO. 17



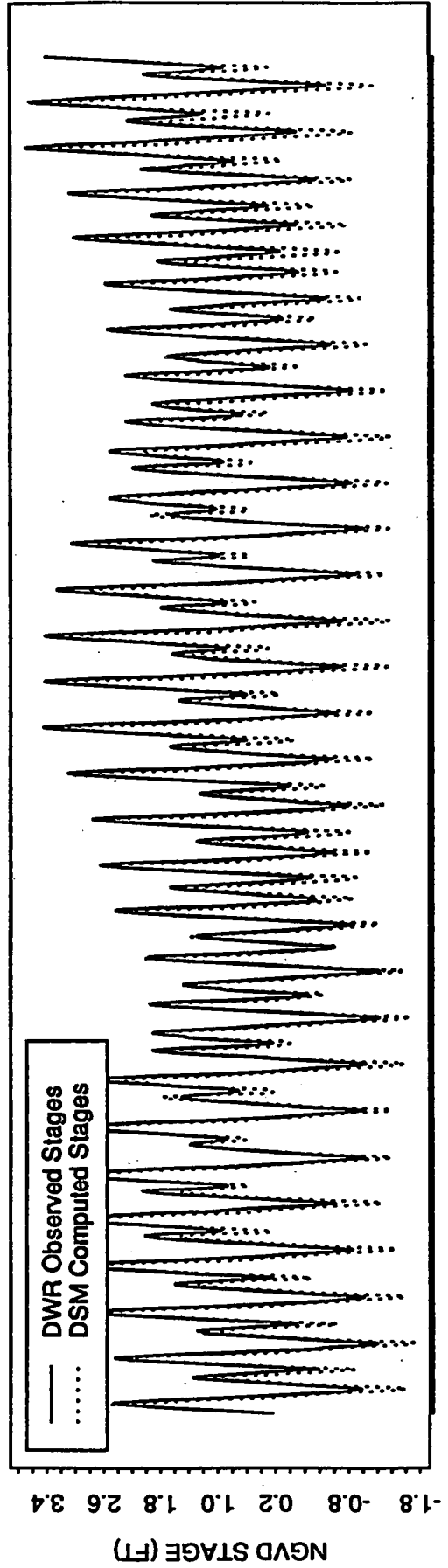
Stage Verification at B95460 (Chnl 153)  
STATION NO. 18



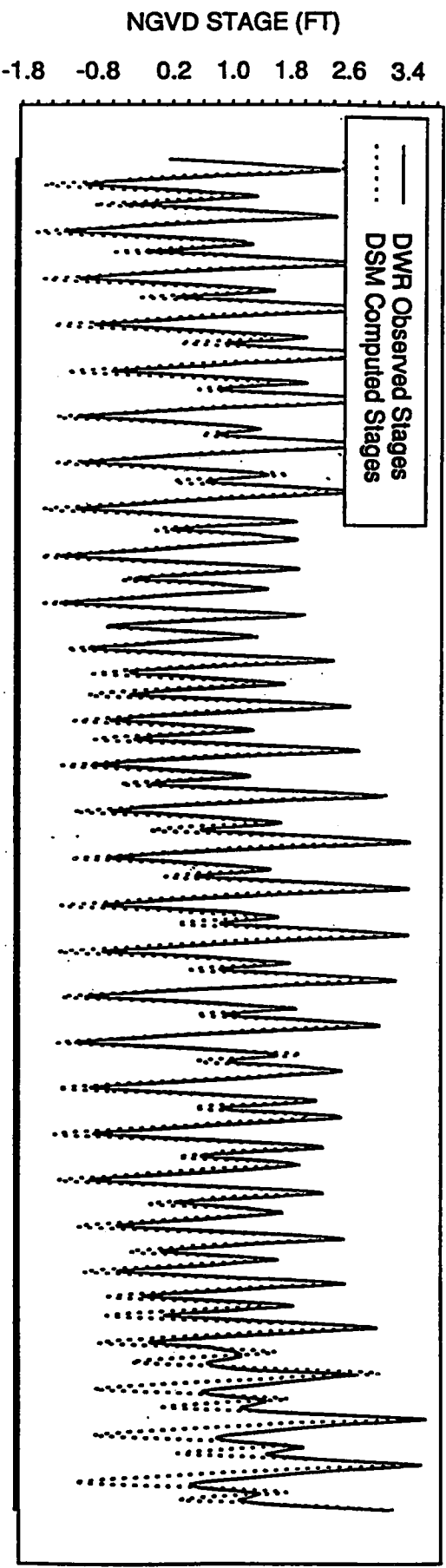
Stage Verification at B95468 (Chnl 145)  
STATION NO. 19



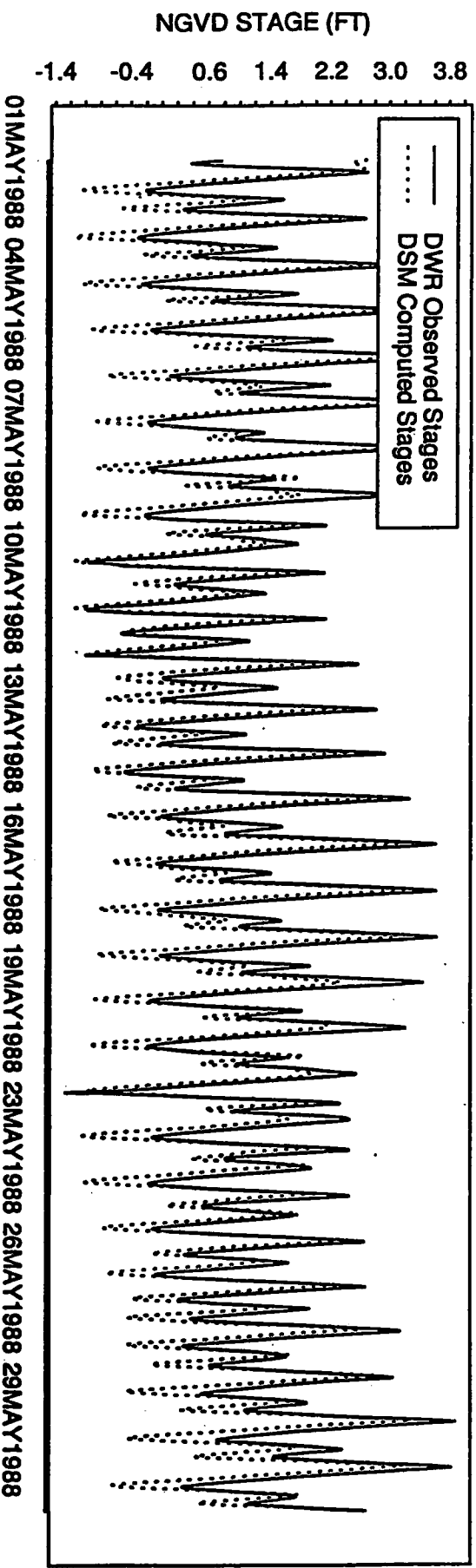
Stage Verification at B95500 (Chnl 134)  
STATION NO. 20



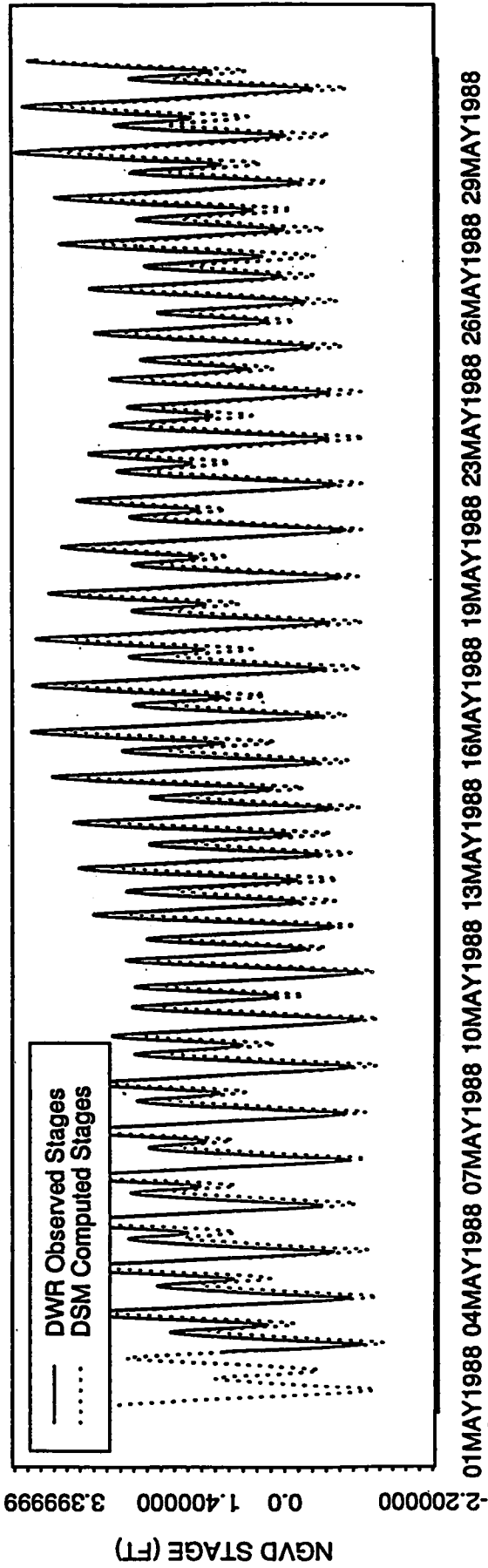
Stage Verification at B95503 (Chnl 133)  
STATION NO. 21



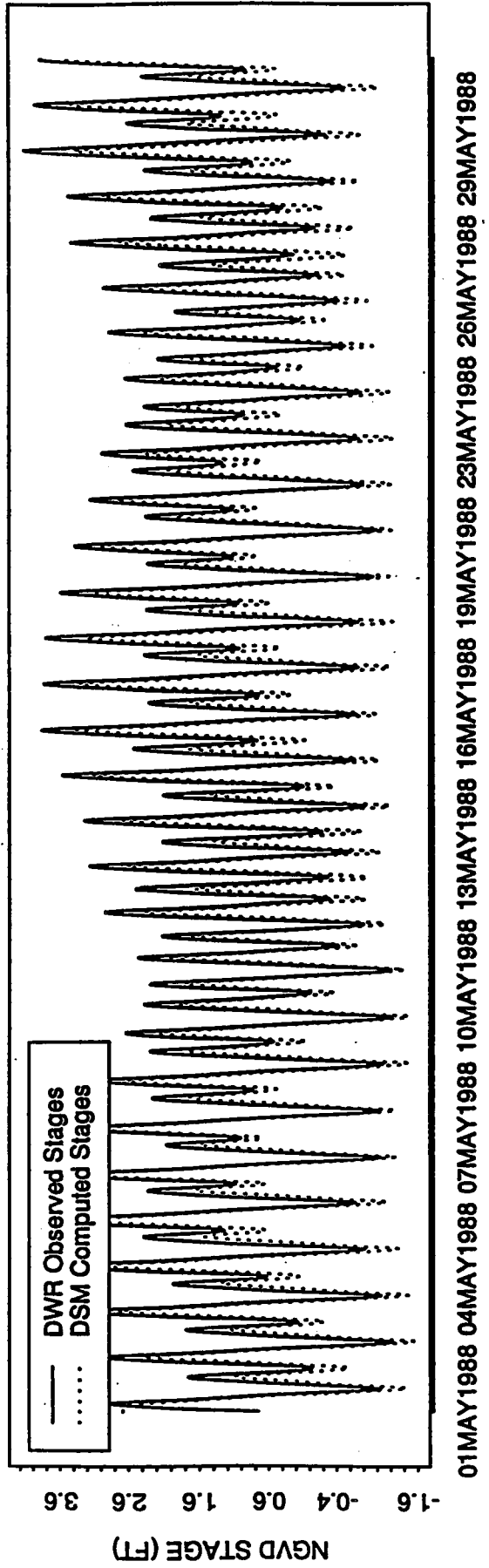
Stage Verification at B95540 (Chnl 125)  
STATION NO. 22



Stage Verification at B95580 (Chnl 37)  
STATION NO. 23



Stage Verification at B95620 (Chnl 24)  
STATION NO. 24

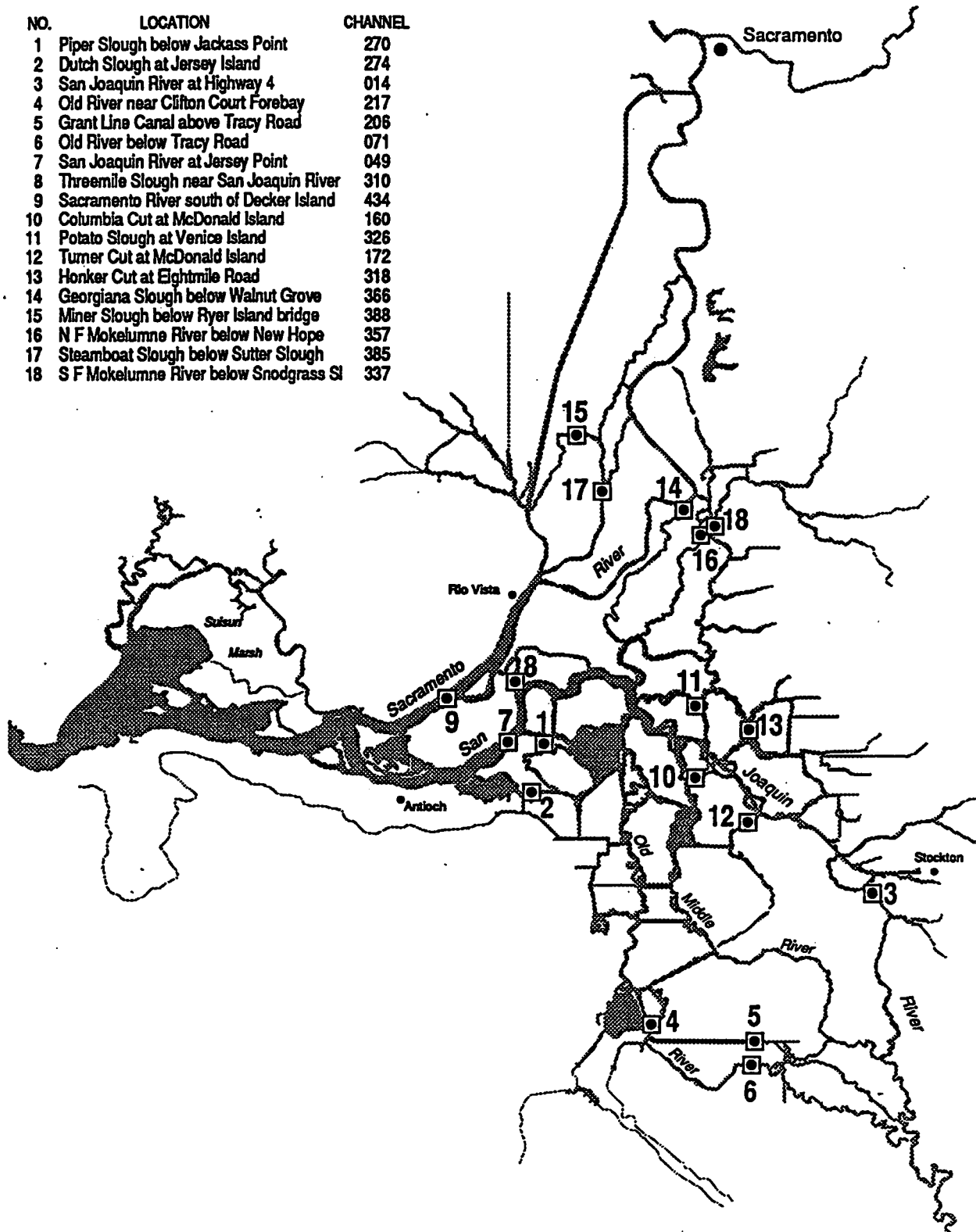


**APPENDIX II**

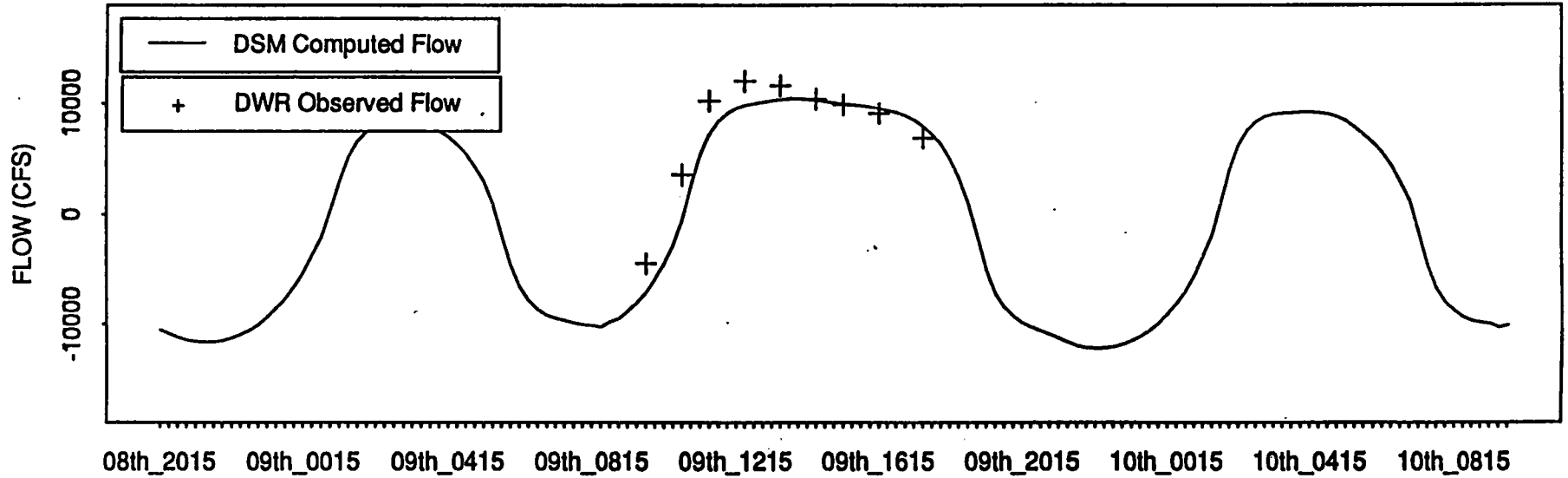
**MAY 1988 FLOW VERIFICATION PLOTS**

# LOCATION MAP 1988 FIELD MEASUREMENT SITES

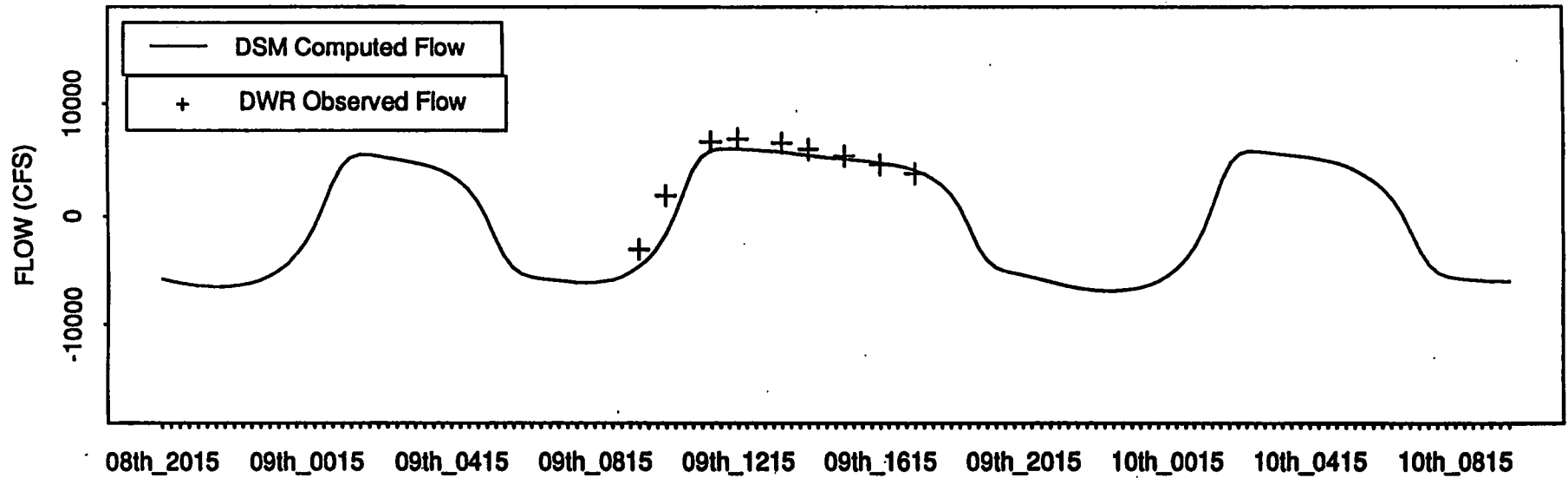
NO.	LOCATION	CHANNEL
1	Piper Slough below Jackass Point	270
2	Dutch Slough at Jersey Island	274
3	San Joaquin River at Highway 4	014
4	Old River near Clifton Court Forebay	217
5	Grant Line Canal above Tracy Road	206
6	Old River below Tracy Road	071
7	San Joaquin River at Jersey Point	049
8	Threemile Slough near San Joaquin River	310
9	Sacramento River south of Decker Island	434
10	Columbia Cut at McDonald Island	160
11	Potato Slough at Venice Island	326
12	Turner Cut at McDonald Island	172
13	Honker Cut at Eightmile Road	318
14	Georgiana Slough below Walnut Grove	366
15	Miner Slough below Ryer Island bridge	388
16	N F Mokelumne River below New Hope	357
17	Steamboat Slough below Sutter Slough	385
18	S F Mokelumne River below Snodgrass Sl	337



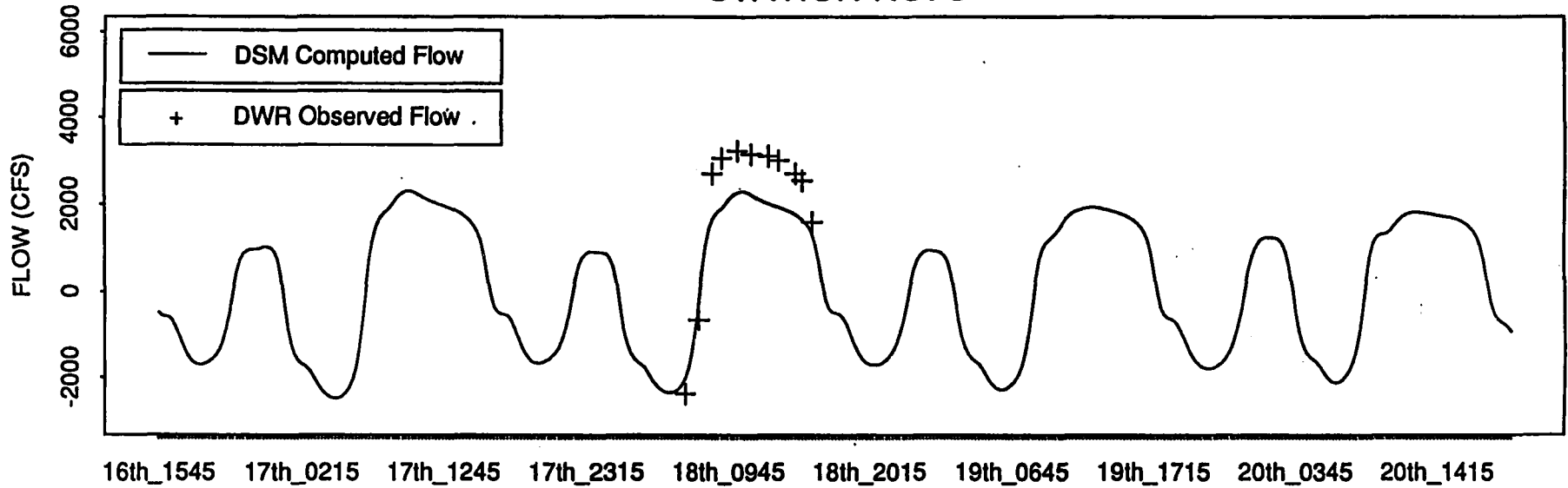
May 1988 Flow Verification at Piper Slough (Chnl 270)  
STATION NO. 1



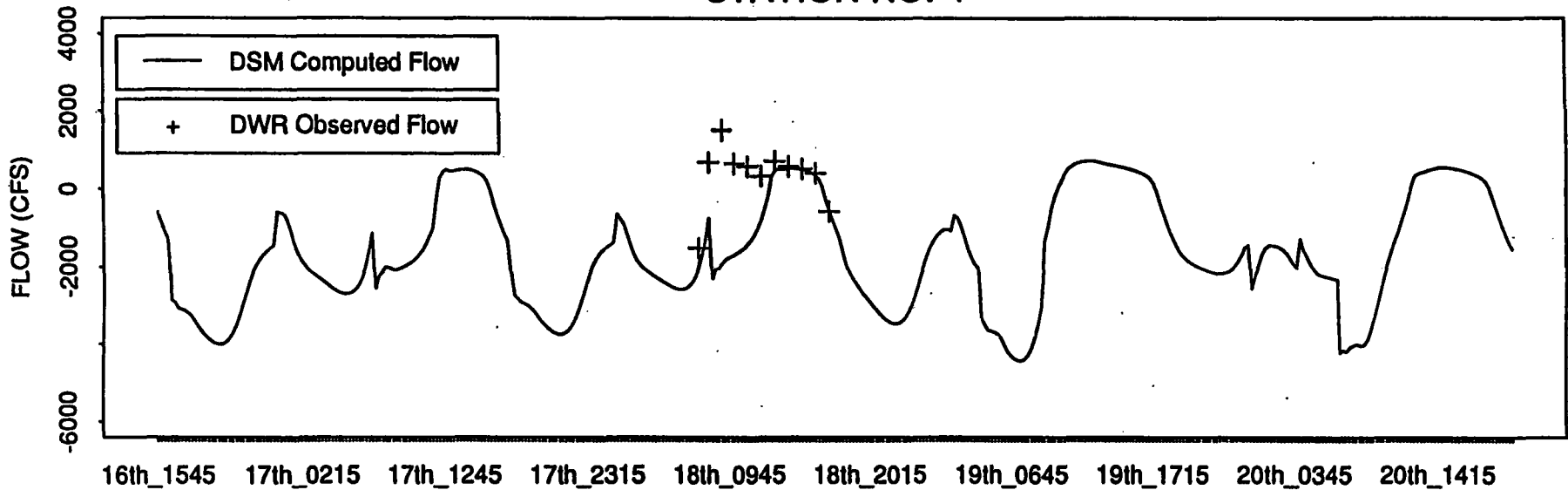
May 1988 Flow Verification at Dutch Slough at Jersey Island (Chnl 274)  
STATION NO. 2



May 1988 Flow Verification at SJR at Highway 4 (Chnl 14)  
STATION NO. 3



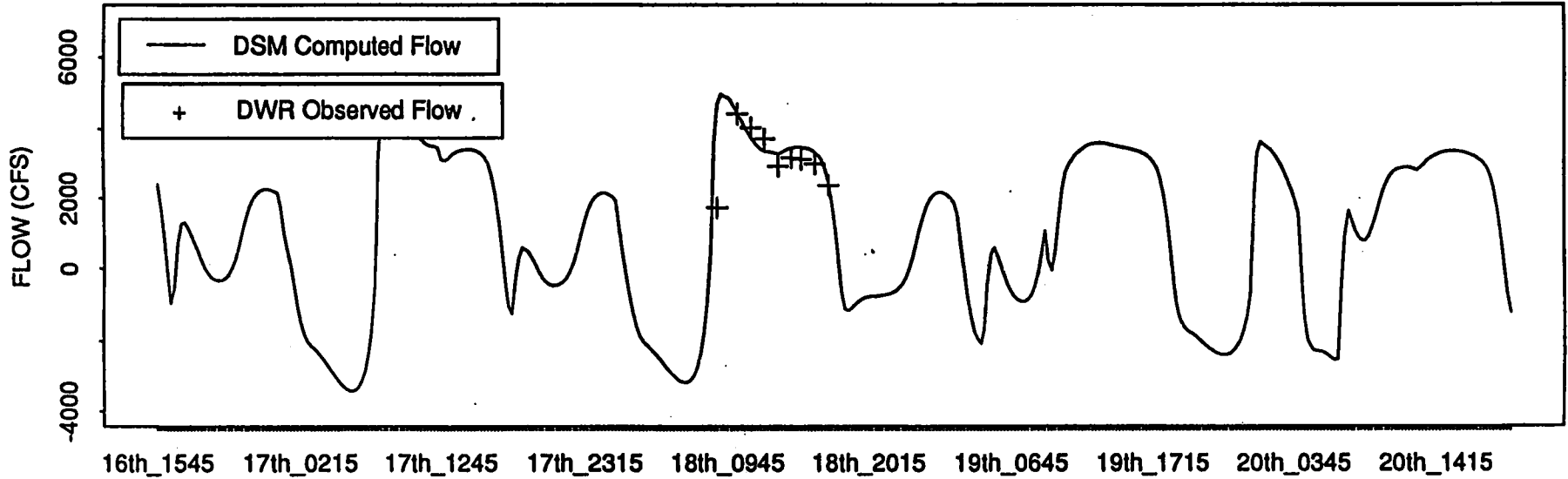
May 1988 Flow Verification at Old River Near CCFB (Chnl 217)  
STATION NO. 4



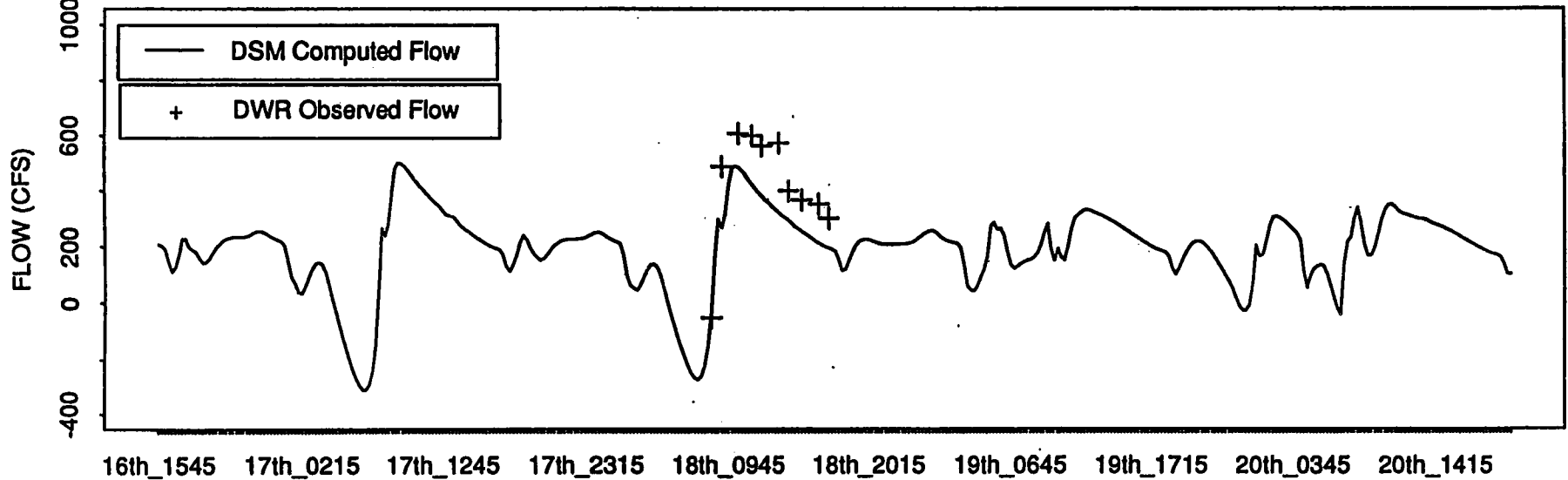
ATIA-3



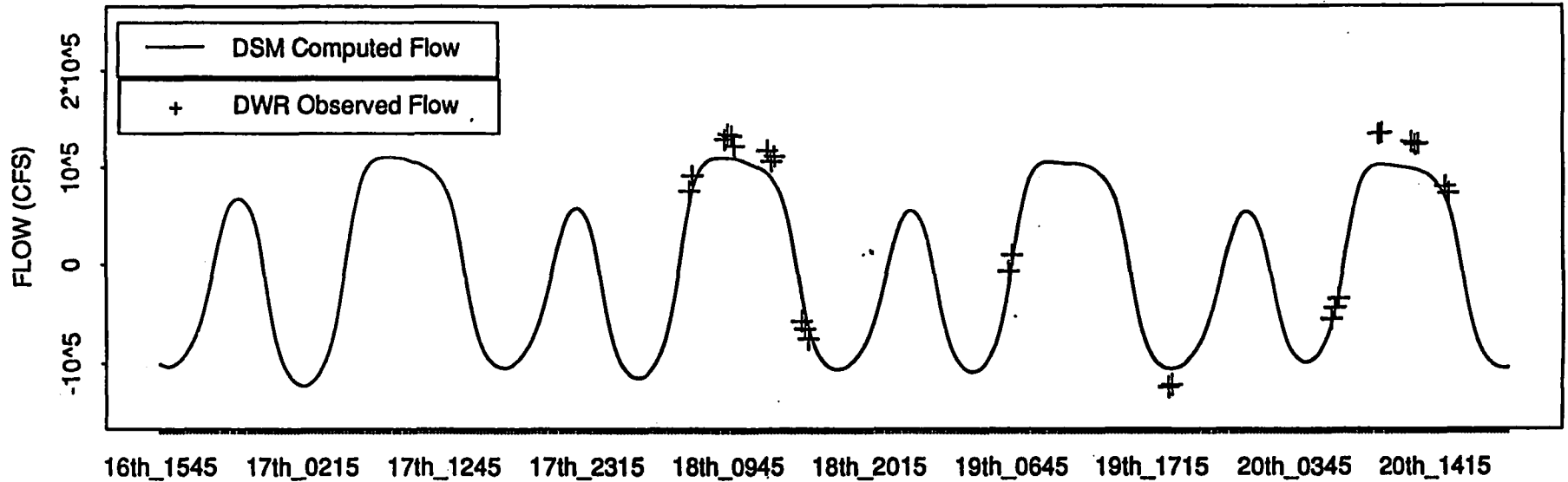
May 1988 Flow Verification at Grant Line Canal above Tracy Rd. (Chnl 206)  
STATION NO. 5



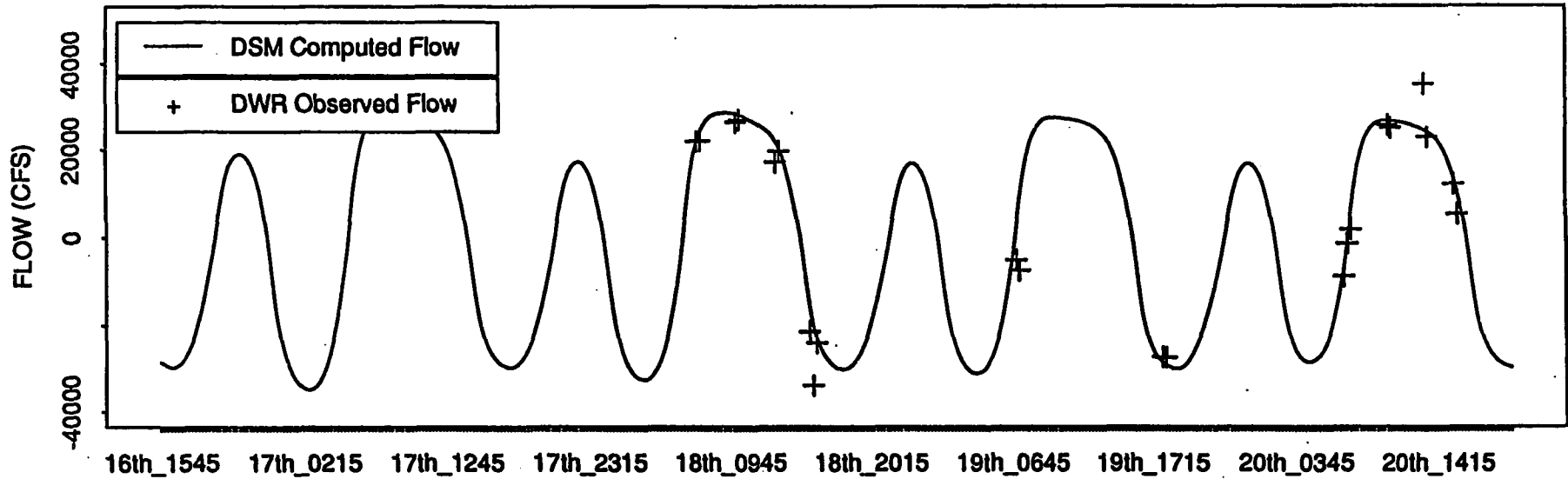
May 1988 Flow Verification at Old River Below Tracy Rd. (Chnl 71)  
STATION NO. 6



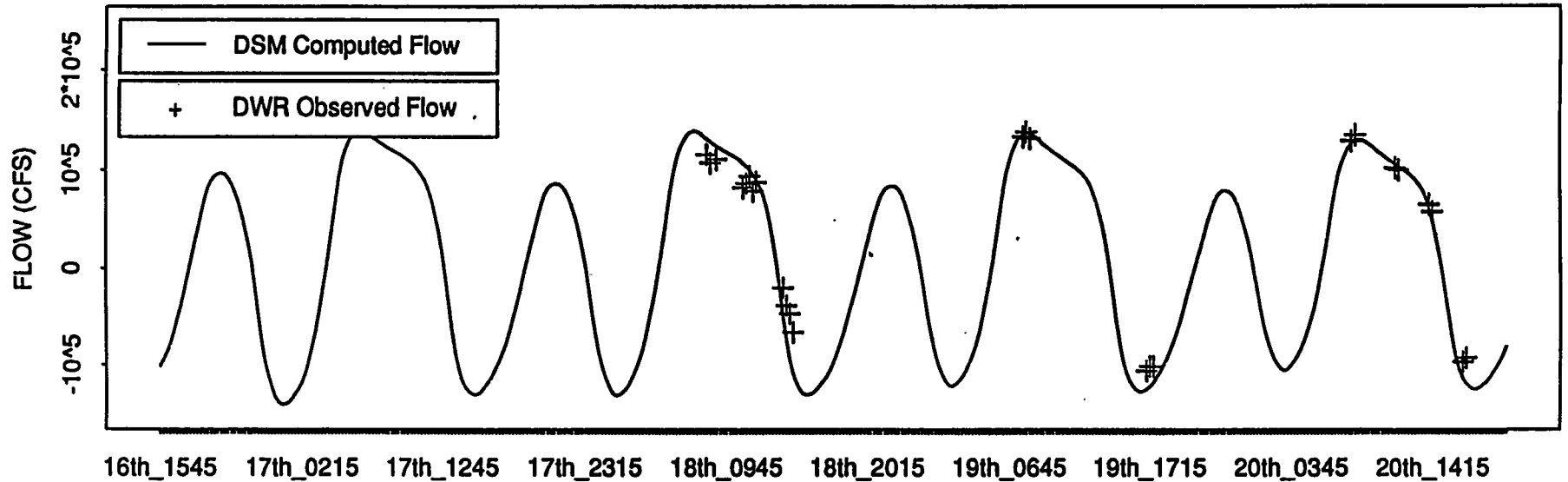
May 1988 Flow Verification at San Joaquin River at Jersey Point (Chnl 49)  
STATION NO. 7



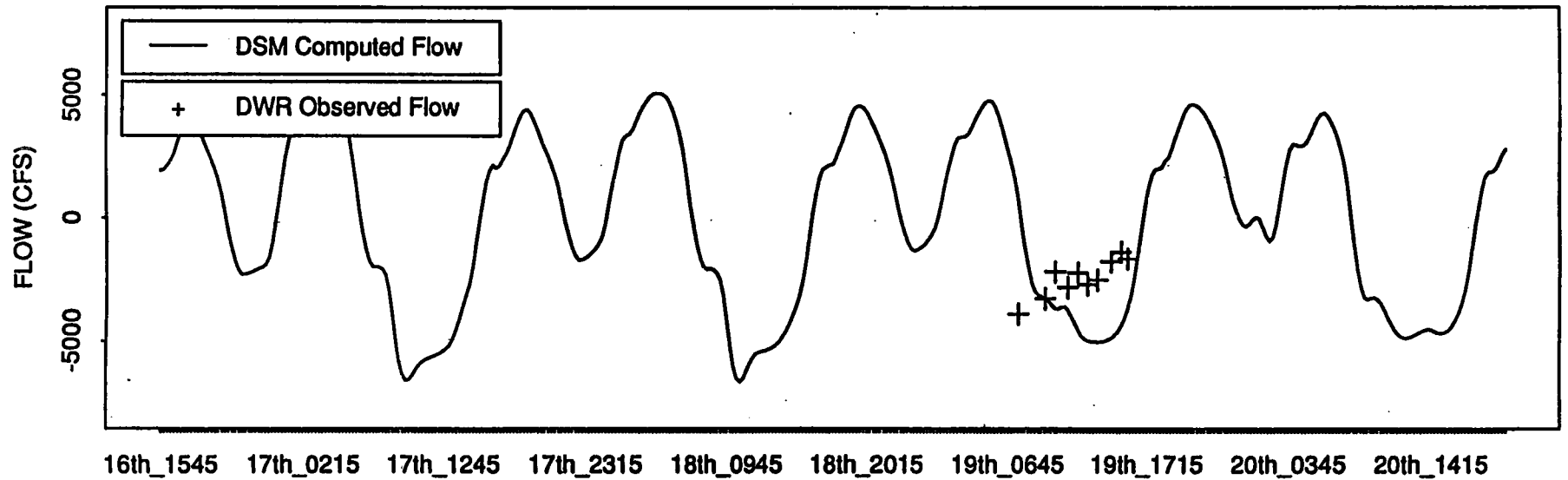
May 1988 Flow Verification at Threemile Slough Near the San Joaquin River (Chnl 310)  
STATION NO. 8



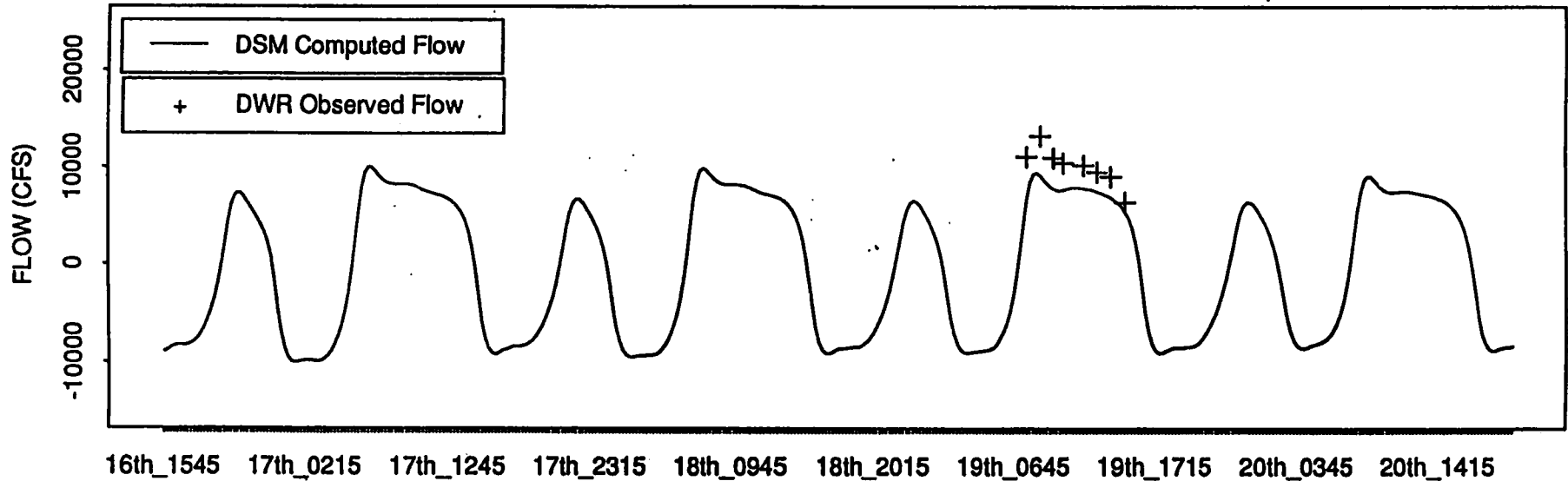
May 1988 Flow Verification at Sacramento River South of Decker Island (Chnl 434)  
STATION NO. 9



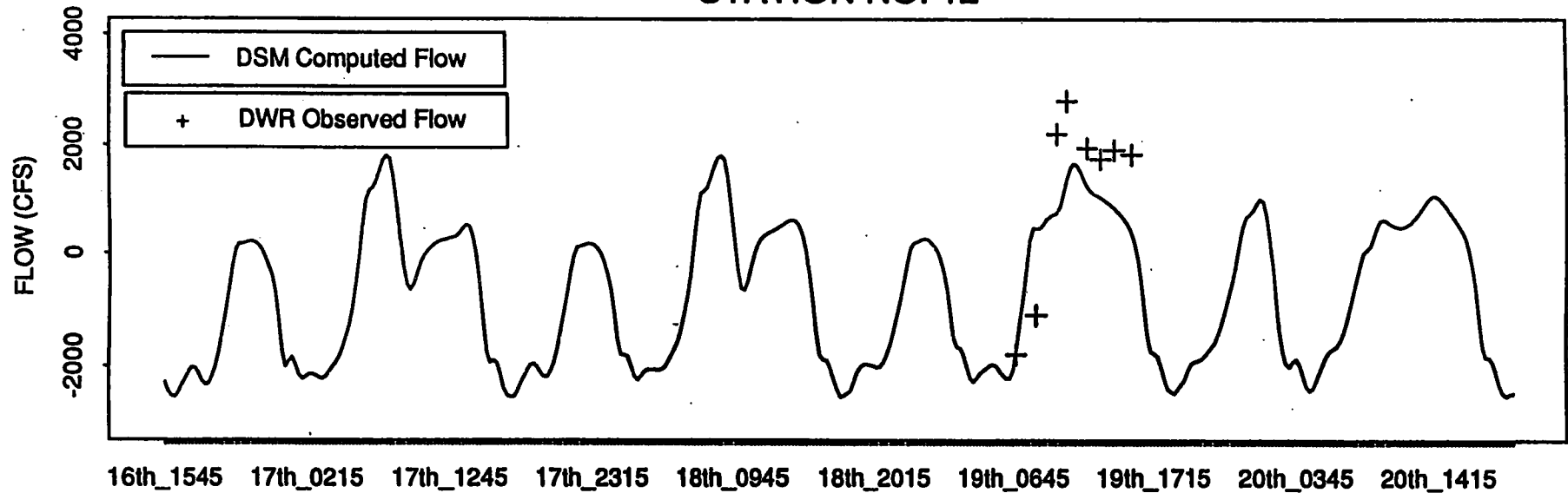
May 1988 Flow Verification at Columbia Cut at McDonald Island (Chnl 160)  
STATION NO. 10



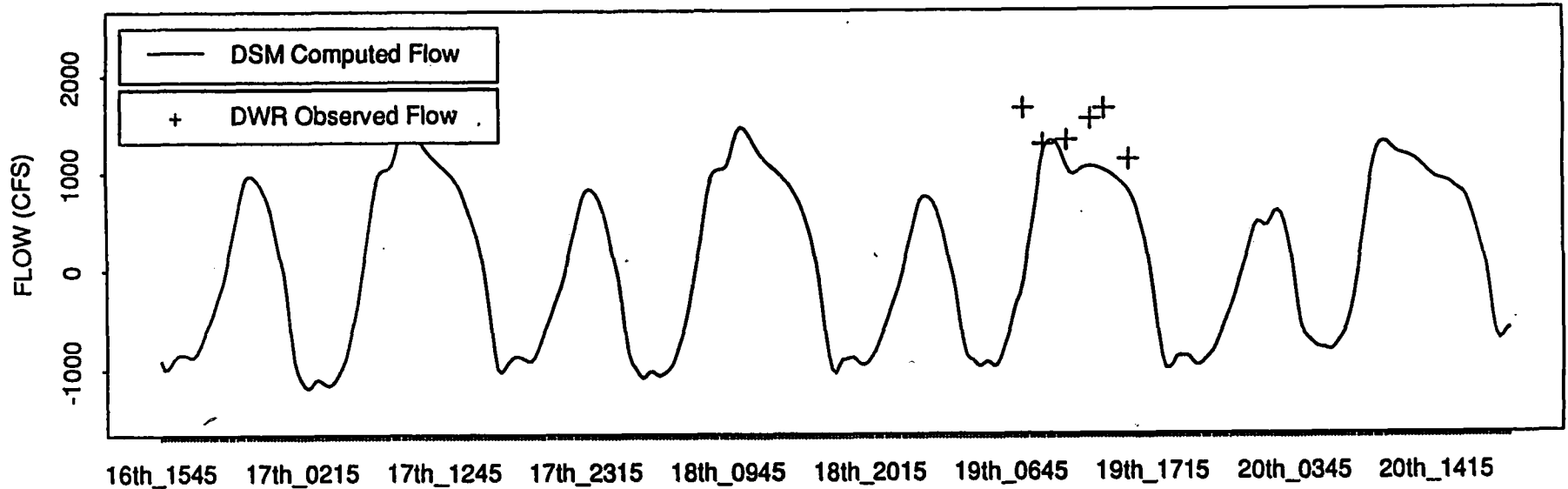
May 1988 Flow Verification at Potato Slough South of Decker Island (Chnl 326)  
STATION NO. 11



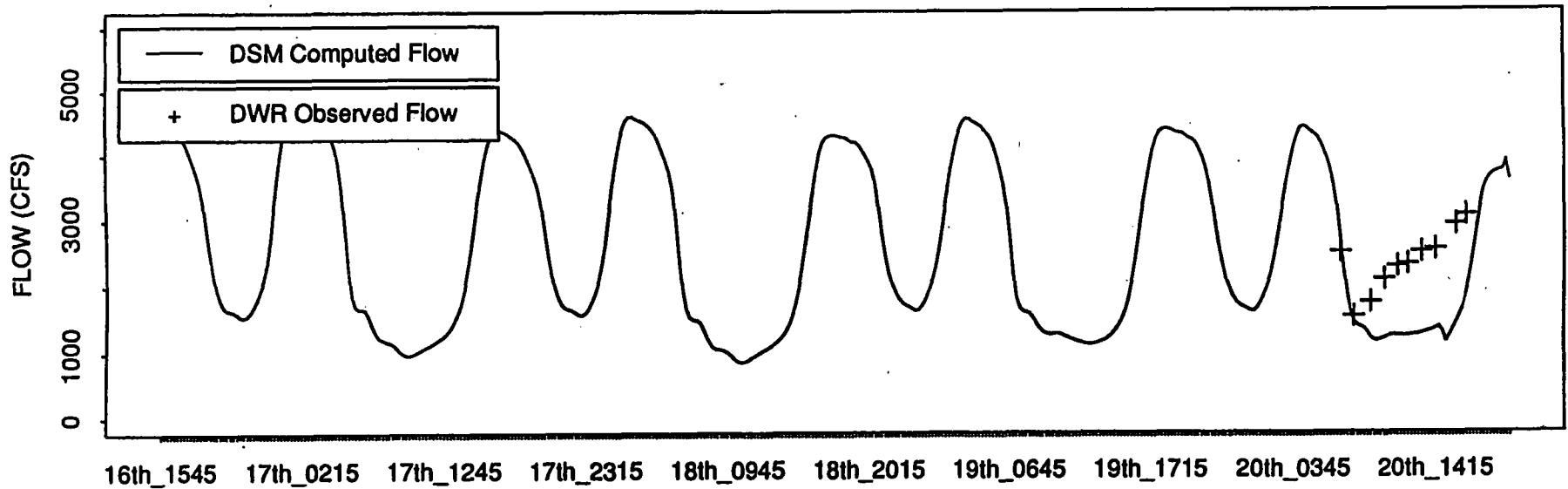
May 1988 Flow Verification at Turner Cut at McDonald Island (Chnl 172)  
STATION NO. 12



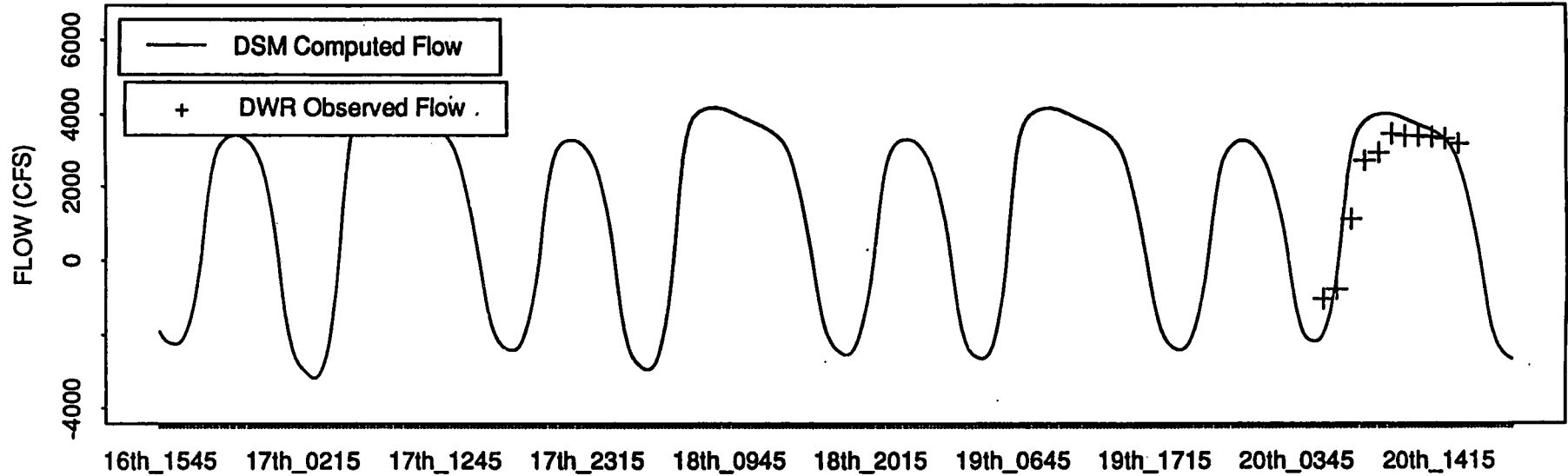
May 1988 Flow Verification at Honker Cut at Eightmile Road (Chnl 318)  
STATION NO. 13.



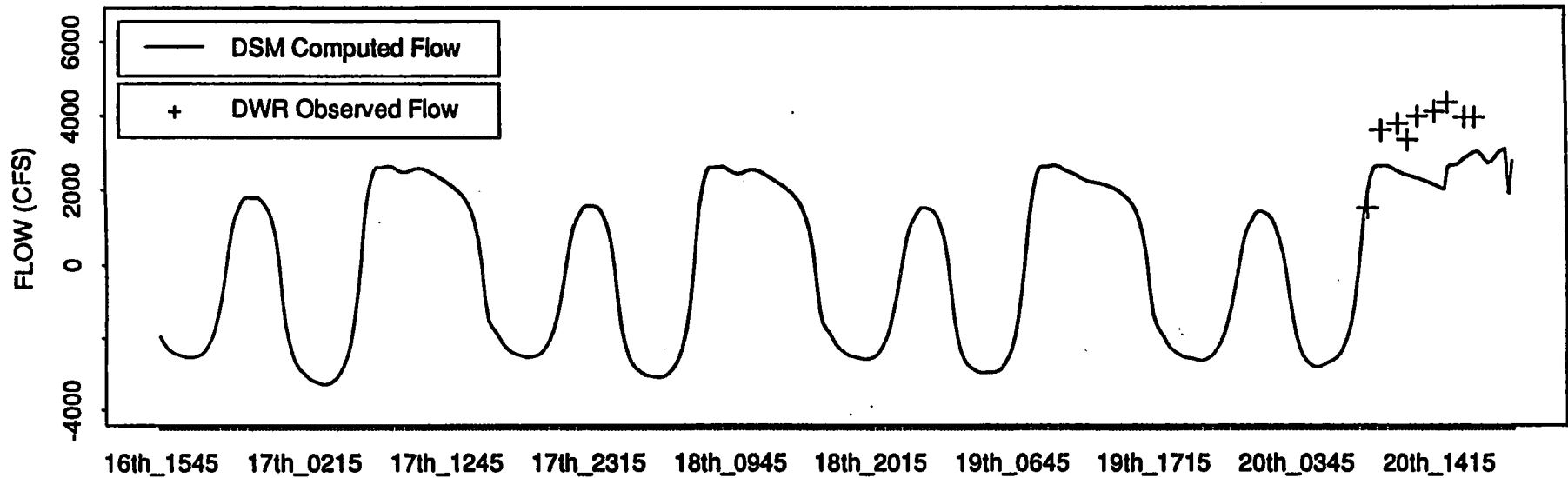
May 1988 Flow Verification at Georgiana Slough Below Walnut Grove (Chnl 366)  
STATION NO. 14



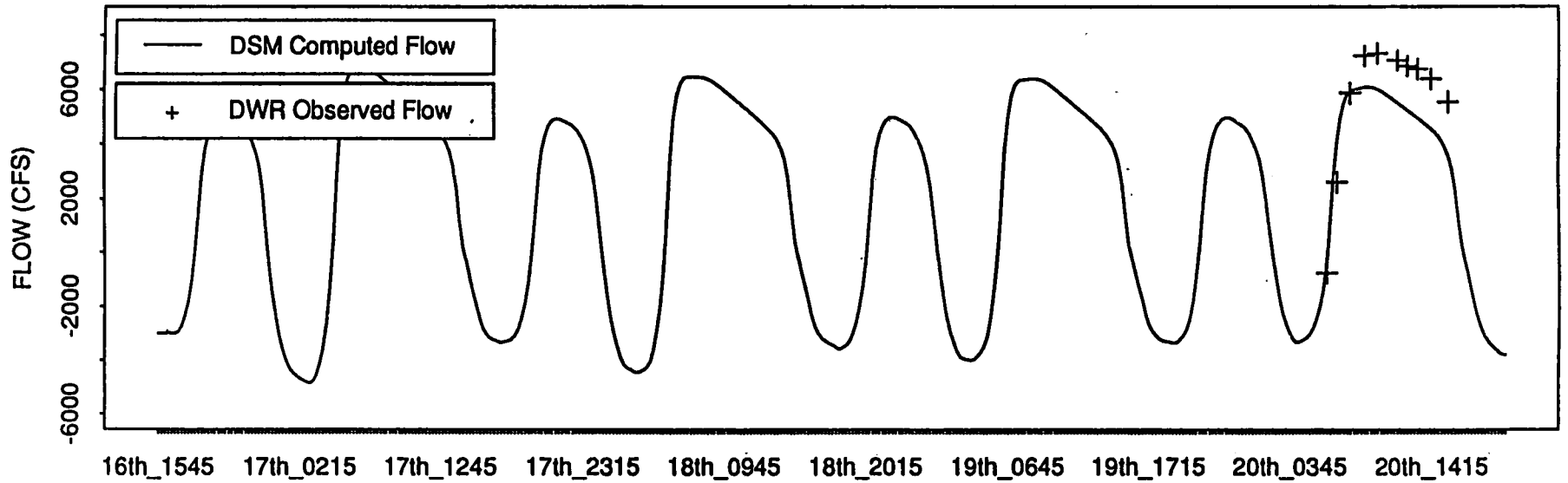
May 1988 Flow Verification at Miner Slough Below Ryer Island Bridge (Chnl 388)  
STATION NO. 15



May 1988 Flow Verification at NF Mokelumne Below New Hope (Chnl 357)  
STATION NO. 16



May 1988 Flow Verification at Steamboat Slough Below Sutter Slough (Chnl 385)  
STATION NO. 17



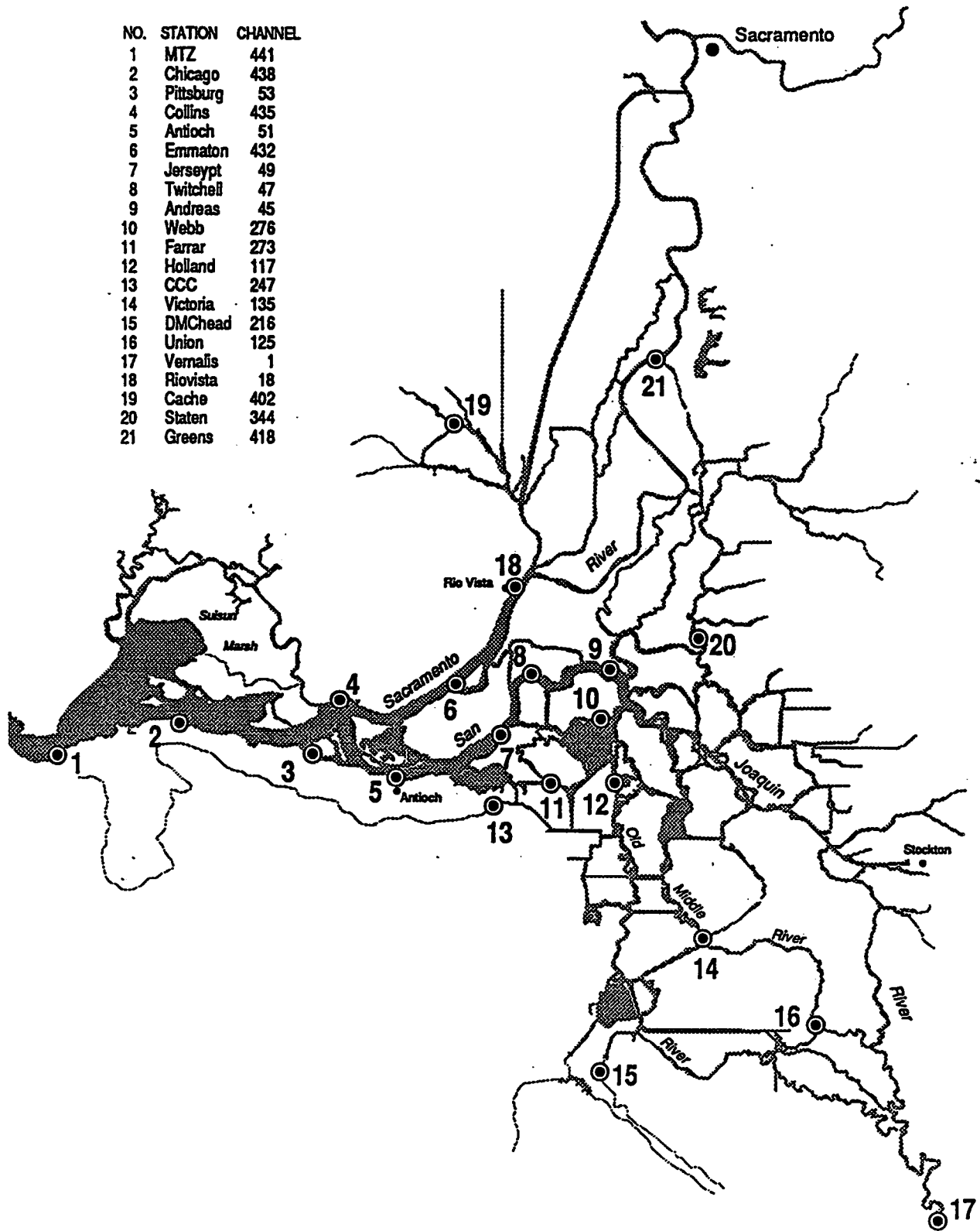
APPENDIX III

TWENTY-FOUR YEAR MONTHLY AVERAGE  
SALINITY VERIFICATION PLOTS

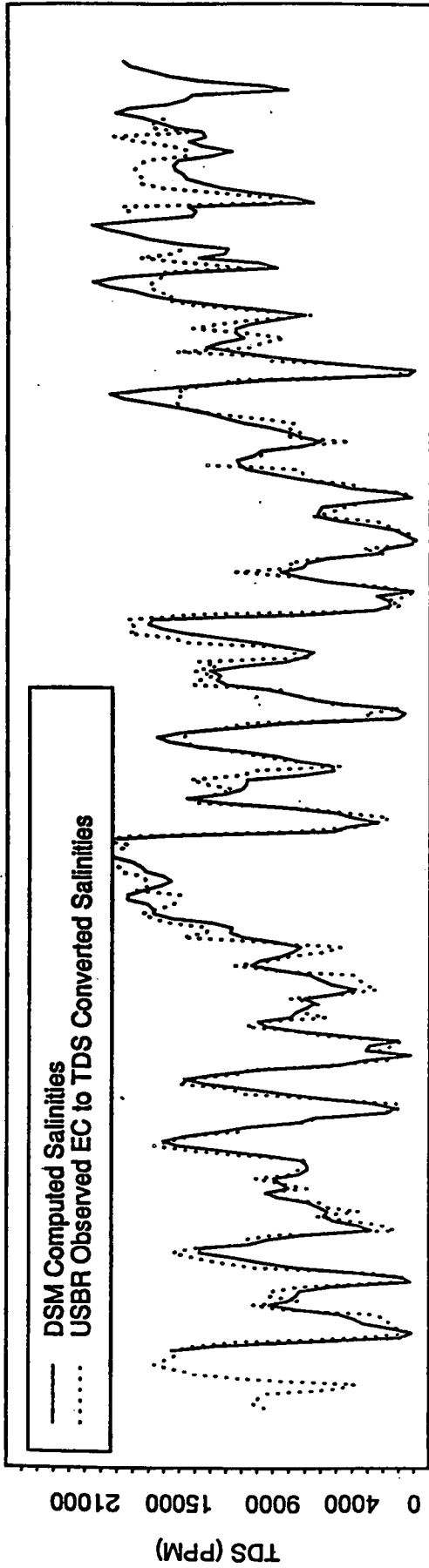


# LOCATION MAP USBR EC STATIONS

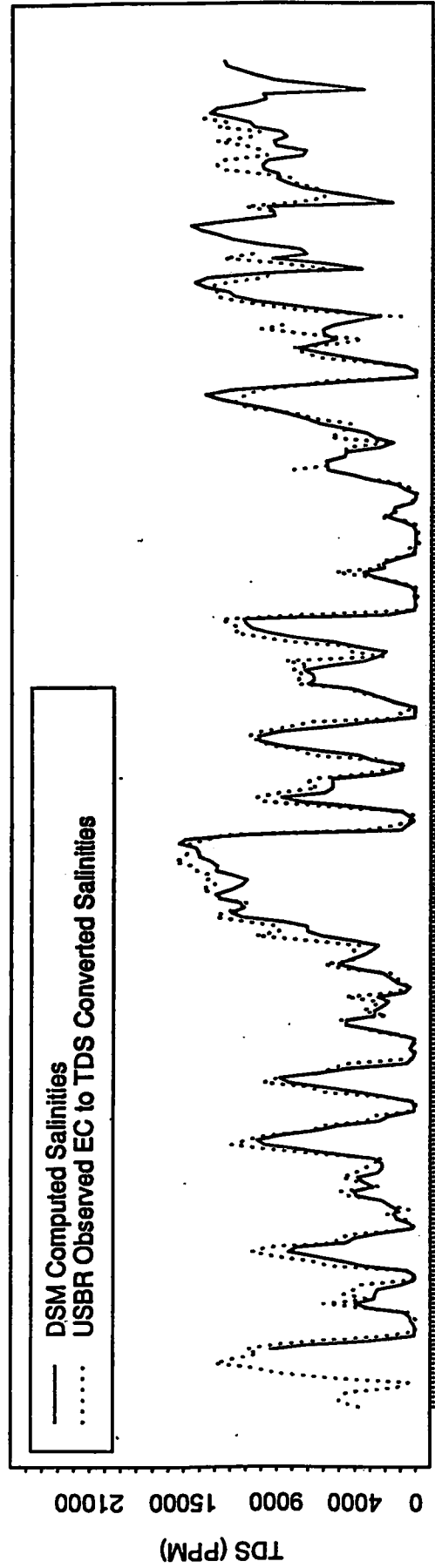
NO.	STATION	CHANNEL
1	MTZ	441
2	Chicago	438
3	Pittsburg	53
4	Collins	435
5	Antioch	51
6	Emmaton	432
7	Jerseypt	49
8	Twitchell	47
9	Andreas	45
10	Webb	276
11	Farrar	273
12	Holland	117
13	CCC	247
14	Victoria	135
15	DMChhead	216
16	Union	125
17	Vernalis	1
18	Rio Vista	18
19	Cache	402
20	Staten	344
21	Greens	418



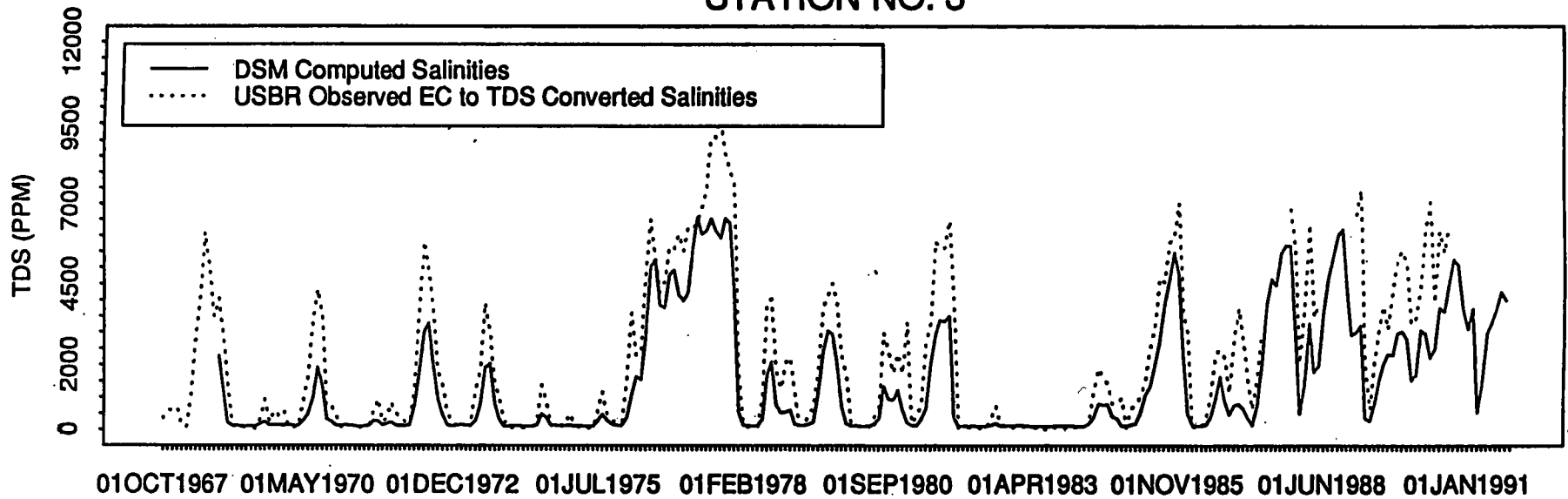
Salinity Verification at Martinez (Chnl 441)  
STATION NO. 1



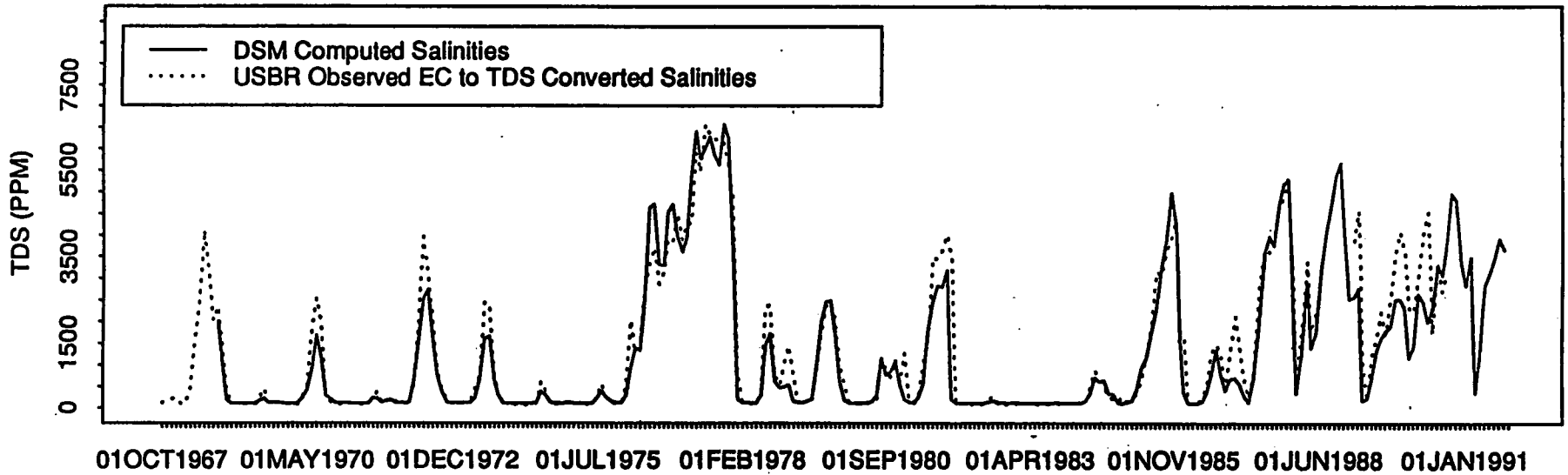
Salinity Verification at Chicago (Chnl 438)  
STATION NO. 2



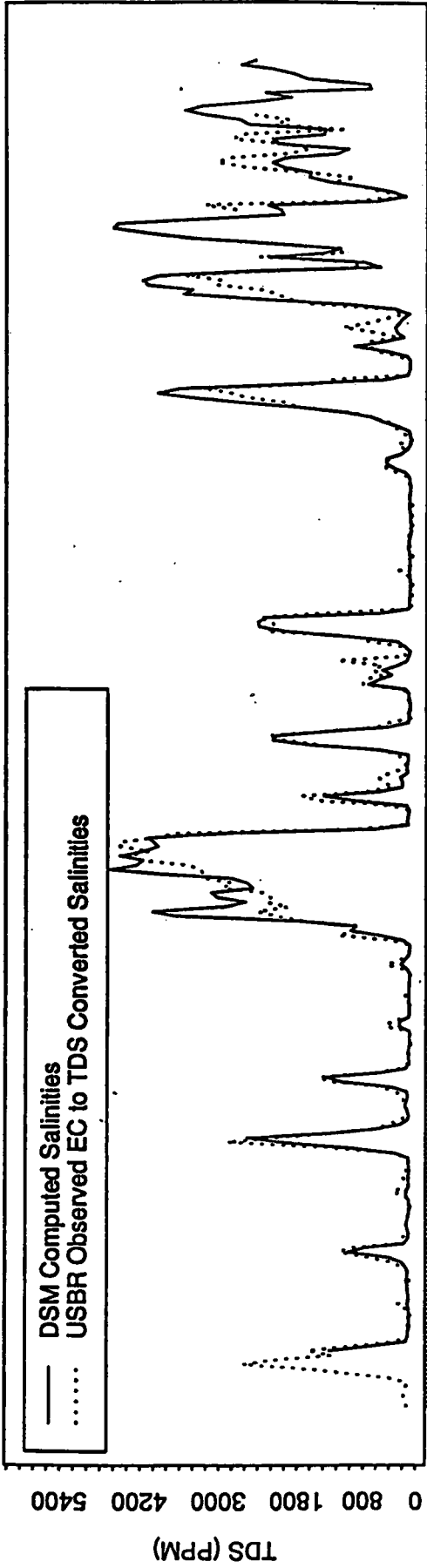
### Salinity Verification at Pittsburg (Chnl 53) STATION NO. 3



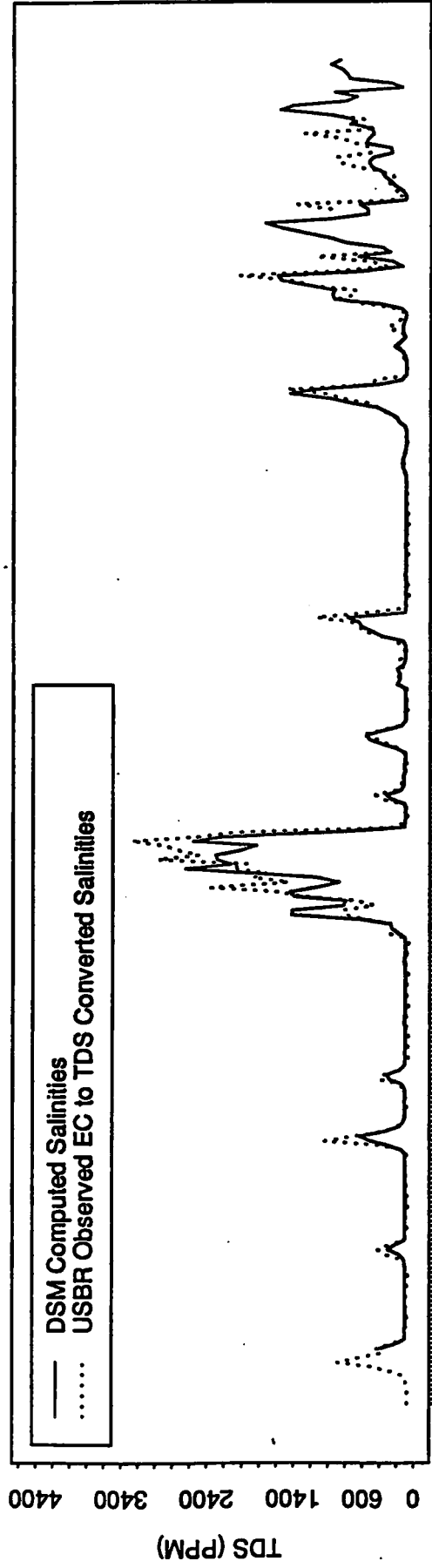
### Salinity Verification at Collinsville (Chnl 435) STATION NO. 4



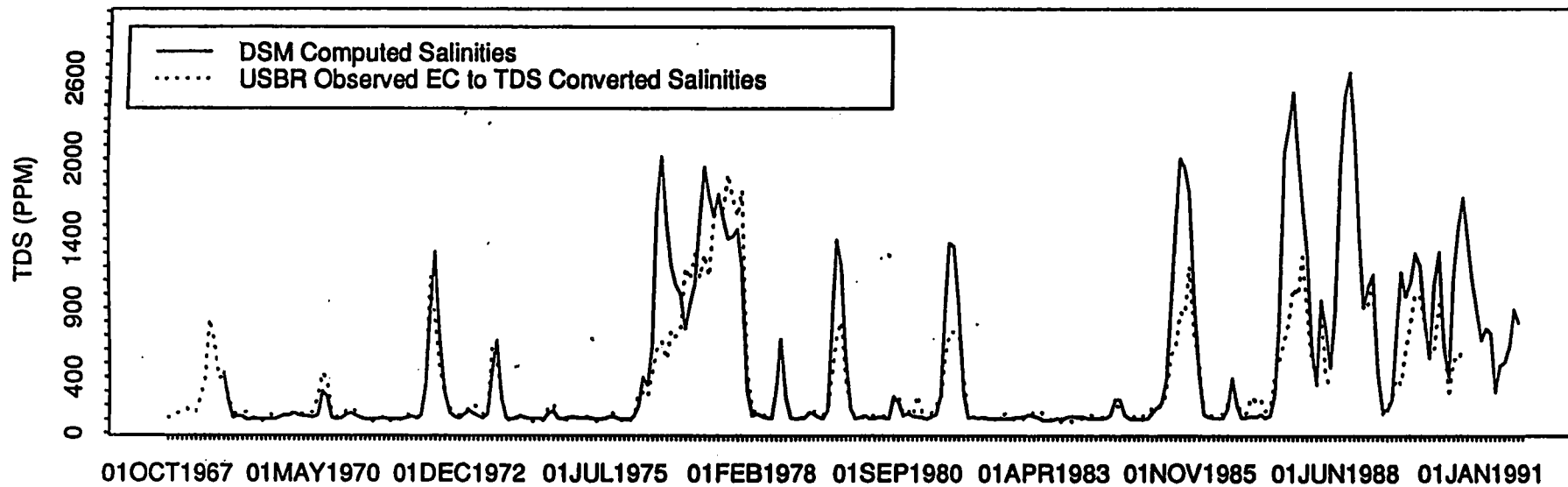
Salinity Verification at Antioch (Chnl 51)  
STATION NO. 5



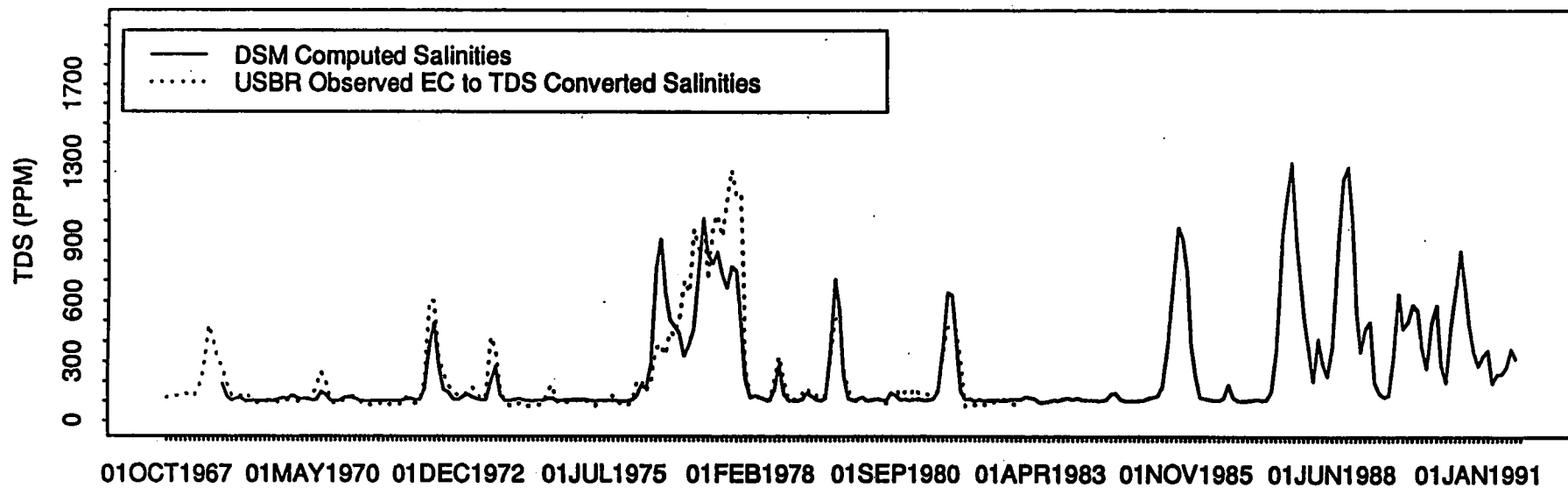
Salinity Verification at Emmaton (Chnl 432)  
STATION NO. 6



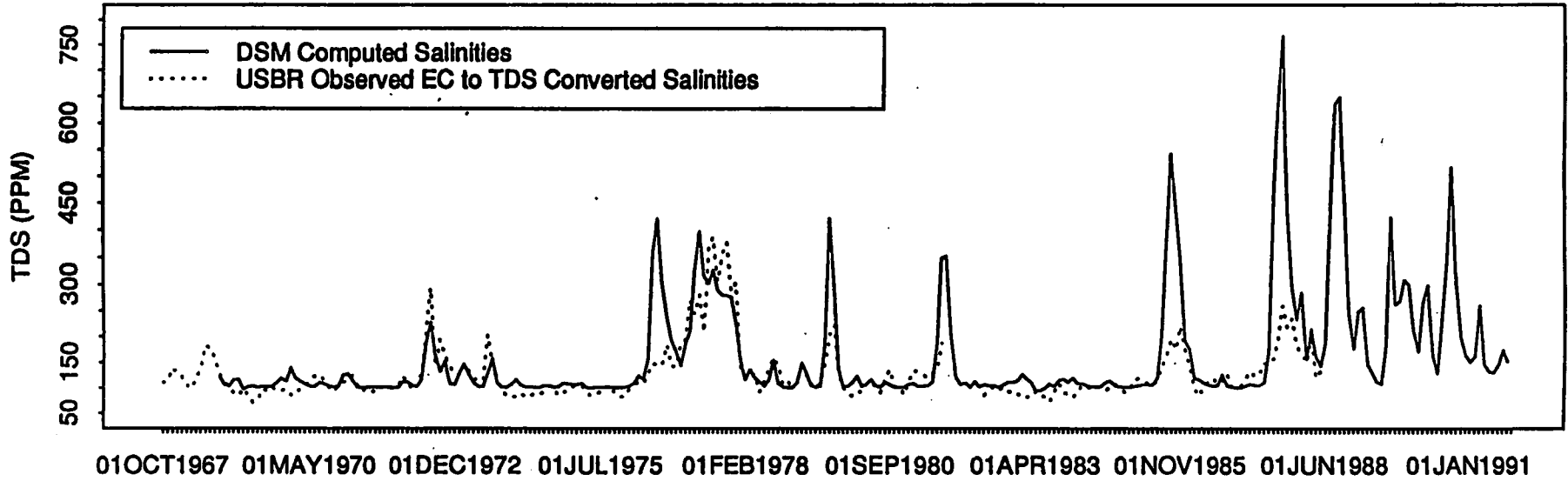
### Salinity Verification at Jersey Point (Chnl 49) STATION NO. 7



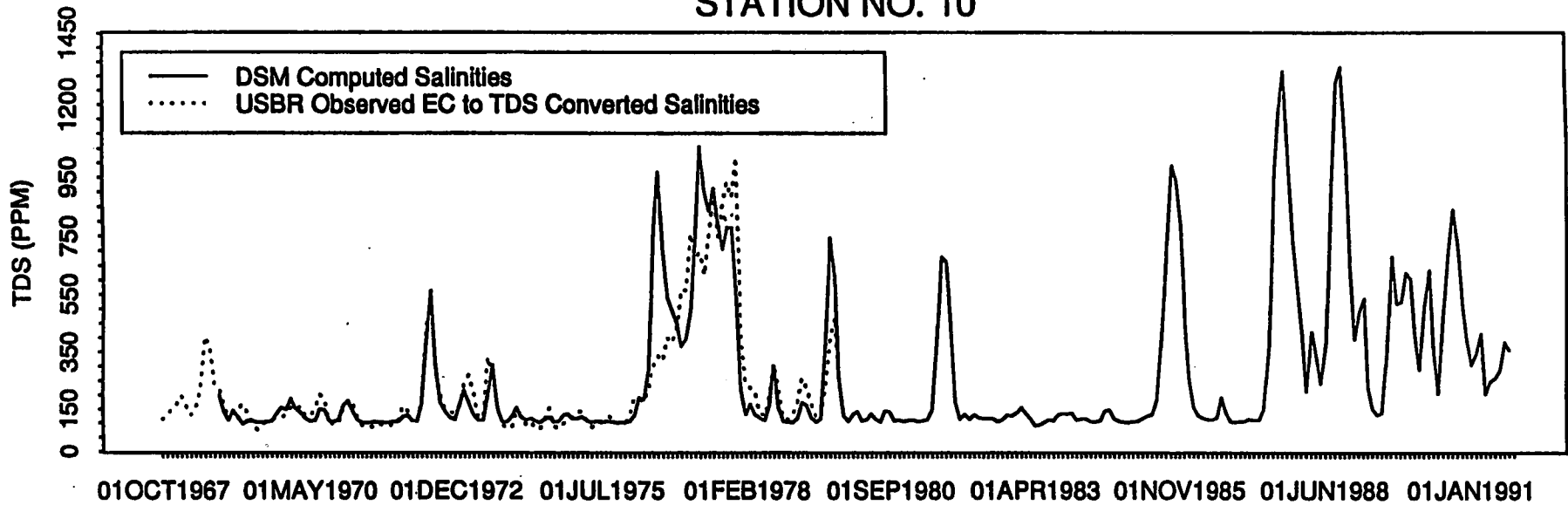
### Salinity Verification at Twitchell (Chnl 47) STATION NO. 8



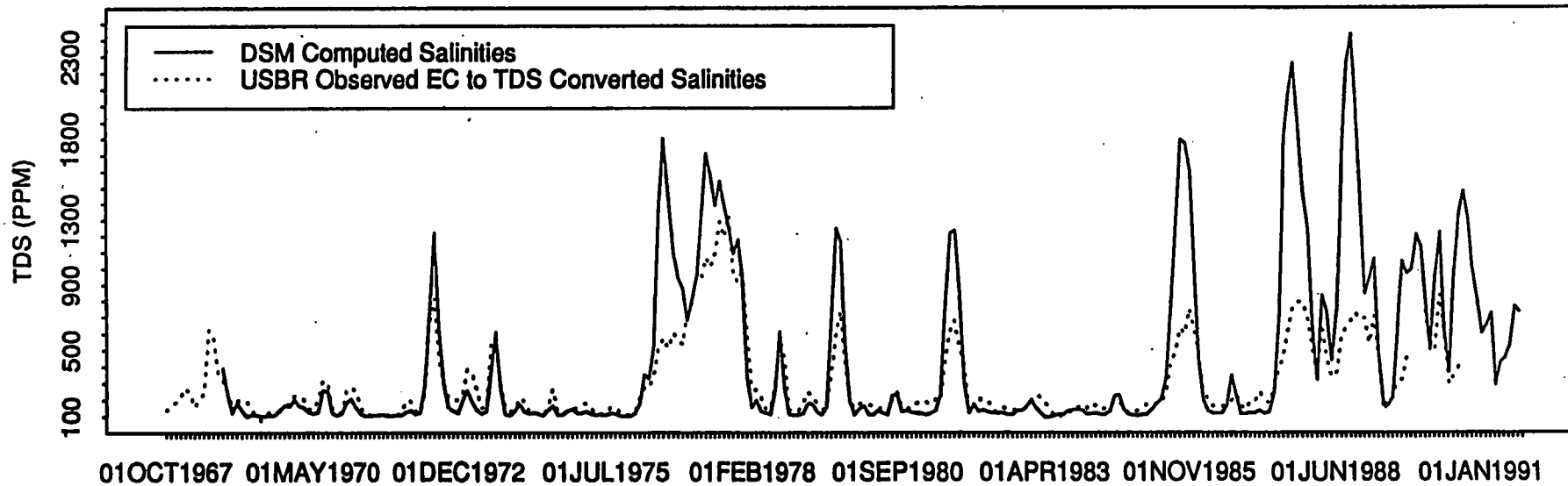
### Salinity Verification at Andreas (Chnl 45) STATION NO. 9



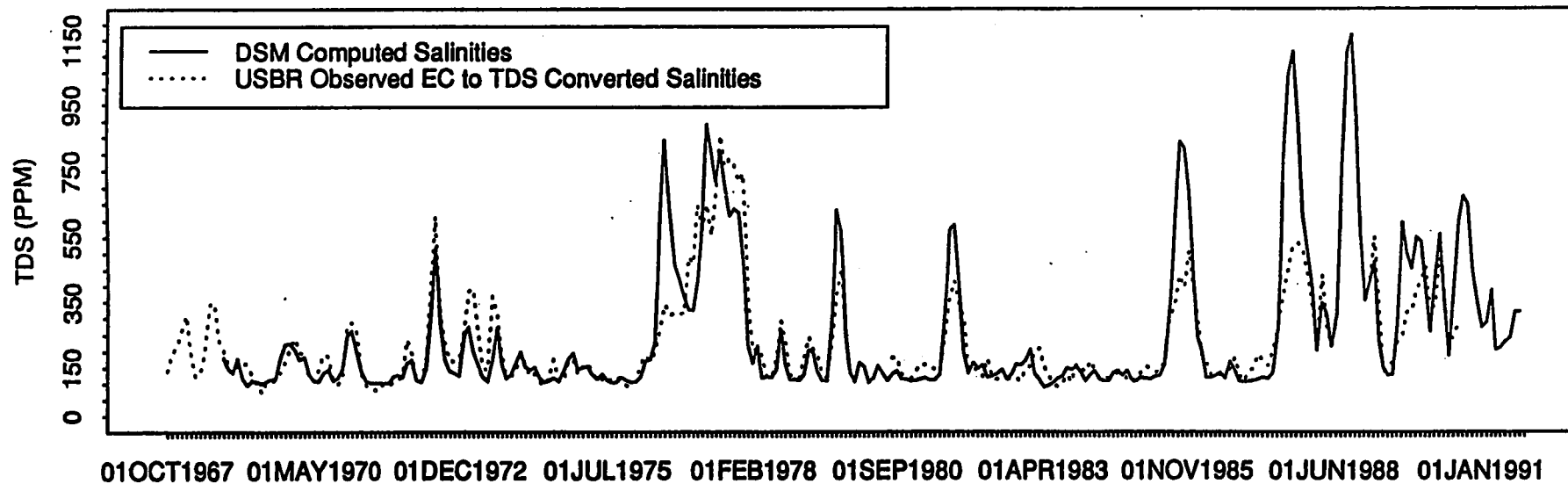
### Salinity Verification at Webb (Chnl 276) STATION NO. 10



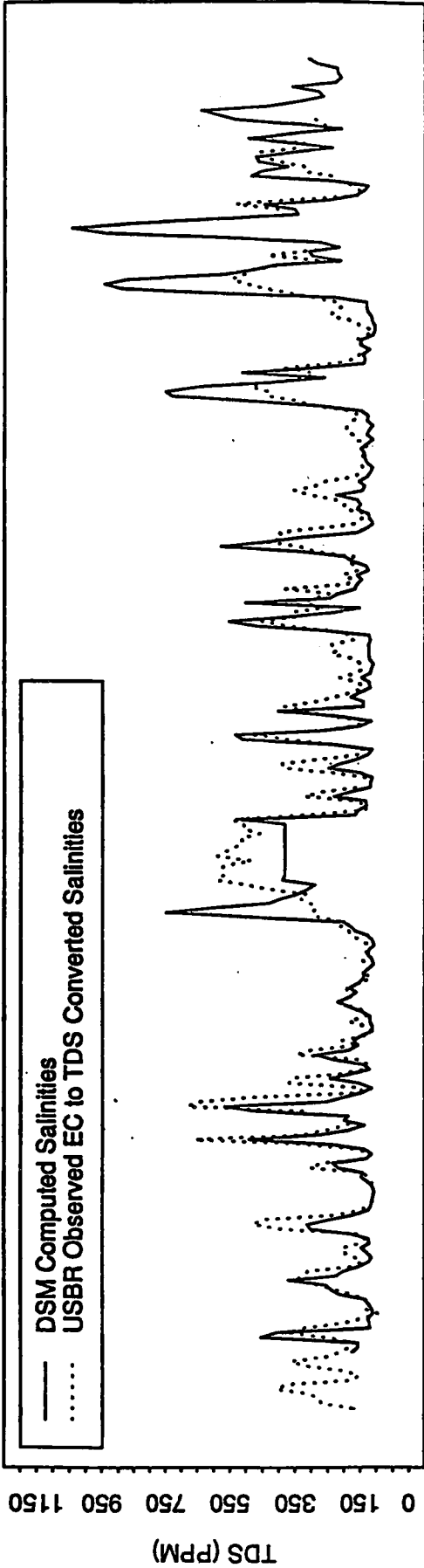
### Salinity Verification at Farrar (Chnl 273) STATION NO. 11



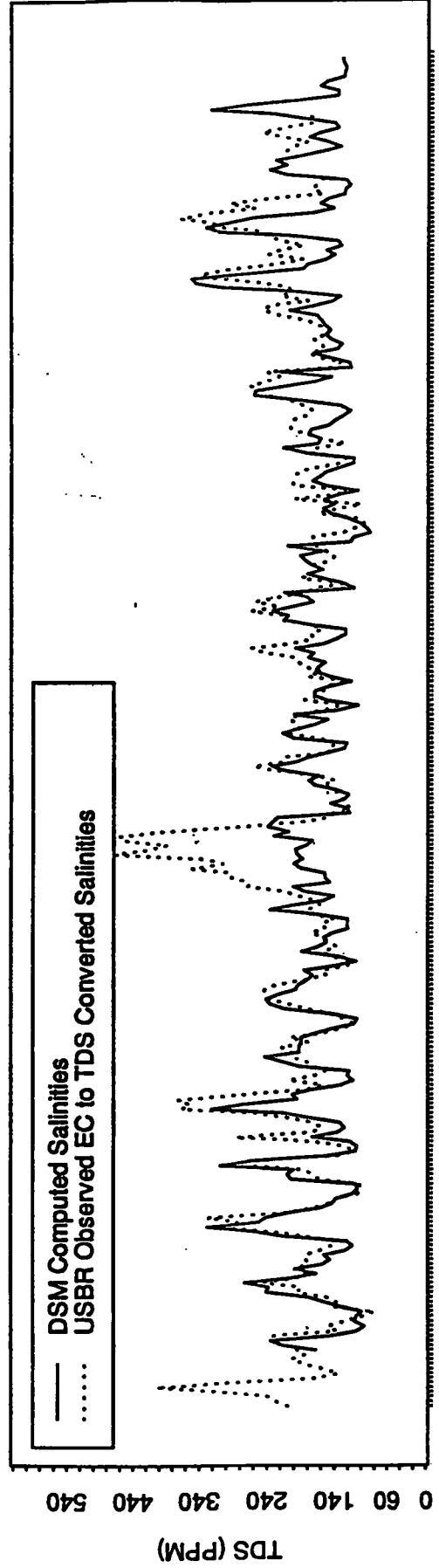
### Salinity Verification at Holland (Chnl 117) STATION NO. 12



Salinity Verification at Contra Costa Canal (Chnl 247)  
STATION NO. 13

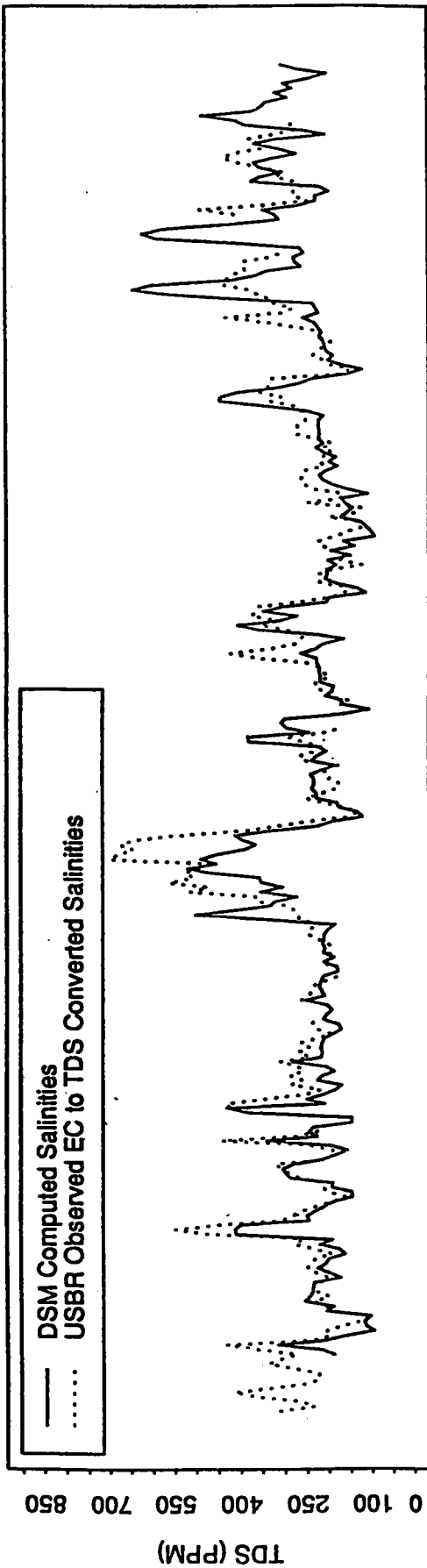


Salinity Verification at Victoria (Chnl 135)  
STATION NO. 14

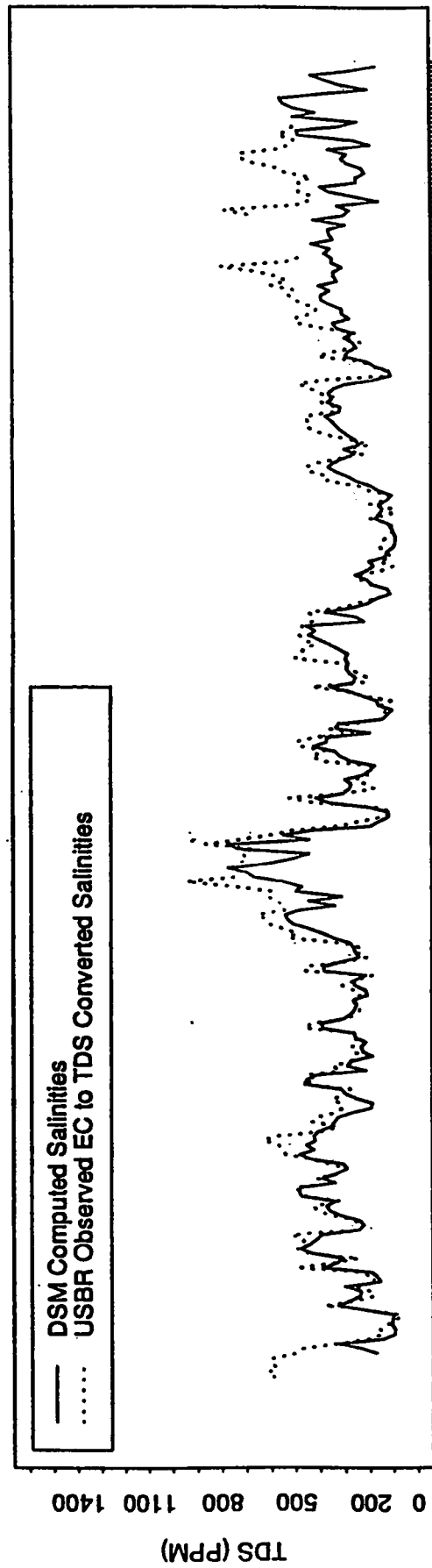




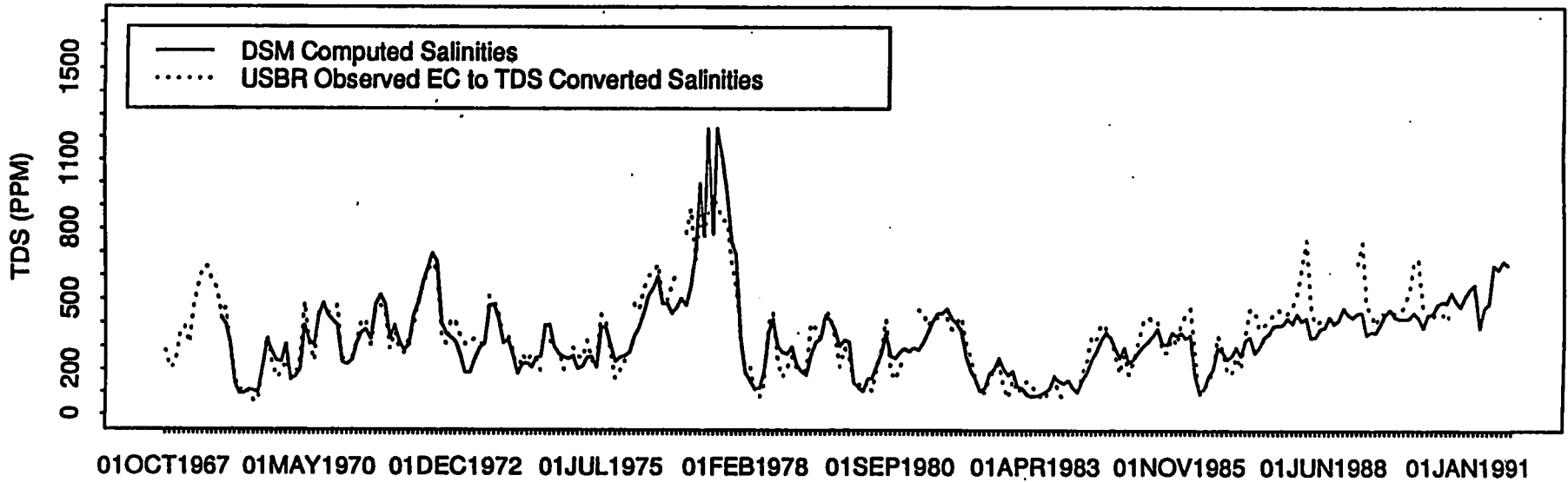
Salinity Verification at DMCHEAD (Chnl 216)  
STATION NO. 15



Salinity Verification at Union (Chnl 125)  
STATION NO. 16

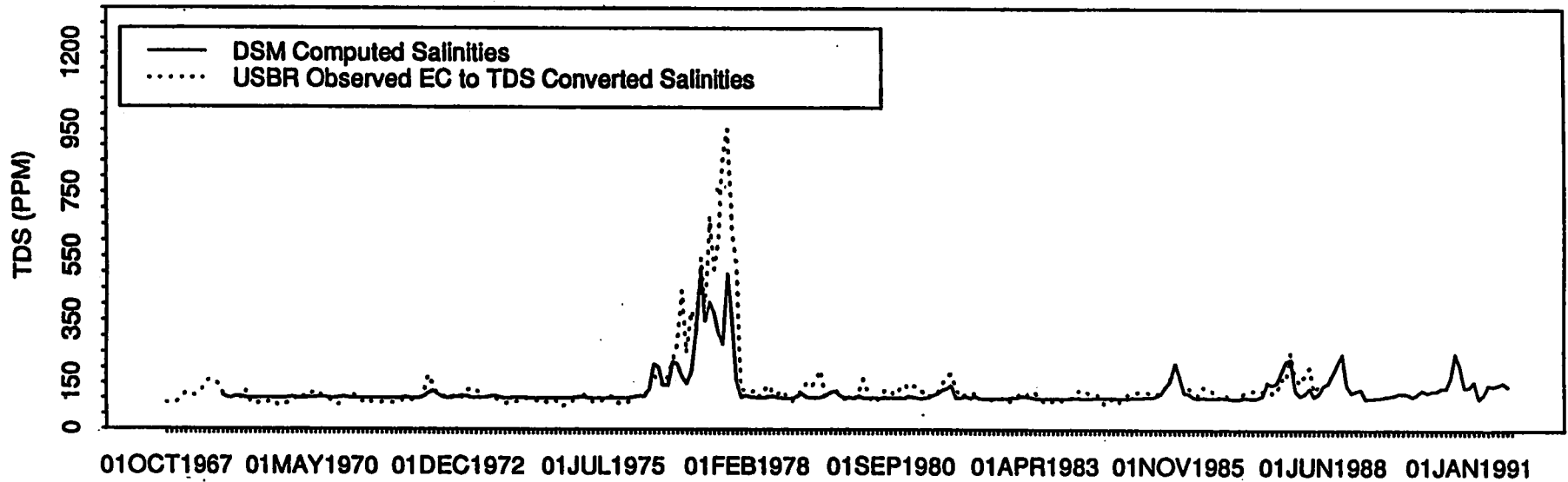


### Salinity Verification at Vernalis (Chnl 1) STATION NO. 17

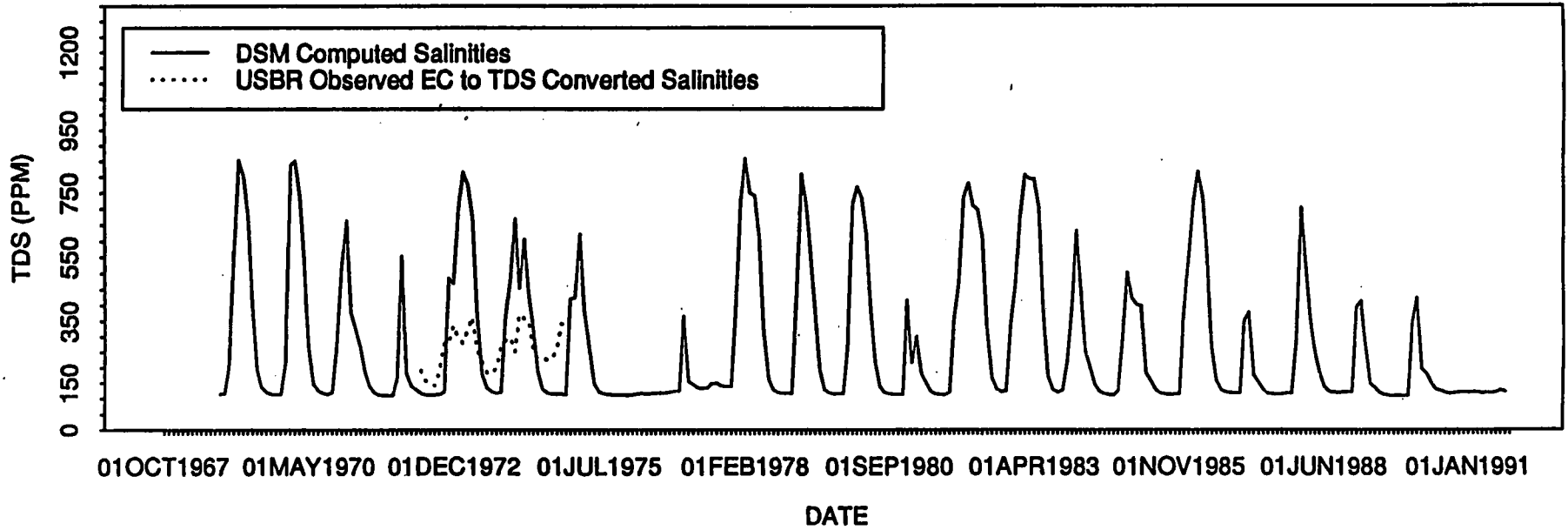


01-III-10

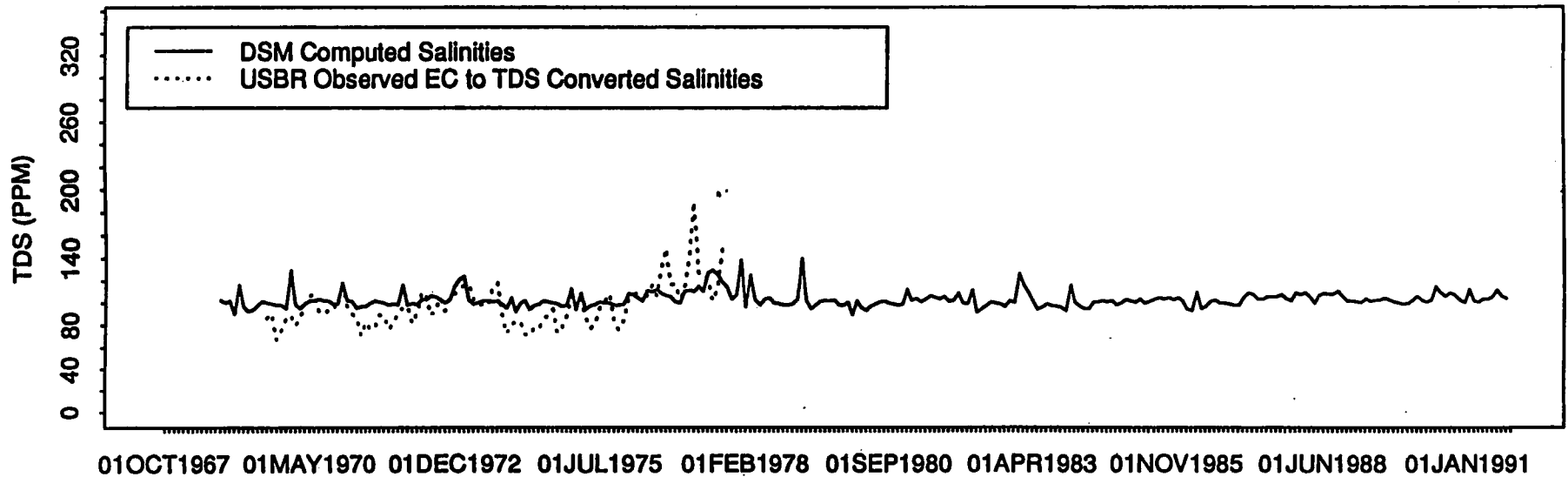
### Salinity Verification at Rio Vista (Chnl 430) STATION NO. 18



### Salinity Verification at Cache (Chnl 402) STATION NO. 19

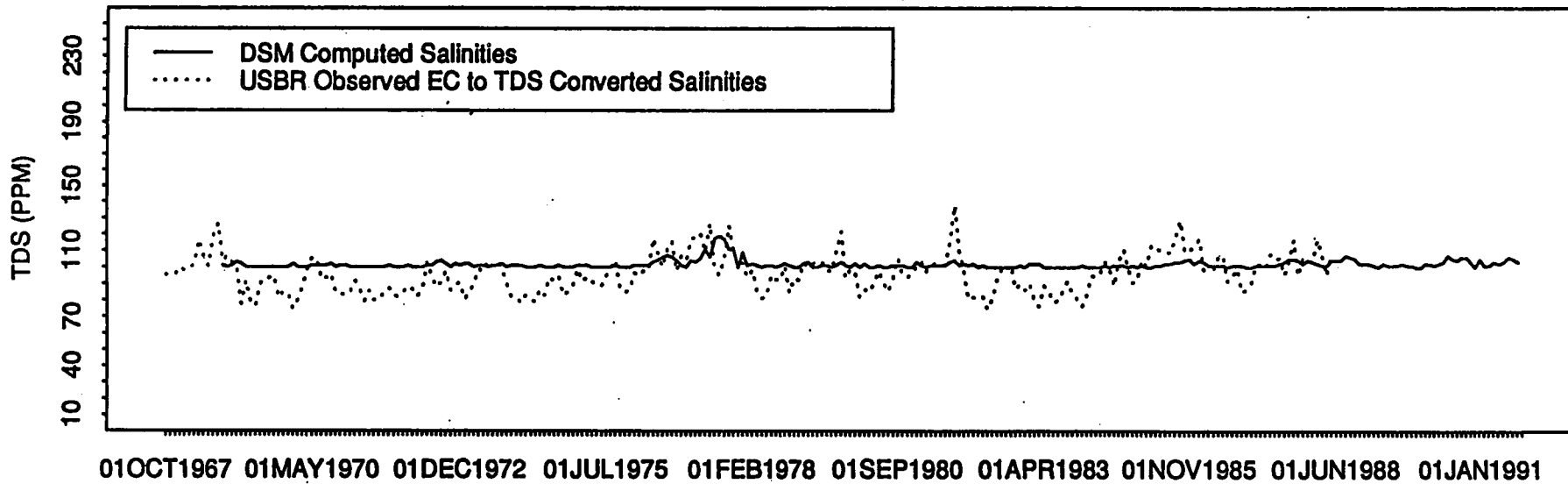


### Salinity Verification at Staten (Chnl 344) STATION NO. 20



AIII-11

# Salinity Verification at Greens (Chnl 418) STATION NO. 21



21-1111V

## Description of the DWR MDO Program

The Minimum Delta Outflow (MDO) computer program computes minimum Delta outflow requirements due to various water quality and flow standards in the Delta, and is run as a separate, adjunct program to the DWRSIM program.

MDO may be discussed in terms of two independent parts. The first part consists of those standards where salinity concentrations are generally a function of net Delta outflow (NDO) only, and not a function of export, for instance, a water quality standard at Emmaton. The second part of MDO are those standards which are considered to vary with net export as well as NDO; only Jersey Point, Rock Slough, and Clifton Court Forebay fall into this category. Contra Costa Water District Pumping #1 and Rock Slough are assumed to be the same by the MDO routine, even though in reality local drainage effects the Pumping Plant #1 quality. This second part of MDO is often referred to as the "Carriage Water" routine.

MDO produces two main tables, corresponding to the two different routines, for input to DWRSIM. The first table contains estimates of minimum required NDO by month and year over the desired study period (usually from 1922 to 1991). Water quality standards in the Delta are converted to NDO values by means of empirical relationships, while standards already in terms of NDO are used directly.

The second table consists of NDO estimates for the five different water year types, as a function of month and net export level. The net export is project pumping by Contra Costa, the SWP, and the Central Valley Project, minus San Joaquin and Eastside stream inflows.

Most of the second part of MDO was described by the DWR in Phase I testimony by Mike Ford, July 21, 1987, Volume VI, pp. 63-71, and in exhibits DWR-260 through DWR-264. That testimony described the method used to calculate the NDO required because of water quality standards at Rock Slough. In addition to that standard, there are standards at Clifton Court Forebay and at Jersey Point that are also considered to be a function of exports.

For Clifton Court Forebay, the standard is converted to a Rock Slough standard by a linear equation: 100 ppm Cl at Contra Costa Canal equals 70 ppm Cl at Clifton Court, and 250 ppm Cl at CCC equals 140 ppm Cl at Clifton Court. The Jersey Point standard is converted to a net Delta outflow requirement by means of a bilinear interpolation between both net export and water quality.

For each table, the NDO is computed for every standard in that table; whichever is highest controls for that day. The daily NDO requirements are averaged for each month, and that number output in the table. A minimum daily outflow of 2500 cfs is output if all the other standards produce a required outflow of less than that.

Output from both portions of the MDO program are read by DWRSIM as input tables. In any given month and year, DWRSIM uses data from the first table "as-is", since it is already listed by month and year. DWRSIM uses information from the second table (the "carriage water" table) by first determining the proper year type, then interpolating between net export levels to find the minimum required net Delta outflow. The minimum required net Delta outflow for the month is taken as the higher of either the first or second table. At that point, DWRSIM may modify its releases and/or exports so as to satisfy minimum outflow requirements and its internal rule curves. If exports are modified, then some iteration is required to arrive at a final Delta balance, because carriage water requirements are a function of export.

TABLE 7: BASE salinity (umhos/cm): 1995-Monterey-412

	Emmaton	J.P.	S.A.	Terminus	P.P.	B.C.	B.B.	OR@MR	OR@Tracy	Vernalis	
1987	October	1123	1071	207	169	203	356	358	360	481	364
	November	1504	2001	311	165	209	496	511	511	541	516
	December	1796	1832	300	162	205	448	467	467	485	474
	January	1160	2250	438	213	290	536	676	666	706	667
	February	343	885	248	207	223	630	708	677	739	675
	March	202	318	213	239	213	611	694	643	773	628
	April	348	421	180	172	172	594	613	596	640	593
	May	971	759	197	178	185	679	684	552	602	677
	June	1413	1566	294	172	209	572	747	730	790	722
	July	644	1783	436	172	288	421	683	759	933	751
	August	706	1630	396	171	272	366	747	762	882	751
	September	2111	2118	432	172	270	783	798	805	706	789
1988	October	2034	1821	302	172	217	793	805	808	557	805
	November	1892	1985	310	166	209	674	689	689	702	692
	December	715	1961	420	189	282	377	732	710	722	714
	January	254	574	406	332	359	390	810	768	805	764
	February	364	623	225	196	201	455	577	878	912	932
	March	850	1171	252	178	197	439	796	742	777	739
	April	651	1190	254	169	199	373	936	761	791	756
	May	1180	1154	235	175	193	793	822	485	593	813
	June	1514	1812	337	171	225	640	858	819	772	811
	July	655	1895	481	172	315	319	538	832	984	858
	August	1308	1830	390	174	264	331	939	880	786	865
	September	2814	2568	501	174	282	812	832	839	709	823
1989	October	2100	2243	357	174	239	713	718	722	658	716
	November	1872	2622	420	165	250	694	722	722	722	724
	December	1762	2677	467	168	280	484	754	754	765	756
	January	1288	2520	495	210	317	445	774	813	844	813
	February	1409	2337	469	199	302	390	545	995	022	1079
	March	210	564	235	201	209	258	820	711	745	709
	April	208	317	213	174	199	467	662	632	678	627
	May	363	288	172	174	180	684	700	552	605	690
	June	409	445	174	169	172	555	815	785	775	776
	July	441	1035	280	172	213	314	524	827	973	853
	August	418	1088	315	171	237	290	411	817	770	858
	September	628	1226	298	166	219	866	907	907	453	904
1990	October	1374	1636	292	168	207	785	791	791	443	791
	November	1626	2114	349	165	225	737	749	749	747	751
	December	847	2328	514	166	319	392	722	773	778	779
	January	496	1296	337	196	254	305	441	836	864	899
	February	694	1454	375	219	274	445	472	887	798	1025
	March	1044	1655	331	174	233	344	776	757	798	753
	April	900	1150	235	174	195	380	766	732	775	726
	May	1352	1190	233	169	187	830	864	414	501	860
	June	1575	1889	345	171	227	649	863	820	785	811
	July	1242	2226	436	174	276	421	717	868	879	860
	August	2766	2071	392	177	258	458	924	898	823	885
	September	3163	2889	520	174	286	793	810	817	752	801
1991	October	3414	2968	485	174	278	715	717	722	729	716
	November	2961	3779	635	169	333	727	734	732	760	732
	December	3237	3583	627	166	331	657	745	744	752	746
	January	2470	2203	373	216	268	730	890	883	907	882
	February	1852	2182	380	193	254	625	949	888	910	887
	March	254	740	430	226	349	278	909	810	843	795
	April	596	696	215	172	189	412	728	693	734	687
	May	1331	895	207	172	191	681	701	533	593	695
	June	1755	1405	268	169	197	558	834	819	678	811
	July	1847	1759	313	175	223	521	905	881	760	873
	August	1523	2186	396	174	252	446	905	907	829	892
	September	2086	2636	495	172	290	805	822	829	744	811
1992	October	3312	2339	378	165	239	773	796	796	645	796
	November	3195	3042	479	166	266	796	830	830	854	830
	December	2527	3584	621	165	335	569	766	762	770	766
	January	1886	3174	591	213	355	455	915	798	831	796
	February	263	700	298	213	254	564	562	558	656	558
	March	261	381	187	174	176	343	405	791	805	843
	April	763	897	215	172	181	361	710	681	719	677
	May	1459	1042	219	175	195	691	698	557	620	689
	June	1690	1681	298	171	209	584	834	812	786	803
	July	1876	1929	339	175	233	506	885	861	765	853
	August	2885	2188	386	175	245	575	904	880	773	867
	September	3789	3136	566	174	292	813	834	839	790	825

TABLE 8: PLAN salinity (umhos/cm): 1995-SWRCB-409

	Emmaton	J.P.	S.A.	Terminus	P.P.	B.C.	B.B.	OR@MR.	OR@Tracy	Vernalis	
1987	October	1461	1677	266	169	209	361	363	365	407	369
	November 1-15	1044	3012	812	165	392	496	511	511	541	516
	November 16-30	1294	2150	406	165	292	496	511	511	541	516
	December 1-15	1310	2621	743	165	380	448	467	467	485	474
	December 15-31	1758	2010	386	162	290	448	467	467	485	474
	January 1-15	970	3191	1050	242	574	479	672	666	702	667
	January 15-31	1174	2312	564	213	408	547	674	666	706	667
	February	331	1061	579	275	451	674	693	677	737	675
	March	204	322	231	238	223	601	706	643	775	628
	April	229	247	180	190	197	592	606	596	641	593
	May	359	434	189	189	223	637	637	611	508	632
	June	525	574	185	171	176	591	667	655	691	650
	July	412	1175	359	171	258	348	596	732	752	731
	August	624	1417	359	171	254	300	433	834	857	867
	September	1610	1853	380	172	250	781	798	805	791	789
1988	October	2030	2464	408	171	248	701	708	711	745	709
	November 1-15	1509	3484	891	168	414	681	689	516	742	692
	November 16-30	1938	2498	447	166	323	681	689	458	729	692
	December 1-15	824	3547	151	228	908	545	717	728	739	732
	December 15-31	824	2346	658	187	461	424	659	728	740	732
	January 1-15	329	1409	707	309	491	453	633	805	831	826
	January 15-31	272	602	243	242	246	504	626	805	836	826
	February	242	387	243	239	225	509	621	905	932	905
	March	341	519	217	205	195	638	754	742	778	739
	April	455	438	191	193	197	598	635	625	661	623
	May	583	670	213	184	245	628	633	569	518	630
	June	471	596	185	169	176	592	664	652	686	647
	July	567	1158	280	172	211	400	667	795	816	788
	August	1648	1745	351	174	239	365	941	880	902	865
	September	2878	2080	375	175	237	812	832	841	821	823
1989	October	3915	2762	443	177	266	643	645	649	706	645
	November 1-15	1849	4327	1096	169	508	735	773	771	780	773
	November 16-30	2258	2963	508	165	365	737	773	771	780	773
	December 1-15	1349	3845	1178	165	603	613	779	817	826	818
	December 15-31	1591	2617	544	168	388	504	798	817	828	818
	January 1-15	982	3227	1196	226	694	482	778	873	899	875
	January 15-31	1171	2343	579	207	428	456	706	868	899	875
	February	551	1691	700	234	483	414	715	885	915	887
	March	206	422	233	201	213	247	824	715	749	709
	April	195	218	176	174	180	530	586	574	621	571
	May	229	260	176	183	201	633	640	577	488	633
	June	446	419	174	169	172	591	659	645	683	640
	July	391	1099	345	171	252	283	422	773	805	842
	August	516	1441	418	171	288	281	373	785	821	858
	September	1386	1702	371	168	250	868	907	907	768	904
1990	October	2169	1817	302	168	213	706	710	711	737	712
	November 1-15	1708	2666	599	166	292	791	812	812	819	813
	November 16-30	2257	2002	341	165	258	793	812	812	819	813
	December 1-15	925	3414	1111	166	585	728	812	837	841	840
	December 15-31	1019	2241	505	166	363	569	795	836	841	840
	January 1-15	566	2305	1129	220	771	390	735	830	854	842
	January 15-31	573	1564	491	196	373	358	562	807	834	842
	February	320	774.	377	309	308	366	717	849	874	848
	March	425	659.	262	202	233	584	773	757	801	753
	April	272	392	195	180	195	586	642	632	676	627
	May	644	498	195	178	268	618	625	487	585	625
	June	473	610	185	169	174	523	723	705	735	697
	July	590	1146	272	172	207	348	584	854	867	860
	August	1650	1785	355	174	239	339	982	900	918	885
	September	2835	2110	380	175	239	791	810	817	806	801
1991	October	3930	2815	451	175	268	633	633	637	691	635
	November 1-15	2419	3902	942	172	418	751	761	761	796	759
	November 16-30	2999	2810	469	171	349	751	761	761	796	759
	December 1-15	1797	3875	1056	168	501	706	812	810	816	811
	December 15-31	2253	2762	520	166	377	674	812	810	816	811
	January 1-15	1383	3562	1098	211	572	643	864	948	963	947
	January 15-31	1701	2583	556	205	418	613	892	948	966	947
	February	622	1946	763	217	501	577	914	842	864	842
	March	231	477	323	225	284	285	847	805	839	795
	April	229	267	189	178	203	579	640	628	673	625
	May	667	542	195	184	243	626	635	582	508	632
	June	466	576	181	168	172	538	710	693	724	687
	July	548	1131	274	172	209	329	569	859	867	873
	August	1954	1273	272	177	213	371	932	905	925	892
	September	2684	2042	365	175	229	805	822	829	818	811
1992	October	3891	2957	467	165	258	696	711	711	745	712
	November 1-15	2880	3821	902	168	386	834	904	902	927	902



November16-30	3570	2951	483	166	339	856	904	902	930	902
December 1-15	1457	4259	1182	165	585	730	854	820	828	823
December15-31	1694	2777	524	165	380	606	829	820	826	823
January 1-15	1137	3291	1092	236	603	514	917	820	849	818
January 15-31	1391	2380	554	211	412	468	958	822	854	818
February	258	611	300	213	256	564	564	558	654	558
March	217	298	205	180	193	266	671	800	818	801
April	236	249	176	177	181	601	635	625	664	623
May	608	587	197	183	231	638	638	598	498	632
June	482	623	187	169	176	592	667	654	687	648
July	477	1184	321	172	235	336	584	788	810	793
August	1779	1369	300	175	225	354	914	880	902	867
September	2819	1887	335	174	223	812	834	839	816	825

TABLE 9: BASE 1995-MONTEREY-412; \*\*\* MINIMUM STAGE \*\*\*

	Emmaton	J.P.	S.A.	Terminous	P.P.	B.C.	B.B.	OREMR	OR@Tracy	Vernalis
1987										
October	0.76	1.54	1.95	1.84	1.89	1.72	6.70	2.57	2.58	12.65
November	0.74	1.52	1.96	1.84	1.90	1.70	3.79	2.04	1.85	7.99
December	0.74	1.54	1.98	1.85	1.91	1.72	3.24	2.72	2.17	8.43
January	0.75	1.52	1.95	1.85	1.89	1.69	2.56	2.19	1.91	5.63
February	0.77	1.54	1.97	1.91	1.91	1.73	2.57	2.18	1.92	5.62
March	0.85	1.59	2.03	1.96	1.98	1.79	2.72	2.34	2.03	6.20
April	0.76	1.53	1.95	1.86	1.90	1.70	2.70	2.26	1.90	6.46
May	0.75	1.54	1.97	1.83	1.90	1.69	3.86	1.68	2.29	6.39
June	0.74	1.53	1.95	1.81	1.88	1.67	2.52	2.34	2.50	5.09
July	0.75	1.50	1.90	1.82	1.84	1.65	2.36	2.14	2.26	4.77
August	0.75	1.50	1.91	1.81	1.85	1.65	2.41	2.20	2.35	4.88
September	0.74	1.53	1.95	1.80	1.88	1.67	3.30	1.77	2.38	5.30
1988										
October	0.75	1.56	1.98	1.84	1.92	1.71	3.33	1.80	2.51	5.26
November	0.74	1.55	1.98	1.84	1.91	1.71	3.23	1.77	1.72	5.86
December	0.76	1.52	1.93	1.85	1.87	1.69	2.46	2.09	1.85	5.23
January	0.82	1.54	1.96	1.87	1.90	1.71	2.43	2.08	1.86	4.87
February	0.75	1.51	1.92	1.84	1.87	1.68	2.28	1.95	1.77	3.97
March	0.74	1.53	1.96	1.84	1.89	1.69	2.47	2.10	1.85	5.05
April	0.76	1.53	1.96	1.86	1.90	1.70	2.45	2.08	1.83	4.92
May	0.75	1.54	1.97	1.83	1.90	1.69	3.46	1.69	2.32	5.28
June	0.74	1.52	1.95	1.81	1.88	1.67	2.44	2.27	2.47	4.48
July	0.75	1.50	1.90	1.82	1.84	1.64	2.27	2.05	2.21	4.09
August	0.74	1.53	1.94	1.81	1.87	1.65	2.40	2.22	2.46	4.26
September	0.74	1.54	1.95	1.80	1.88	1.67	3.24	1.78	2.40	5.12
1989										
October	0.75	1.55	1.97	1.83	1.90	1.70	3.50	1.79	2.44	5.85
November	0.74	1.53	1.97	1.84	1.90	1.70	3.15	1.72	1.69	5.58
December	0.74	1.53	1.96	1.83	1.90	1.69	2.48	2.11	1.88	4.94
January	0.74	1.52	1.96	1.84	1.89	1.69	2.41	2.07	1.85	4.58
February	0.74	1.53	1.96	1.84	1.89	1.69	2.32	1.99	1.82	3.62
March	0.91	1.61	2.04	2.00	1.98	1.80	2.52	2.15	1.91	5.23
April	0.78	1.52	1.92	1.82	1.86	1.66	2.57	2.16	1.83	6.06
May	0.76	1.55	1.99	1.87	1.92	1.72	3.82	1.70	2.30	6.25
June	0.75	1.54	1.97	1.85	1.91	1.70	2.48	2.30	2.49	4.70
July	0.75	1.50	1.90	1.82	1.84	1.64	2.27	2.05	2.22	4.12
August	0.76	1.50	1.89	1.81	1.82	1.62	2.29	2.08	2.21	4.18
September	0.75	1.51	1.91	1.81	1.85	1.66	3.13	1.68	2.24	4.77
1990										
October	0.75	1.53	1.96	1.83	1.89	1.68	3.33	1.74	2.39	5.32
November	0.74	1.53	1.97	1.84	1.90	1.70	3.11	1.70	1.68	5.41
December	0.75	1.51	1.93	1.84	1.87	1.68	2.37	2.02	1.81	4.72
January	0.76	1.52	1.94	1.87	1.88	1.70	2.33	1.99	1.81	4.11
February	0.75	1.51	1.94	1.84	1.87	1.68	2.24	1.91	1.74	3.64
March	0.74	1.52	1.96	1.84	1.89	1.69	2.45	2.09	1.86	4.94
April	0.75	1.54	1.99	1.86	1.92	1.72	2.54	2.17	1.91	5.18
May	0.75	1.54	1.97	1.83	1.90	1.70	3.40	1.73	2.41	5.07
June	0.74	1.52	1.95	1.81	1.88	1.67	2.43	2.26	2.46	4.48
July	0.74	1.51	1.94	1.82	1.87	1.66	2.36	2.18	2.39	4.17
August	0.74	1.55	1.97	1.82	1.90	1.69	2.51	2.36	2.63	4.26
September	0.74	1.53	1.95	1.81	1.88	1.68	3.29	1.81	2.43	5.25
1991										
October	0.74	1.55	1.97	1.82	1.90	1.70	3.50	1.81	2.48	5.85
November	0.74	1.53	1.96	1.83	1.90	1.69	3.14	1.72	1.69	5.54
December	0.74	1.54	1.97	1.83	1.91	1.70	2.54	2.18	1.95	5.03
January	0.74	1.55	2.00	1.85	1.93	1.73	2.52	2.22	2.03	4.35
February	0.74	1.54	1.98	1.85	1.91	1.71	2.45	2.13	1.94	4.28
March	0.82	1.55	1.97	1.89	1.91	1.73	2.38	2.03	1.82	4.63
April	0.75	1.53	1.95	1.84	1.89	1.70	2.54	2.17	1.90	5.47
May	0.75	1.55	1.98	1.83	1.91	1.70	3.80	1.71	2.35	6.21
June	0.74	1.55	1.97	1.82	1.90	1.69	2.51	2.34	2.56	4.53
July	0.74	1.54	1.96	1.82	1.89	1.68	2.44	2.27	2.50	4.18
August	0.74	1.52	1.95	1.82	1.88	1.67	2.41	2.25	2.49	4.15
September	0.74	1.52	1.94	1.81	1.87	1.66	3.25	1.75	2.35	5.17
1992										
October	0.74	1.55	1.98	1.83	1.91	1.71	3.35	1.87	2.55	5.31
November	0.74	1.54	1.98	1.83	1.91	1.71	3.03	1.74	1.73	4.95
December	0.74	1.53	1.96	1.83	1.89	1.69	2.47	2.10	1.87	4.88
January	0.74	1.52	1.96	1.84	1.89	1.69	2.44	2.09	1.87	4.69
February	0.85	1.59	2.02	1.95	1.96	1.78	2.92	2.47	2.08	7.04
March	0.77	1.53	1.95	1.89	1.90	1.71	2.36	2.02	1.82	4.38
April	0.75	1.53	1.95	1.84	1.89	1.70	2.56	2.19	1.91	5.56
May	0.75	1.55	1.98	1.83	1.91	1.70	3.81	1.70	2.35	6.26
June	0.74	1.54	1.96	1.82	1.89	1.68	2.47	2.29	2.49	4.54
July	0.74	1.54	1.96	1.82	1.89	1.68	2.45	2.28	2.50	4.27
August	0.74	1.55	1.97	1.82	1.90	1.69	2.52	2.36	2.62	4.34
September	0.74	1.54	1.96	1.81	1.89	1.68	3.25	1.83	2.46	5.12

TABLE 10: BASE 1995-MONTEREY-412; \*\*\* MAXIMUM STAGE \*\*\*

	Emmaton	J.P.	S.A.	Terminus	P.P.	B.C.	B.B.	OR@MR	OR@Tracy	Vernalis	
1987	October	6.21	5.53	5.34	5.63	5.45	5.71	7.66	5.11	4.61	12.79
	November	6.21	5.53	5.30	5.56	5.39	5.62	5.80	4.56	4.44	8.23
	December	6.20	5.53	5.31	5.56	5.39	5.61	5.63	5.05	4.81	8.71
	January	6.22	5.53	5.30	5.55	5.39	5.60	5.16	4.55	4.43	6.09
	February	6.25	5.55	5.34	5.59	5.43	5.65	5.18	4.47	4.33	6.06
	March	6.41	5.63	5.34	5.59	5.43	5.65	5.28	4.68	4.52	6.61
	April	6.23	5.53	5.32	5.58	5.41	5.65	5.41	4.96	4.86	6.92
	May	6.20	5.53	5.34	5.61	5.43	5.67	5.81	4.67	4.54	6.82
	June	6.22	5.53	5.32	5.59	5.41	5.64	5.28	4.84	4.66	5.86
	July	6.25	5.54	5.31	5.58	5.41	5.65	5.15	4.51	4.17	5.48
	August	6.24	5.53	5.31	5.58	5.41	5.65	5.18	4.57	4.24	5.58
	September	6.21	5.53	5.31	5.58	5.40	5.63	5.49	4.70	4.59	6.06
1988	October	6.20	5.52	5.31	5.57	5.40	5.62	5.48	5.07	5.02	6.03
	November	6.20	5.53	5.31	5.57	5.40	5.61	5.51	4.85	4.78	6.41
	December	6.23	5.53	5.30	5.55	5.39	5.60	5.08	4.39	4.27	5.72
	January	6.36	5.58	5.28	5.52	5.36	5.57	5.03	4.35	4.25	5.42
	February	6.23	5.52	5.30	5.54	5.38	5.60	4.93	4.21	4.15	4.78
	March	6.21	5.53	5.30	5.55	5.39	5.60	5.11	4.61	4.53	5.64
	April	6.22	5.53	5.32	5.58	5.41	5.64	5.22	4.71	4.73	5.70
	May	6.20	5.53	5.33	5.60	5.43	5.66	5.54	4.69	4.57	6.09
	June	6.22	5.53	5.32	5.59	5.41	5.64	5.22	4.71	4.59	5.47
	July	6.25	5.54	5.31	5.58	5.41	5.65	5.07	4.35	4.09	5.01
	August	6.22	5.53	5.31	5.57	5.40	5.63	5.17	4.64	4.56	5.30
	September	6.21	5.52	5.30	5.57	5.40	5.63	5.45	4.73	4.69	5.93
1989	October	6.20	5.52	5.31	5.58	5.41	5.63	5.61	4.74	4.70	6.46
	November	6.21	5.53	5.30	5.55	5.39	5.60	5.44	4.65	4.57	6.17
	December	6.21	5.53	5.30	5.55	5.38	5.59	5.12	4.67	4.60	5.59
	January	6.22	5.53	5.30	5.55	5.39	5.60	5.04	4.48	4.42	5.26
	February	6.21	5.53	5.30	5.55	5.39	5.60	4.98	4.48	4.45	4.82
	March	6.47	5.66	5.38	5.62	5.46	5.68	5.14	4.42	4.30	5.73
	April	6.31	5.54	5.25	5.49	5.34	5.57	5.27	4.79	4.71	6.54
	May	6.22	5.54	5.36	5.64	5.46	5.70	5.80	4.69	4.56	6.74
	June	6.23	5.54	5.35	5.62	5.44	5.68	5.27	4.77	4.63	5.62
	July	6.25	5.54	5.31	5.58	5.41	5.65	5.08	4.36	4.09	5.03
	August	6.25	5.53	5.31	5.58	5.41	5.65	5.09	4.36	4.07	5.07
	September	6.24	5.53	5.31	5.58	5.41	5.66	5.40	4.53	4.24	5.67
1990	October	6.21	5.52	5.31	5.57	5.40	5.63	5.50	4.67	4.52	6.08
	November	6.21	5.53	5.30	5.55	5.39	5.60	5.41	4.67	4.60	6.03
	December	6.23	5.52	5.29	5.54	5.38	5.59	5.01	4.33	4.24	5.30
	January	6.24	5.53	5.31	5.56	5.40	5.61	4.96	4.26	4.21	4.89
	February	6.22	5.52	5.29	5.54	5.38	5.59	4.90	4.21	4.17	4.62
	March	6.22	5.53	5.30	5.55	5.39	5.60	5.08	4.57	4.49	5.54
	April	6.21	5.53	5.32	5.58	5.42	5.65	5.30	4.91	4.93	5.97
	May	6.20	5.53	5.33	5.60	5.43	5.66	5.50	4.76	4.65	5.94
	June	6.22	5.53	5.32	5.59	5.41	5.64	5.22	4.71	4.59	5.46
	July	6.23	5.53	5.31	5.58	5.41	5.65	5.16	4.58	4.41	5.22
	August	6.21	5.53	5.31	5.58	5.40	5.63	5.25	4.99	4.95	5.50
	September	6.21	5.53	5.31	5.58	5.40	5.63	5.48	4.78	4.70	6.02
1991	October	6.19	5.52	5.30	5.57	5.40	5.62	5.60	4.85	4.82	6.46
	November	6.20	5.52	5.30	5.55	5.38	5.59	5.43	4.71	4.64	6.13
	December	6.20	5.52	5.29	5.55	5.38	5.59	5.17	4.88	4.83	5.75
	January	6.20	5.53	5.31	5.56	5.40	5.61	5.16	4.94	4.91	5.44
	February	6.21	5.53	5.30	5.55	5.39	5.60	5.09	4.76	4.72	5.28
	March	6.38	5.59	5.30	5.54	5.38	5.60	5.00	4.28	4.18	5.22
	April	6.21	5.53	5.30	5.57	5.40	5.63	5.29	4.89	4.89	6.13
	May	6.20	5.53	5.33	5.60	5.43	5.66	5.76	4.72	4.67	6.70
	June	6.21	5.53	5.31	5.58	5.41	5.64	5.24	4.98	4.92	5.61
	July	6.21	5.53	5.31	5.58	5.41	5.63	5.20	4.85	4.79	5.38
	August	6.22	5.53	5.31	5.59	5.41	5.65	5.20	4.66	4.51	5.25
	September	6.22	5.53	5.31	5.58	5.41	5.64	5.47	4.67	4.50	5.97
1992	October	6.19	5.52	5.31	5.58	5.40	5.63	5.50	4.94	4.89	6.08
	November	6.20	5.52	5.30	5.55	5.39	5.60	5.34	4.88	4.83	5.72
	December	6.21	5.52	5.29	5.54	5.38	5.59	5.12	4.71	4.65	5.57
	January	6.21	5.53	5.30	5.55	5.38	5.59	5.07	4.56	4.50	5.37
	February	6.40	5.62	5.35	5.59	5.43	5.65	5.40	4.67	4.45	7.37
	March	6.25	5.54	5.33	5.58	5.42	5.63	5.01	4.29	4.21	5.06
	April	6.21	5.53	5.30	5.57	5.40	5.63	5.31	4.92	4.92	6.20
	May	6.20	5.52	5.33	5.60	5.42	5.66	5.77	4.72	4.68	6.73
	June	6.21	5.53	5.31	5.58	5.41	5.64	5.23	4.81	4.71	5.54
	July	6.21	5.53	5.31	5.58	5.41	5.64	5.21	4.83	4.76	5.42
	August	6.21	5.53	5.31	5.58	5.40	5.63	5.25	5.00	4.96	5.54
	September	6.20	5.53	5.31	5.58	5.40	5.63	5.46	4.85	4.77	5.94

TABLE 11: BASE 1995-MONTEREY-412; \*\*\* AVERAGE MONTHLY STAGE \*\*\*

	Emmaton	J.P.	S.A.	Terminous	P.P.	B.C.	B.B.	OR@MR	OR@Tracy	Vernalis
1987										
October	3.48	3.54	3.59	3.63	3.59	3.61	7.07	3.53	3.41	12.71
November	3.48	3.53	3.57	3.60	3.56	3.57	4.58	3.26	3.12	8.08
December	3.47	3.53	3.58	3.61	3.58	3.58	4.26	3.81	3.46	8.54
January	3.48	3.52	3.56	3.60	3.56	3.55	3.72	3.30	3.12	5.81
February	3.51	3.55	3.59	3.65	3.59	3.58	3.72	3.23	3.04	5.79
March	3.59	3.59	3.62	3.67	3.62	3.61	3.86	3.42	3.21	6.36
April	3.49	3.53	3.57	3.61	3.57	3.56	3.86	3.43	3.19	6.63
May	3.48	3.54	3.58	3.62	3.58	3.59	4.59	3.24	3.35	6.56
June	3.48	3.53	3.57	3.60	3.57	3.56	3.73	3.59	3.53	5.37
July	3.49	3.53	3.55	3.59	3.54	3.53	3.55	3.21	3.09	5.02
August	3.49	3.52	3.55	3.59	3.54	3.53	3.59	3.27	3.18	5.12
September	3.47	3.53	3.56	3.59	3.56	3.56	4.19	3.31	3.42	5.57
1988										
October	3.47	3.54	3.58	3.61	3.58	3.58	4.21	3.40	3.60	5.54
November	3.47	3.53	3.58	3.61	3.58	3.58	4.18	3.34	3.27	6.05
December	3.49	3.53	3.56	3.60	3.55	3.54	3.62	3.15	2.98	5.41
January	3.56	3.55	3.56	3.59	3.56	3.55	3.59	3.13	2.98	5.07
February	3.49	3.52	3.55	3.59	3.55	3.53	3.46	3.02	2.91	4.26
March	3.48	3.53	3.56	3.60	3.56	3.55	3.67	3.34	3.20	5.28
April	3.49	3.53	3.57	3.61	3.57	3.56	3.65	3.32	3.16	5.19
May	3.48	3.53	3.58	3.61	3.58	3.58	4.28	3.26	3.38	5.58
June	3.48	3.53	3.57	3.60	3.56	3.56	3.66	3.52	3.48	4.85
July	3.49	3.52	3.54	3.59	3.54	3.52	3.46	3.12	3.04	4.40
August	3.48	3.53	3.56	3.59	3.56	3.55	3.64	3.47	3.47	4.66
September	3.47	3.53	3.56	3.59	3.56	3.56	4.15	3.36	3.49	5.41
1989										
October	3.47	3.53	3.58	3.61	3.58	3.58	4.33	3.34	3.50	6.08
November	3.47	3.53	3.57	3.60	3.56	3.56	4.11	3.21	3.15	5.79
December	3.48	3.53	3.56	3.60	3.56	3.55	3.68	3.38	3.25	5.20
January	3.48	3.52	3.56	3.60	3.56	3.55	3.60	3.24	3.11	4.83
February	3.48	3.53	3.56	3.60	3.56	3.55	3.54	3.25	3.16	4.09
March	3.63	3.62	3.65	3.70	3.64	3.63	3.69	3.20	3.03	5.42
April	3.53	3.53	3.53	3.56	3.53	3.52	3.72	3.26	3.02	6.23
May	3.49	3.55	3.61	3.65	3.61	3.61	4.57	3.26	3.37	6.44
June	3.49	3.55	3.59	3.63	3.59	3.58	3.71	3.56	3.51	5.04
July	3.50	3.52	3.54	3.59	3.54	3.52	3.47	3.12	3.04	4.43
August	3.50	3.52	3.54	3.59	3.54	3.52	3.47	3.08	3.01	4.48
September	3.49	3.53	3.55	3.60	3.55	3.54	4.06	2.98	3.08	5.09
1990										
October	3.48	3.53	3.57	3.60	3.57	3.56	4.20	3.22	3.37	5.59
November	3.47	3.53	3.57	3.60	3.57	3.56	4.08	3.22	3.16	5.63
December	3.49	3.52	3.55	3.59	3.54	3.53	3.55	3.11	2.97	4.94
January	3.50	3.53	3.56	3.61	3.56	3.55	3.50	3.06	2.95	4.40
February	3.49	3.52	3.55	3.59	3.54	3.53	3.44	3.03	2.94	4.00
March	3.48	3.52	3.56	3.60	3.56	3.55	3.64	3.30	3.16	5.17
April	3.48	3.54	3.59	3.62	3.59	3.58	3.75	3.50	3.35	5.46
May	3.48	3.54	3.58	3.61	3.58	3.58	4.23	3.30	3.46	5.40
June	3.48	3.53	3.57	3.60	3.56	3.56	3.66	3.51	3.47	4.84
July	3.48	3.53	3.56	3.59	3.56	3.54	3.58	3.38	3.33	4.55
August	3.47	3.53	3.58	3.60	3.58	3.58	3.75	3.69	3.71	4.76
September	3.47	3.53	3.57	3.59	3.57	3.57	4.18	3.38	3.51	5.53
1991										
October	3.47	3.53	3.58	3.60	3.57	3.58	4.33	3.40	3.57	6.07
November	3.47	3.52	3.56	3.59	3.56	3.56	4.10	3.25	3.19	5.75
December	3.47	3.53	3.57	3.59	3.57	3.56	3.75	3.53	3.40	5.32
January	3.47	3.54	3.59	3.62	3.59	3.59	3.74	3.58	3.49	4.78
February	3.47	3.53	3.58	3.61	3.57	3.57	3.67	3.44	3.35	4.67
March	3.57	3.56	3.58	3.62	3.57	3.56	3.55	3.08	2.94	4.85
April	3.48	3.53	3.57	3.60	3.56	3.56	3.72	3.39	3.21	5.70
May	3.47	3.54	3.59	3.62	3.59	3.59	4.54	3.32	3.46	6.40
June	3.47	3.54	3.58	3.61	3.58	3.58	3.75	3.66	3.65	4.96
July	3.47	3.53	3.58	3.60	3.57	3.57	3.69	3.59	3.58	4.67
August	3.48	3.53	3.56	3.60	3.56	3.55	3.62	3.45	3.43	4.54
September	3.47	3.53	3.56	3.59	3.56	3.56	4.15	3.25	3.35	5.46
1992										
October	3.47	3.53	3.58	3.61	3.58	3.59	4.22	3.46	3.64	5.59
November	3.47	3.53	3.57	3.60	3.57	3.57	4.02	3.35	3.30	5.23
December	3.47	3.52	3.56	3.59	3.56	3.55	3.68	3.40	3.28	5.15
January	3.48	3.52	3.56	3.60	3.56	3.55	3.63	3.30	3.18	4.95
February	3.58	3.59	3.63	3.67	3.62	3.62	3.99	3.45	3.16	7.16
March	3.51	3.54	3.58	3.63	3.58	3.56	3.54	3.08	2.95	4.62
April	3.48	3.53	3.57	3.60	3.56	3.56	3.74	3.41	3.23	5.78
May	3.47	3.54	3.59	3.62	3.59	3.59	4.55	3.32	3.46	6.44
June	3.47	3.53	3.57	3.60	3.57	3.57	3.71	3.59	3.56	4.93
July	3.47	3.53	3.57	3.60	3.57	3.57	3.69	3.59	3.58	4.73
August	3.47	3.53	3.58	3.60	3.58	3.57	3.76	3.69	3.70	4.82
September	3.47	3.53	3.57	3.59	3.57	3.57	4.16	3.42	3.55	5.42

TABLE 12: PLAN 1995-SWRCB-409; \*\*\* MINIMUM STAGE \*\*\*

	Emmaton	J.P.	S.A.	Terminus	P.P.	B.C.	B.B.	OR@MR	OR@Tracy	Vernalis	
1987	October	0.75	1.53	1.93	1.81	1.87	1.69	6.54	2.38	2.10	12.40
	November 1-15	0.74	1.51	1.95	1.81	1.88	1.68	3.77	2.02	1.84	7.99
	November16-30	0.75	1.53	1.97	1.85	1.91	1.71	3.79	2.05	1.86	7.99
	December 1-15	0.74	1.53	1.97	1.83	1.90	1.70	3.24	2.73	2.18	8.44
	December15-31	0.74	1.54	1.98	1.85	1.92	1.72	3.24	2.73	2.17	8.43
	January 1-15	0.75	1.51	1.93	1.81	1.87	1.67	2.54	2.17	1.89	5.63
	January 15-31	0.75	1.53	1.96	1.85	1.90	1.70	2.57	2.20	1.92	5.64
	February	0.78	1.53	1.96	1.86	1.90	1.71	2.57	2.19	1.92	5.62
	March	0.85	1.57	2.00	1.93	1.94	1.76	2.68	2.29	1.99	6.19
	April	0.77	1.58	2.03	1.90	1.97	1.77	2.84	2.46	2.11	6.52
	May	0.76	1.55	1.99	1.85	1.93	1.73	4.09	1.72	1.89	6.92
	June	0.75	1.53	1.97	1.85	1.90	1.69	2.62	2.37	2.11	5.74
	July	0.75	1.49	1.86	1.78	1.79	1.58	2.28	2.03	1.79	4.87
	August	0.75	1.50	1.90	1.81	1.84	1.64	2.29	2.03	1.87	4.15
	September	0.74	1.53	1.94	1.81	1.87	1.66	3.29	1.67	1.81	5.30
1988	October	0.74	1.53	1.96	1.82	1.89	1.68	3.50	1.71	1.86	5.89
	November 1-15	0.74	1.54	1.96	1.82	1.90	1.69	3.21	1.75	1.70	5.85
	November16-30	0.74	1.55	1.98	1.85	1.91	1.71	3.23	1.77	1.72	5.86
	December 1-15	0.75	1.49	1.88	1.78	1.82	1.64	2.38	2.01	1.78	5.05
	December15-31	0.75	1.51	1.92	1.84	1.86	1.68	2.42	2.04	1.82	5.07
	January 1-15	0.81	1.53	1.94	1.85	1.88	1.70	2.36	2.01	1.81	4.47
	January 15-31	0.81	1.57	2.00	1.98	1.95	1.77	2.42	2.07	1.88	4.50
	February	0.77	1.54	1.99	1.87	1.93	1.74	2.46	2.20	2.03	4.21
	March	0.76	1.56	2.00	1.86	1.93	1.73	2.57	2.24	2.00	5.11
	April	0.76	1.58	2.03	1.89	1.97	1.77	2.80	2.45	2.13	6.16
	May	0.75	1.56	2.00	1.85	1.93	1.73	4.12	1.74	1.92	6.95
	June	0.75	1.54	1.98	1.86	1.91	1.70	2.63	2.38	2.12	5.77
	July	0.75	1.51	1.93	1.82	1.86	1.65	2.34	2.08	1.88	4.54
	August	0.74	1.54	1.95	1.81	1.88	1.67	2.44	2.19	2.00	4.28
	September	0.74	1.55	1.97	1.82	1.90	1.70	3.26	1.78	1.94	5.13
1989	October	0.74	1.55	1.98	1.82	1.91	1.71	3.71	1.83	1.97	6.51
	November 1-15	0.74	1.53	1.97	1.83	1.90	1.70	3.08	1.74	1.72	5.25
	November16-30	0.74	1.55	1.99	1.85	1.92	1.72	3.10	1.76	1.74	5.27
	December 1-15	0.74	1.53	1.95	1.81	1.89	1.68	2.42	2.06	1.85	4.57
	December15-31	0.75	1.54	1.97	1.85	1.91	1.70	2.45	2.09	1.87	4.59
	January 1-15	0.75	1.51	1.93	1.80	1.87	1.66	2.35	2.01	1.82	4.25
	January 15-31	0.75	1.53	1.96	1.85	1.90	1.69	2.38	2.05	1.85	4.27
	February	0.76	1.54	1.97	1.84	1.90	1.70	2.41	2.07	1.87	4.25
	March	0.89	1.60	2.02	1.97	1.96	1.78	2.49	2.11	1.88	5.22
	April	0.81	1.59	2.05	1.94	1.99	1.79	2.89	2.48	2.10	6.82
	May	0.77	1.56	2.00	1.87	1.93	1.73	4.08	1.70	1.86	6.90
	June	0.75	1.53	1.97	1.85	1.90	1.70	2.63	2.38	2.12	5.85
	July	0.75	1.49	1.85	1.78	1.79	1.58	2.17	1.93	1.74	4.10
	August	0.75	1.49	1.86	1.77	1.79	1.58	2.21	1.97	1.79	4.13
	September	0.74	1.52	1.95	1.81	1.88	1.67	3.14	1.70	1.87	4.78
1990	October	0.74	1.54	1.98	1.83	1.91	1.71	3.52	1.81	1.97	5.88
	November 1-15	0.74	1.55	1.99	1.84	1.92	1.72	3.06	1.75	1.74	5.06
	November16-30	0.75	1.56	2.00	1.85	1.93	1.73	3.08	1.77	1.75	5.07
	December 1-15	0.75	1.51	1.93	1.80	1.87	1.66	2.36	2.01	1.81	4.40
	December15-31	0.75	1.53	1.97	1.85	1.90	1.70	2.40	2.05	1.84	4.43
	January 1-15	0.76	1.49	1.88	1.77	1.82	1.63	2.28	1.94	1.75	4.33
	January 15-31	0.76	1.51	1.93	1.85	1.87	1.68	2.33	1.98	1.79	4.36
	February	0.78	1.56	2.00	1.88	1.93	1.73	2.44	2.11	1.90	4.40
	March	0.75	1.56	2.00	1.86	1.94	1.74	2.56	2.23	2.00	5.01
	April	0.77	1.58	2.03	1.90	1.97	1.77	2.77	2.41	2.09	6.13
	May	0.75	1.57	2.01	1.86	1.94	1.75	4.19	1.80	2.00	7.05
	June	0.75	1.55	1.97	1.85	1.90	1.69	2.53	2.26	2.02	5.28
	July	0.74	1.51	1.93	1.82	1.86	1.65	2.30	2.05	1.87	4.13
	August	0.74	1.54	1.95	1.81	1.88	1.67	2.41	2.16	1.99	4.18
	September	0.74	1.54	1.97	1.82	1.90	1.70	3.30	1.80	1.95	5.25
1991	October	0.74	1.55	1.98	1.82	1.91	1.71	3.75	1.83	1.97	6.63
	November 1-15	0.74	1.55	1.98	1.83	1.92	1.72	3.13	1.77	1.74	5.37
	November16-30	0.74	1.56	2.00	1.85	1.93	1.73	3.14	1.78	1.76	5.38
	December 1-15	0.74	1.54	1.97	1.82	1.90	1.69	2.48	2.11	1.88	4.64
	December15-31	0.75	1.56	1.98	1.84	1.92	1.71	2.50	2.13	1.90	4.65
	January 1-15	0.74	1.53	1.96	1.81	1.89	1.68	2.39	2.04	1.85	4.01
	January 15-31	0.75	1.55	1.98	1.85	1.91	1.71	2.41	2.07	1.87	4.03
	February	0.76	1.54	1.97	1.84	1.91	1.70	2.44	2.09	1.87	4.46
	March	0.83	1.55	1.97	1.90	1.91	1.73	2.38	2.02	1.81	4.62
	April	0.77	1.58	2.04	1.91	1.98	1.78	2.78	2.41	2.10	6.14
	May	0.75	1.56	2.00	1.85	1.93	1.73	4.10	1.75	1.92	6.94
	June	0.75	1.55	1.98	1.86	1.91	1.70	2.56	2.30	2.06	5.38
	July	0.75	1.51	1.93	1.82	1.86	1.64	2.28	2.03	1.85	4.05
	August	0.74	1.56	1.98	1.83	1.91	1.71	2.51	2.30	2.13	4.23
	September	0.74	1.54	1.96	1.81	1.90	1.69	3.27	1.77	1.92	5.19
1992	October	0.74	1.54	1.97	1.82	1.90	1.70	3.52	1.80	1.98	5.89
	November 1-15	0.74	1.55	1.99	1.84	1.92	1.73	2.98	1.76	1.76	4.65

November16-30	0.74	1.56	2.00	1.85	1.93	1.73	3.00	1.77	1.77	4.67
December 1-15	0.75	1.53	1.96	1.82	1.89	1.68	2.43	2.07	1.85	4.55
December15-31	0.75	1.55	1.98	1.85	1.91	1.71	2.46	2.10	1.88	4.56
January 1-15	0.74	1.52	1.95	1.81	1.88	1.68	2.41	2.07	1.85	4.56
January 15-31	0.75	1.53	1.97	1.85	1.90	1.70	2.44	2.09	1.88	4.57
February	0.84	1.58	2.00	1.94	1.95	1.77	2.90	2.44	2.05	7.03
March	0.78	1.56	2.00	1.90	1.94	1.74	2.48	2.15	1.93	4.68
April	0.77	1.58	2.04	1.91	1.98	1.78	2.79	2.43	2.12	6.17
May	0.75	1.55	1.99	1.84	1.93	1.73	4.08	1.73	1.90	6.92
June	0.75	1.53	1.97	1.86	1.91	1.70	2.61	2.36	2.10	5.75
July	0.75	1.50	1.89	1.81	1.83	1.64	2.29	2.02	1.83	4.46
August	0.74	1.55	1.97	1.82	1.90	1.69	2.48	2.26	2.09	4.32
September	0.74	1.55	1.97	1.82	1.91	1.70	3.26	1.82	1.97	5.13

TABLE 13: PLAN 1995-SWRCB-409; \*\*\* MAXIMUM STAGE \*\*\*

	Emmaton	J.P.	S.A.	Terminus	P.P.	B.C.	B.B.	OR@MR	OR@Tracy	Vernalis	
1987	October	6.20	5.52	5.33	5.61	5.43	5.69	7.53	5.00	4.47	12.54
	November 1-15	6.23	5.52	5.24	5.47	5.32	5.54	5.73	4.50	4.38	8.21
	November16-30	6.21	5.53	5.32	5.57	5.40	5.63	5.81	4.57	4.45	8.23
	December 1-15	6.22	5.52	5.24	5.48	5.33	5.54	5.57	5.00	4.77	8.70
	December15-31	6.20	5.53	5.31	5.56	5.40	5.61	5.63	5.06	4.83	8.71
	January 1-15	6.24	5.51	5.22	5.45	5.30	5.51	5.09	4.52	4.40	6.07
	January 15-31	6.22	5.53	5.30	5.55	5.39	5.60	5.17	4.59	4.47	6.10
	February	6.29	5.55	5.26	5.49	5.34	5.55	5.12	4.52	4.39	6.07
	March	6.41	5.61	5.32	5.56	5.40	5.62	5.24	4.56	4.39	6.57
	April	6.25	5.55	5.30	5.55	5.39	5.62	5.52	5.32	5.27	7.05
	May	6.23	5.53	5.30	5.55	5.39	5.64	5.85	4.75	4.64	7.23
	June	6.23	5.54	5.34	5.61	5.44	5.68	5.38	4.98	4.65	6.35
	July	6.26	5.53	5.29	5.56	5.39	5.63	5.10	4.40	3.94	5.51
	August	6.24	5.53	5.31	5.57	5.40	5.64	5.09	4.38	4.11	5.06
	September	6.22	5.53	5.31	5.58	5.41	5.63	5.48	4.57	4.47	6.05
1988	October	6.20	5.52	5.31	5.57	5.40	5.63	5.61	4.65	4.48	6.48
	November 1-15	6.22	5.51	5.25	5.48	5.33	5.54	5.44	4.76	4.69	6.37
	November16-30	6.21	5.53	5.31	5.57	5.40	5.61	5.51	4.83	4.75	6.40
	December 1-15	6.26	5.50	5.20	5.43	5.28	5.48	4.95	4.23	4.11	5.52
	December15-31	6.23	5.52	5.29	5.54	5.38	5.59	5.04	4.31	4.20	5.56
	January 1-15	6.36	5.57	5.26	5.50	5.34	5.56	4.95	4.22	4.14	5.08
	January 15-31	6.30	5.58	5.38	5.63	5.47	5.69	5.06	4.33	4.25	5.15
	February	6.28	5.55	5.27	5.50	5.35	5.56	5.02	4.67	4.64	5.18
	March	6.24	5.53	5.27	5.50	5.35	5.56	5.18	4.96	4.91	5.83
	April	6.22	5.53	5.29	5.54	5.38	5.61	5.48	5.31	5.29	6.78
	May	6.22	5.53	5.30	5.55	5.39	5.63	5.86	4.80	4.71	7.26
	June	6.23	5.55	5.35	5.62	5.45	5.69	5.39	4.99	4.64	6.37
	July	6.24	5.54	5.31	5.58	5.41	5.65	5.13	4.49	4.22	5.34
	August	6.21	5.52	5.30	5.56	5.39	5.62	5.15	4.89	4.80	5.41
	September	6.21	5.53	5.31	5.58	5.41	5.64	5.46	4.87	4.80	5.94
1989	October	6.19	5.52	5.31	5.57	5.40	5.63	5.75	4.87	4.80	6.95
	November 1-15	6.22	5.52	5.25	5.48	5.33	5.54	5.34	4.78	4.71	5.90
	November16-30	6.21	5.53	5.31	5.57	5.40	5.61	5.40	4.84	4.78	5.94
	December 1-15	6.23	5.51	5.23	5.46	5.31	5.52	5.03	4.64	4.59	5.35
	December15-31	6.21	5.53	5.31	5.56	5.40	5.61	5.10	4.70	4.65	5.40
	January 1-15	6.24	5.52	5.22	5.45	5.30	5.51	4.94	4.41	4.36	5.04
	January 15-31	6.22	5.53	5.31	5.55	5.39	5.60	5.02	4.48	4.43	5.09
	February	6.25	5.53	5.25	5.48	5.33	5.54	5.01	4.61	4.57	5.16
	March	6.46	5.65	5.35	5.60	5.44	5.66	5.11	4.36	4.23	5.70
	April	6.33	5.59	5.34	5.59	5.43	5.67	5.56	5.30	5.23	7.30
	May	6.25	5.54	5.31	5.57	5.41	5.65	5.86	4.72	4.58	7.22
	June	6.23	5.54	5.35	5.62	5.44	5.68	5.40	5.00	4.66	6.43
	July	6.26	5.53	5.29	5.56	5.39	5.63	5.01	4.21	3.84	4.95
	August	6.25	5.52	5.29	5.55	5.39	5.63	5.04	4.26	3.91	4.99
	September	6.22	5.53	5.31	5.58	5.41	5.64	5.39	4.65	4.45	5.68
1990	October	6.20	5.53	5.31	5.58	5.41	5.64	5.63	4.86	4.68	6.49
	November 1-15	6.21	5.52	5.25	5.49	5.34	5.56	5.33	5.01	4.96	5.80
	November16-30	6.20	5.53	5.31	5.57	5.40	5.62	5.39	5.07	5.01	5.84
	December 1-15	6.25	5.52	5.22	5.45	5.30	5.51	4.96	4.47	4.42	5.16
	December15-31	6.22	5.53	5.31	5.56	5.40	5.61	5.05	4.55	4.50	5.22
	January 1-15	6.27	5.51	5.20	5.42	5.28	5.48	4.86	4.13	4.05	4.95
	January 15-31	6.24	5.53	5.30	5.55	5.38	5.60	4.96	4.22	4.14	5.01
	February	6.27	5.55	5.28	5.51	5.36	5.57	5.06	4.70	4.66	5.30
	March	6.23	5.53	5.27	5.50	5.35	5.56	5.18	4.97	4.93	5.78
	April	6.25	5.55	5.30	5.55	5.39	5.62	5.47	5.26	5.24	6.74
	May	6.21	5.53	5.30	5.56	5.40	5.64	5.89	4.89	4.84	7.34
	June	6.23	5.54	5.34	5.61	5.44	5.67	5.28	4.78	4.60	5.96
	July	6.24	5.53	5.31	5.58	5.41	5.64	5.10	4.43	4.24	5.10
	August	6.21	5.52	5.30	5.56	5.39	5.62	5.15	4.78	4.71	5.31
	September	6.21	5.53	5.32	5.59	5.41	5.64	5.49	4.84	4.76	6.03
1991	October	6.19	5.52	5.31	5.57	5.40	5.63	5.77	4.87	4.79	7.03
	November 1-15	6.21	5.51	5.25	5.49	5.34	5.56	5.39	5.04	4.98	6.03
	November16-30	6.20	5.53	5.31	5.57	5.40	5.62	5.44	5.10	5.04	6.07
	December 1-15	6.22	5.51	5.24	5.48	5.32	5.54	5.13	4.91	4.87	5.56
	December15-31	6.20	5.52	5.30	5.57	5.40	5.62	5.20	4.97	4.93	5.61
	January 1-15	6.22	5.51	5.24	5.47	5.32	5.53	5.01	4.66	4.63	5.11
	January 15-31	6.21	5.53	5.31	5.56	5.40	5.61	5.09	4.73	4.70	5.17
	February	6.25	5.53	5.25	5.49	5.34	5.54	5.06	4.70	4.66	5.33
	March	6.39	5.59	5.30	5.54	5.38	5.59	4.99	4.25	4.15	5.20
	April	6.25	5.55	5.31	5.55	5.40	5.63	5.47	5.27	5.24	6.75
	May	6.21	5.52	5.29	5.55	5.39	5.63	5.85	4.80	4.73	7.25
	June	6.23	5.55	5.35	5.61	5.44	5.67	5.32	4.85	4.63	6.05
	July	6.24	5.54	5.31	5.58	5.41	5.65	5.09	4.39	4.19	5.03
	August	6.21	5.53	5.31	5.58	5.40	5.63	5.23	5.09	5.02	5.52
	September	6.21	5.53	5.31	5.58	5.41	5.63	5.47	4.81	4.75	5.98
1992	October	6.19	5.52	5.31	5.57	5.40	5.63	5.62	4.86	4.73	6.49
	November 1-15	6.21	5.51	5.25	5.49	5.34	5.56	5.27	5.08	5.04	5.55

November16-30	6.20	5.53	5.31	5.57	5.40	5.62	5.32	5.13	5.09	5.59
December 1-15	6.23	5.52	5.24	5.47	5.32	5.53	5.05	4.70	4.66	5.38
December15-31	6.21	5.53	5.31	5.57	5.40	5.61	5.12	4.77	4.73	5.43
January 1-15	6.23	5.52	5.23	5.46	5.31	5.52	5.00	4.53	4.48	5.28
January 15-31	6.21	5.53	5.31	5.56	5.39	5.61	5.07	4.59	4.54	5.32
February	6.39	5.61	5.33	5.58	5.42	5.64	5.37	4.62	4.38	7.35
March	6.30	5.56	5.30	5.53	5.38	5.59	5.08	4.63	4.58	5.40
April	6.25	5.55	5.30	5.55	5.39	5.62	5.48	5.29	5.26	6.78
May	6.21	5.52	5.29	5.54	5.39	5.63	5.85	4.77	4.69	7.23
June	6.23	5.55	5.35	5.62	5.45	5.68	5.38	4.97	4.62	6.34
July	6.25	5.53	5.30	5.57	5.40	5.64	5.09	4.39	4.06	5.24
August	6.21	5.53	5.31	5.57	5.40	5.63	5.21	4.96	4.90	5.49
September	6.21	5.53	5.32	5.59	5.41	5.64	5.46	4.88	4.82	5.95



TABLE 14: PLAN 1995-SWRCB-409; \*\*\* AVERAGE MONTHLY STAGE \*\*\*

	Emmaton	J.P.	S.A.	Terminous	P.P.	B.C.	B.B.	OR@MR	OR@Tracy	Vernalis	
1987	October	3.48	3.53	3.58	3.62	3.57	3.59	6.92	3.35	3.07	12.45
	November 1-15	3.48	3.51	3.53	3.55	3.53	3.53	4.54	3.23	3.09	8.07
	November16-30	3.48	3.53	3.57	3.61	3.57	3.58	4.59	3.28	3.13	8.08
	December 1-15	3.48	3.52	3.54	3.56	3.54	3.54	4.23	3.79	3.44	8.54
	December15-31	3.47	3.53	3.58	3.61	3.58	3.58	4.26	3.82	3.47	8.54
	January 1-15	3.49	3.51	3.52	3.53	3.51	3.50	3.68	3.28	3.10	5.80
	January 15-31	3.48	3.53	3.56	3.60	3.56	3.55	3.73	3.33	3.15	5.82
	February	3.52	3.53	3.55	3.58	3.55	3.54	3.71	3.28	3.10	5.79
	March	3.58	3.58	3.60	3.64	3.60	3.59	3.81	3.31	3.08	6.33
	April	3.51	3.56	3.61	3.63	3.61	3.61	4.01	3.83	3.64	6.72
	May	3.49	3.54	3.58	3.60	3.58	3.59	4.76	3.32	3.25	7.04
	June	3.49	3.54	3.59	3.62	3.58	3.58	3.81	3.61	3.34	5.96
	July	3.50	3.52	3.53	3.57	3.52	3.50	3.47	2.97	2.69	5.08
	August	3.49	3.52	3.54	3.58	3.54	3.52	3.48	3.13	2.92	4.46
	September	3.47	3.53	3.56	3.59	3.56	3.56	4.18	3.21	3.13	5.57
1988	October	3.47	3.53	3.57	3.60	3.56	3.56	4.33	3.19	3.14	6.11
	November 1-15	3.48	3.52	3.54	3.56	3.54	3.54	4.14	3.29	3.22	6.03
	November16-30	3.48	3.53	3.58	3.61	3.58	3.58	4.18	3.33	3.26	6.05
	December 1-15	3.50	3.50	3.49	3.51	3.48	3.47	3.52	3.01	2.84	5.22
	December15-31	3.49	3.52	3.55	3.59	3.54	3.53	3.57	3.07	2.90	5.24
	January 1-15	3.55	3.54	3.55	3.58	3.54	3.53	3.51	3.02	2.88	4.69
	January 15-31	3.55	3.58	3.63	3.70	3.63	3.61	3.59	3.10	2.96	4.74
	February	3.52	3.54	3.57	3.59	3.57	3.56	3.62	3.37	3.28	4.56
	March	3.49	3.54	3.57	3.59	3.57	3.57	3.78	3.60	3.47	5.40
	April	3.49	3.55	3.60	3.62	3.60	3.60	3.99	3.85	3.68	6.40
	May	3.49	3.54	3.58	3.60	3.58	3.59	4.78	3.36	3.31	7.07
	June	3.49	3.55	3.59	3.63	3.59	3.58	3.82	3.61	3.33	5.99
	July	3.49	3.53	3.55	3.59	3.55	3.53	3.55	3.25	3.02	4.82
	August	3.47	3.53	3.56	3.59	3.56	3.56	3.67	3.51	3.31	4.72
	September	3.47	3.53	3.58	3.60	3.58	3.58	4.16	3.42	3.35	5.42
1989	October	3.46	3.53	3.58	3.60	3.58	3.58	4.50	3.41	3.35	6.68
	November 1-15	3.48	3.52	3.54	3.56	3.54	3.54	4.04	3.29	3.24	5.49
	November16-30	3.48	3.53	3.58	3.61	3.58	3.58	4.08	3.33	3.28	5.51
	December 1-15	3.48	3.51	3.53	3.55	3.53	3.52	3.62	3.36	3.24	4.87
	December15-31	3.48	3.53	3.57	3.61	3.57	3.56	3.67	3.40	3.29	4.90
	January 1-15	3.49	3.51	3.52	3.53	3.51	3.50	3.53	3.20	3.09	4.54
	January 15-31	3.48	3.53	3.57	3.60	3.56	3.55	3.58	3.25	3.14	4.57
	February	3.50	3.53	3.55	3.57	3.54	3.54	3.61	3.35	3.25	4.60
	March	3.62	3.60	3.63	3.68	3.62	3.61	3.65	3.13	2.95	5.40
	April	3.55	3.58	3.63	3.66	3.63	3.63	4.05	3.78	3.56	7.00
	May	3.51	3.55	3.59	3.61	3.59	3.60	4.76	3.28	3.21	7.03
	June	3.49	3.54	3.59	3.62	3.59	3.58	3.83	3.62	3.34	6.06
	July	3.50	3.52	3.52	3.57	3.52	3.50	3.37	2.87	2.62	4.39
	August	3.49	3.51	3.52	3.57	3.52	3.50	3.40	2.92	2.69	4.41
	September	3.48	3.53	3.56	3.59	3.56	3.56	4.07	3.17	3.12	5.10
1990	October	3.47	3.53	3.58	3.61	3.58	3.58	4.35	3.33	3.28	6.10
	November 1-15	3.48	3.52	3.56	3.57	3.56	3.56	4.03	3.41	3.37	5.33
	November16-30	3.47	3.54	3.59	3.62	3.59	3.59	4.07	3.44	3.40	5.35
	December 1-15	3.49	3.51	3.52	3.53	3.51	3.50	3.55	3.24	3.13	4.69
	December15-31	3.49	3.53	3.57	3.61	3.57	3.56	3.61	3.29	3.18	4.72
	January 1-15	3.50	3.50	3.49	3.51	3.48	3.47	3.43	2.94	2.80	4.55
	January 15-31	3.50	3.53	3.55	3.60	3.55	3.53	3.49	3.00	2.87	4.59
	February	3.51	3.54	3.58	3.60	3.57	3.57	3.65	3.41	3.31	4.75
	March	3.49	3.54	3.57	3.59	3.57	3.57	3.77	3.60	3.48	5.31
	April	3.50	3.56	3.61	3.63	3.61	3.61	3.96	3.80	3.62	6.36
	May	3.48	3.54	3.59	3.61	3.59	3.60	4.84	3.43	3.40	7.16
	June	3.49	3.54	3.59	3.63	3.59	3.58	3.75	3.55	3.29	5.54
	July	3.49	3.53	3.55	3.59	3.55	3.54	3.52	3.25	3.04	4.48
	August	3.47	3.53	3.56	3.59	3.56	3.55	3.65	3.48	3.29	4.63
	September	3.47	3.53	3.58	3.60	3.58	3.58	4.19	3.41	3.34	5.53
1991	October	3.46	3.53	3.58	3.60	3.58	3.58	4.53	3.41	3.35	6.78
	November 1-15	3.47	3.52	3.56	3.57	3.56	3.56	4.09	3.43	3.38	5.61
	November16-30	3.47	3.54	3.59	3.61	3.59	3.59	4.12	3.46	3.41	5.63
	December 1-15	3.48	3.52	3.54	3.56	3.54	3.53	3.71	3.51	3.39	5.01
	December15-31	3.47	3.53	3.58	3.61	3.58	3.57	3.75	3.55	3.43	5.04
	January 1-15	3.48	3.51	3.53	3.55	3.53	3.52	3.60	3.37	3.28	4.45
	January 15-31	3.48	3.53	3.58	3.61	3.57	3.57	3.65	3.41	3.32	4.49
	February	3.50	3.53	3.55	3.57	3.55	3.54	3.65	3.41	3.30	4.80
	March	3.57	3.56	3.58	3.62	3.57	3.56	3.54	3.04	2.90	4.83
	April	3.51	3.56	3.61	3.63	3.61	3.61	3.97	3.80	3.62	6.38
	May	3.48	3.54	3.58	3.60	3.58	3.59	4.77	3.37	3.31	7.06
	June	3.49	3.55	3.59	3.63	3.59	3.58	3.77	3.58	3.32	5.63
	July	3.49	3.53	3.55	3.59	3.55	3.53	3.50	3.21	3.00	4.40
	August	3.47	3.54	3.59	3.61	3.59	3.58	3.75	3.66	3.48	4.73
	September	3.47	3.53	3.58	3.60	3.58	3.58	4.17	3.39	3.31	5.47
1992	October	3.47	3.53	3.57	3.60	3.57	3.58	4.35	3.36	3.32	6.11
	November 1-15	3.47	3.52	3.56	3.57	3.56	3.56	3.98	3.45	3.41	4.99

November16-30	3.47	3.54	3.59	3.61	3.59	3.59	4.01	3.48	3.44	5.01
December 1-15	3.48	3.52	3.54	3.55	3.53	3.52	3.64	3.40	3.29	4.87
December15-31	3.48	3.53	3.58	3.61	3.58	3.57	3.69	3.44	3.33	4.91
January 1-15	3.48	3.51	3.53	3.54	3.52	3.51	3.59	3.29	3.17	4.83
January 15-31	3.48	3.53	3.57	3.61	3.57	3.56	3.64	3.33	3.21	4.86
February	3.58	3.58	3.61	3.66	3.61	3.61	3.97	3.39	3.09	7.15
March	3.53	3.55	3.59	3.62	3.58	3.58	3.67	3.37	3.25	4.95
April	3.51	3.56	3.61	3.63	3.61	3.61	3.98	3.82	3.65	6.40
May	3.48	3.54	3.58	3.60	3.58	3.59	4.75	3.35	3.28	7.04
June	3.49	3.54	3.59	3.63	3.59	3.58	3.81	3.59	3.31	5.96
July	3.49	3.52	3.54	3.58	3.54	3.52	3.48	3.10	2.86	4.72
August	3.47	3.53	3.58	3.60	3.58	3.57	3.73	3.61	3.42	4.78
September	3.47	3.53	3.58	3.60	3.58	3.58	4.17	3.45	3.37	5.42