Appendix A. Detailed Methodology for Using Transport, Chinook Salmon Mortality, and Estuarine Habitat Models

Appendix A. Detailed Methodology for Using Transport, Chinook Salmon Mortality, and Estuarine Habitat Models

This appendix describes the methodology used for assessing potential DW project impacts on winter-run chinook salmon, delta smelt, and longfin smelt using the transport model DeltaMOVE, a chinook salmon mortality model, and an estuarine habitat model.

TRANSPORT MODEL

Eggs and larvae of species with planktonic life stages, such as delta and longfin smelt, are moved by flow (including tidal flows) from spawning areas to rearing areas and away from the effects of Delta diversions. Delta smelt, longfin smelt, and striped bass spawn primarily in the Delta; striped bass also spawn upstream of the Delta. Optimal rearing habitat for larvae and juveniles of these three species under current flow and export conditions is downstream of the Delta, extending from Honker Bay to San Pablo Bay, depending on species needs and salinity distribution. Changes in river flow, Delta outflow, Delta flow patterns, and diversions during the planktonic egg, larval, and early juvenile life stages could affect survival and distribution.

Model Structure

The transport model DeltaMOVE was developed to evaluate potential changes in movement of fish (assumed to behave as concentrations of particles) under alternative DW project operation scenarios. The model is used to calculate an entrainment index, which provides a measure of the potential loss of fish eggs and larvae to Delta diversions for a given set of Delta conditions. Changes in the entrainment index estimated by the model represent general patterns that may be expected for changes in flow and diversions relative to a base condition. The model may also be used to track transport between habitat units within and downstream of the Delta.

Habitat Units

The transport model (DeltaMOVE) represents the Delta and estuary as nine major habitat units (Figures 1 and 2):

- lower Sacramento River,
- confluence of the Sacramento and San Joaquin Rivers,
- Suisun Bay,
- Suisun Marsh,
- lower San Joaquin River,
- Mokelumne River,
- central Delta,
- Honker Bay, and
- south Delta.

The volumes of the nine habitat units are calculated from the channel volumes used in the water quality module of the Resource Management Associates (RMA) Delta model (Table 1) (Smith and Durbin 1989). The habitat unit volumes determine the effects of net and tidal flow on movement of fish eggs and larvae (i.e., particle concentrations) from one habitat unit to another.

Time Step

The transport model simulates movement of fish eggs and larvae on a daily time step. For impact assessment, input to the transport model is on a monthly time step. The average daily flow for the month is assumed to be applicable to each day of the month.

Timing and Location of Spawning

The timing and location of spawning or hatching determines the abundance of planktonic life stages and influences the magnitude of the entrainment index (i.e., losses to diversions and transport to downstream habitat units). The timing of spawning or hatching for each species varies each year. For the impact assessment, an average monthly abundance of planktonic life stages is assumed for delta smelt, longfin smelt, and striped bass (Table 2).

The spawning location varies each year and, for delta and longfin smelt, is only generally known. For striped bass, it is assumed that 55% of spawning occurs in the Sacramento River upstream of the Delta habitat units and 45% in the lower San Joaquin River habitat unit in the Delta. The delta smelt spawn is assumed to be equally divided between the lower Sacramento River habitat unit (50%) and the San Joaquin River side of the Delta (50%). The spawn on the San Joaquin side of the Delta is assumed to be equally divided between the central Delta, Mokelumne River, and lower San Joaquin River habitat units (i.e., 16.67% in each unit). Longfin smelt are assumed to spawn only in the lower Sacramento River habitat unit.

The effect of spawning location variability (i.e., particles entering the Delta through variable habitat units) on distribution and survival depends on flow patterns and proximity to Suisun Bay. In general, eggs and larvae spawned in the Mokelumne River, central Delta, and south Delta habitat units are more likely to be entrained in Delta diversions and less likely to be transported to Suisun Bay (Figure 3).

Flow and Transport

As described above, the transport model (DeltaMOVE) consists of nine habitat units. Upon entering a habitat unit (i.e., through spawning, hatching, or transport), the particles (i.e., eggs and larvae) are assumed to be evenly distributed throughout the available volume within the habitat unit. Net and tidal flows transport water and the associated particles from one compartment to another. For transport by net flows, the proportion of eggs and larvae transported from one compartment to another is the daily net flow volume divided by the habitat unit volume. Each habitat unit receives inflow from specific sources and contributes outflows to adjacent habitat units (Table 3 and Figure 2).

The average daily ebb and flood flows are used to estimate the tidal transport of eggs and larvae. The volume of tidal flows between the habitat units of the model is based on the average tide used in hydrodynamic simulations performed using the RMA model (Table 3). In contrast with the net flow, the effective tidal flow (i.e., the proportion of flow that moves particles or fish from one unit to the next) is assumed to be about 3% of the total tidal flow volume.

Salinity

Estuarine species are assumed to have preferred salinity ranges (Table 4). The distribution of striped bass, delta smelt, and longfin smelt larvae is partially determined by salinity. The transport model calculates the location of the salinity barrier for each species and does not allow larvae to be transported to areas with salinity greater than the prescribed level. The location of the salinity barrier determines the habitat units (and the available area in the habitat unit containing the salinity barrier) that can receive larvae transported from other habitat units. The salinity barrier for striped bass and delta smelt transport is set at 3 parts per thousand (ppt) and the salinity barrier for longfin smelt transport is set at 18 ppt (the salinity of 3 ppt is the approximate downstream isohaline of the larval delta and longfin smelt habitat).

Transport Index Calculation

The transport model is run independently for each species. For each month, spawning or hatching is simulated for the first day of a 30-day simulation. The model simulates the movement of particle concentration (i.e., eggs and larvae) and calculates the entrainment index at the end of 30 days. The monthly entrainment index is the total number of eggs and larvae lost to Delta diversions after 30 days divided by the total number of eggs spawned or hatched during the month. The annual entrainment index for a species is the sum of the monthly indices weighted by the monthly abundance (Table 2).

Historical Delta flow data for 1959-1992 (California Department of Water Resources [DWR] 1994) were used to calculate entrainment indices for striped bass, delta smelt, and longfin smelt. If transport to habitat downstream of the Delta is important to survival of Delta species, variation in the entrainment index may explain a portion of the observed variation in annual abundance indices for delta smelt, longfin smelt, and young striped

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bass. The regressions calculated for striped bass ($r^2 = 0.51$) and longfin smelt ($r^2 = 0.54$) were significant ($p < 0.01$) and the regression for delta smelt ($r^2 = 0.12$) was not significant ($p > 0.05$ but $p < 0.1$). The proportion of variation explained by the regression (i.e., r^2) and the low probability that variation in the abundance index is not explained by variation in the entrainment index (i.e., p) indicates that for some species transport may be important to the survival of larval Delta fish.

To illustrate the response of the entrainment index to variable Delta flow and diversion conditions, the annual entrainment index for delta smelt was calculated for historical Delta flow conditions from 1930 to 1991 (Figure 4).

MORTALITY INDEX FOR JUVENILE CHINOOK SALMON DURING MIGRATION THROUGH THE DELTA

The main purpose of the mortality index described in this section is to evaluate the potential effects of Delta flow divisions and patterns on survival of juvenile chinook salmon during migration through the Delta. Water project operations affect Delta flow divisions and patterns through control of Delta inflow (i.e., upstream reservoir discharge), operation of channel barriers (i.e., Delta Cross Channel [DCC] gates and Old River temporary barrier), and changes in water diversion rates.

Juvenile winter-run chinook salmon enter the Delta from the Sacramento River. Models have been developed to assess the impacts of changes in Delta flow conditions on migrating juvenile chinook salmon originating in the Sacramento River system. The models were developed primarily from information on fall-run chinook salmon; however, the relationships are assumed to apply to other runs of chinook salmon (i.e., late fall, winter, and spring) and to steelhead trout.

Water temperature, division of flow at the divergence of the Sacramento River and its distributaries, and Delta diversions are the variables included in a model developed by the U.S. Fish and Wildlife Service (USFWS) (Kjelson et al. 1989) to estimate fall-run chinook salmon mortality during April, May, and June migration (Table 5).

For the analysis of DW project effects, a modified USFWS model was used to calculate an index of potential changes in habitat conditions attributable to alternative DW project operations. The modified model was assumed to be applicable to all months and was used to evaluate the effects of Delta flow divisions and patterns on juvenile winter-run chinook salmon. The model may provide less reliable mortality estimates when applied to months other than April through June because water temperatures are lower during winter and higher during summer. The USFWS model was developed primarily from studies of hatchery fish and is assumed to be applicable to wild juveniles, although wild juveniles may respond to Delta flow and temperature conditions differently than hatchery fish.

Cross-Delta Flow

Salvage at the CVP and SWP fish protection facilities indicates that few juvenile chinook salmon from the Sacramento River are entrained in the CVP and SWP diversions. Diversion-caused mortality appears to be a function of factors other than entrainment. One factor influenced by diversion that may affect mortality of juvenile chinook salmon originating in the Sacramento River is cross-Delta flow (i.e., movement of Sacramento River water across the Delta to the SWP and CVP export facilities in the south Delta).

The transport model DeltaMOVE, discussed in the previous section, was used to simulate cross-Delta flow conditions. A concentration of particles was entered into the Mokelumne habitat unit of the transport model, representing water and fish that moved with division of flow off the Sacramento River and through the DCC and Georgiana Slough (Figures 1 and 2). The proportion of the original concentration of particles entrained in Delta diversions after 10 days was used as an indication of cross-Delta transport (reported as the cross-Delta flow parameter, or CDFP).

The mortality of juvenile chinook salmon (hatchery reared fall-run salmon) that moved with the flow division off the Sacramento River and into the DCC and Georgiana Slough has been estimated through field experiments by USFWS (Kjelson et al. 1989). The effect of export, QWEST (net flows through the central Delta), water temperature at Freeport, and CDFP on variability in mortality was evaluated. Water temperature and CDFP were significantly correlated with mortality ($p < 0.01$) (Figure 5). CDFP is also correlated with water temperature, QWEST, and export ($p < 0.05$), and export is correlated with QWEST ($p < 0.05$).

CDFP is a better measure of the effects of export on flow conditions in the central Delta than export alone

because CDFP incorporates the effects of the source and volume of water diverted relative to total flow through the central Delta. When flow is greater through the central Delta (from the DCC, Georgiana Slough, eastside tributaries, and the San Joaquin River) and the proportion of exports composed of Sacramento River water is smaller, exports have less effect on central Delta flow conditions. Export represents only one of the parameters influencing CDFP. Figure 6 shows the annual CDFP for winter-run chinook salmon for historical conditions for 1930-1991.

The equation in Step 2 of the USFWS model (Table 5) was modified by substitution of CDFP for export. CDFP accounts for the source of water and allows discrimination in the impact assessment between export of additional Sacramento River water and export of DW project water. Because of the problems of co-correlation with temperature, the mortality index is valid only for comparison of alternative water project operations and should not be assumed to be predictive of actual levels of mortality.

When the CDFP is substituted for SWP and CVP export in the regression for development of Step 2, the revised equation is

$$M2 = (\text{Sine}\,[-0.281 + \{0.018 \times \text{Temperature}\} + \{0.010 \times \text{CDFP}\}])^2$$

where M2 is mortality between Walnut Grove and Chipps Island for juvenile chinook salmon migrating through the DCC and Georgiana Slough and temperature is measured at Freeport in degrees Fahrenheit.

The r-squared value for the regression is 0.60 (Figure 7).

Variable Juvenile Migration Timing

The timing of juvenile migration to the Delta varies each year. One factor affecting juvenile migration is river flow. In general, high flow increases the number of juvenile chinook salmon that migrate downstream to the Delta prior to smoltification (i.e., prior to physiological change indicative of preparation to enter the ocean) (USFWS 1993).

Delta export may also increase with increasing Delta inflow, potentially changing habitat conditions that affect juvenile chinook salmon survival during migration through the Delta. The proportion of the juvenile chinook salmon population migrating downstream to the Delta was adjusted for flow effects to reflect the potential increased presence in the Delta at higher inflows.

The change in the proportion of the juvenile population migrating to the Delta (PDEL) was adjusted for flow as follows:

$$PDEL_i = PRIV_i \times (PSMOLT_i + PJUV_i - [PSMOLT_i \times PJUV_i])$$

where:

$PDEL_i$ is the proportion of the annual juvenile production migrating to the Delta during month i,

$PRIV_i$ is the proportion of the annual juvenile production in the river at the beginning of month i (i.e., the proportion of annual juvenile production emerged from nests minus the cumulative proportion that migrated to the Delta during all previous months),

$PSMOLT_i$ is the monthly proportion of the annual juvenile production that would migrate during smoltification and is assumed to be the same each year regardless of environmental conditions, and

$PJUV_i$ is the monthly proportion of annual juvenile production that would migrate prior to smoltification because of increased flow. $PJUV_i$ is assumed to equal 0% at Sacramento River inflow to the Delta of less than 14,000 cfs and increases 0.5% for every 1,000-cfs increment in average monthly flow above 14,000 cfs.

Water Temperature

When water temperature is below 69°F temperature-related mortality is lower for fish continuing down the Sacramento River into the western Delta than for fish drawn down the DCC and Georgiana Slough into the eastern and central Delta. Temperature effects during October-March may be different from relationships in the model that are developed for fall-run migration of hatchery fish during April-June. Water temperature during November-March would generally be below 59°F, whereas temperatures would be above 59°F during much of the fall-run migration.

The equation in Step 1 of the migration mortality model calculates negative mortality at temperatures below 58.5°F. The equation in Step 3 calculates negative mortality at temperatures below 50.5°F. To avoid using negative mortality (see 59 FR 849, January 6, 1994 [EPA]), the minimum water temperature is set at 58.5°F in Step 1 and at 50.5°F in Step 3.

Model Performance

Water temperature, division of flow at the divergence of the Sacramento River and its distributaries, and CDFP are the variables included in the Delta migration mortality model. The effects of variable temperature and variable division of flow at the divergence of the DCC and Georgiana Slough are shown in Figure 8 for a fixed CDFP of 0.5. The effects of variable temperature and variable CDFP for a fixed 40% division of flow at the divergence of the DCC and Georgiana Slough are also shown in Figure 8. Increasing temperature, CDFP, and division of flow all increase the Delta migration mortality index for juvenile chinook salmon from the Sacramento River.

HABITAT INDEX FOR ESTUARINE HABITAT AREA

Habitat Area Relationships

The abundance of numerous fish and invertebrate species of the Delta estuary is correlated with Delta outflow. Investigators have suggested that outflow affects species abundance through its effects on estuarine habitat (Moyle et al. 1992). However, attempts to quantify the effects of outflow on estuarine habitat have been limited.

Salinity is an important habitat factor and is strongly affected by outflow; therefore, estuarine habitat often is defined in terms of a salinity range (Hieb and Baxter 1993). All estuarine species are assumed to have optimal salinity ranges (Table 4), and different life stages within a species often differ in their salinity preferences. Species survival may be determined partly by the amount of habitat available within the optimal salinity range. Because survival during an early life stage often determines the size of the year class, which in turn affects the size of the adult population, the optimal salinity habitat of the limiting life stage may be particularly important.

Calculation of the habitat index for a species or life stage incorporates optimal salinity range, geographical location of the upstream and downstream limits of the optimal salinity range, and the water surface area between the upstream and downstream limits.

Optimal Salinity Range

The limits of the optimal salinity ranges for the species investigated (shown in Table 4) were defined as the 10th and 90th percentiles of the salinity distributions of all sampled larvae and young juveniles for each species. The 10th and 90th percentiles of the salinity distributions of longfin smelt were provided by DFG. The 10th and 90th percentiles for striped bass and delta smelt were computed using data from DFG's striped bass egg and larval survey.

Location of Optimal Salinity Habitat

The geographical location of the upstream and downstream limits of the optimal salinity habitat are computed from monthly average Delta outflow and the optimal salinity range of the species. Monthly Delta outflow was used to estimate X2 (the in-channel distance upstream of the Golden Gate Bridge, in kilometers, where the near-bottom salinity is 2 ppt). The distance (X) upstream of the Golden Gate Bridge of the salinity representing the upper and lower limits of the optimal salinity range were computed from X2 using a logistic equation derived from longitudinal salinity profiles (Monismith 1993).

Monthly (end-of-month) X2 was computed using the following equation (Kimmerer and Monismith 1992):

$$X2_t = 122.2 + (0.3278 \times X2_{t-1}) - (17.65 \times \log[QOUT_t])$$

where $X2_t$ is the average 2-ppt positions for the current month, $X2_{t-1}$ is the average 2-ppt position for the previous month, and $\log[QOUT_t]$ is the $\log_{10}$ of the average Delta outflow for the current month.

Monismith (1993) showed that when X2 is known, the average position (X) in the estuary of other salinity can be estimated. For the ratio of X/X2, mean salinity is nearly constant regardless of the value of X2. To derive an equation for estimating X, a logistic model was fitted to Monismith's data using nonlinear regression (SAS Institute 1990). Parameters of the regression model were modified slightly to improve the fit in the low-salinity

region of the curve (X/X2 equal to or less than 1) because low salinity represents important habitat for many estuarine species. The logistic equation was solved for X to compute the position of the upstream and downstream limits of the optimal salinity habitat for the current month, as follows:

$$X_t = -X2_t \times ([\ln([31 - S] / [515.67 \times S]) \times -0.1429] - 1.5)$$

where S is the upper or lower limit of the optimal salinity range, $X2_t$ is the average 2-ppt position for the current month, and X_t is the average position of the upper or lower limit of the optimal salinity habitat for the current month.

Water Surface Area of Optimal Salinity Habitat

Surface area rather than volume was used as an index of optimal salinity habitat because habitat surface area is positively correlated with habitat volume and surface area is calculated more easily with available information.

Because the Delta estuary has a complex shape, the area of optimal salinity habitat varies greatly with its location. The surface area at different locations was estimated using tracings of nautical charts (prepared by U.S. Bureau of Reclamation) to measure the shore-to-shore width perpendicular to the main shipping channel at each kilometer of distance along the channel upstream from the Golden Gate Bridge (Figure 9). The shorelines on the nautical charts represent mean lower low tide position. Total surface area of the optimal salinity habitat was computed by addition of all the widths (measured in kilometers) contained between the upstream and downstream limits of the habitat. The south Bay was not included in the analyses.

The annual index of optimal salinity habitat area was computed through weighting of monthly habitat areas by the estimated average proportion of the limiting life stage present in each month (Table 6). Thus, the weighted habitat area gives a presumed relative importance to species survival for the month in which the habitat area was present. The proportions of the limiting life stage present in each month were computed from DFG survey data (Baxter, Hieb, Mecum, and Sweetnam pers. comms.).

Results of Historical Comparisons

Mean monthly Delta outflows for 1922-1929 (calculated from historical hydrologic data) and for 1930-1993 (DWR 1994) were used to calculate optimal salinity habitat area for several species under a variety of outflow conditions. The database included many outflows greatly exceeding those that would produce the minimum X2 value (i.e., X2=58 kilometers) included in the data that Monismith (1993) used to investigate the relationship between X/X2 and salinity. The relationship between X/X2 and salinity was assumed to be unchanged at low X2 (i.e., high outflow).

Computed optimal salinity habitat area for delta smelt, longfin smelt, striped bass, and the shrimp *Crangon franciscorum* are plotted against outflow in Figure 10 and against X2 in Figure 11. The species show important differences in the response of computed habitat area to changes in outflow or X2. For example, computed habitat areas for striped bass and delta smelt increased rapidly as X2 moved downstream of 100 kilometers, but the habitat area for longfin smelt and *C. franciscorum* changed little until X2 was below 80 or 90 kilometers (Figure 11). At X2 below about 60 kilometers, the habitat areas for striped bass and delta smelt declined, while those for longfin smelt and *C. franciscorum* increased continuously.

If surface area of optimal salinity habitat is an important contributor to survival of estuarine species and if the method described above for estimating this area is reliable, then variation in computed habitat area for the limiting life stage should explain a significant portion of the observed variation in annual abundance indices for these species. The relationship between abundance and habitat area was examined for the species listed in Table 6 by linear regression analysis of annual indices of abundance on annual indices of optimal salinity habitat area. The regressions were significant ($p < 0.05$) for all the species (Table 7).

The optimal habitat surface area should be useful for evaluating the salinity habitat conditions of any estuarine species for which optimal salinity range is known. Hieb and Baxter (1993) presented results of analyses relating abundance of three estuarine species to estimated optimal salinity habitat area. They estimated habitat area by extrapolating from measured salinity. The method presented here relies on general relationships between outflow and salinity and therefore can be used to predict habitat area from measured and simulated outflow.

Statistically significant relationships have been demonstrated between abundance indices of the species listed in Table 7 and Delta outflow or X2 (Jassby 1992). Optimal salinity habitat area of these species also generally increases with increased outflow (i.e., reduced X2) (Figures 10 and 11). The effect of habitat area on species abundance is difficult to separate from effects of other factors related to outflow, such as residence time, nutrient inputs, sediment transport, transport of eggs and larvae, entrainment in diversions, and dilution of toxics. Nevertheless, an index of habitat area is assumed to be a reasonable tool for assessment of impacts of DW project operations.

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Appendix A, Table 1. Habitat Unit Volumes Included in the Transport Model

Unit	Volume (TAF)
Lower Sacramento River	115
Confluence of the Sacramento and San Joaquin Rivers	215
Suisun Bay	300
Suisun Marsh	68
Lower San Joaquin River	167
Mokelumne River	52
Central Delta	120
Honker Bay	200
South Delta	80

Note: TAF = thousand acre-feet.

Appendix A, Table 2. Assumed Timing of Spawning (Planktonic Eggs) and Hatching (Planktonic Larvae) of Longfin Smelt, Delta Smelt, and Striped Bass Used in Development of the Transport Index

			Monthly Abundance (% of annual production)					
Species	Location	Life Stage	January	February	March	April	May	June
Delta smelt	Delta	Larvae	0	10	25	35	25	5
Longfin smelt	Delta	Larvae	10	45	35	10	0	0
Striped bass	Delta	Eggs	0	0	0	80	20	0
Striped bass	Sacramento River	Eggs	0	0	0	0	80	20

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Appendix A, Table 3. Average Tidal Flows between Habitat Units Included in the Transport Model

Outflow Unit			
Number	Name	Inflow Unit Number	Tidal Flow (cfs)
1	Lower Sacramento River[a]	2	105
1	Lower Sacramento River[a]	5	20
2	Confluence of the Sacramento and San Joaquin Rivers	1	105
2	Confluence of the Sacramento and San Joaquin Rivers	5	105
2	Confluence of the Sacramento and San Joaquin Rivers	4	5
2	Confluence of the Sacramento and San Joaquin Rivers	8	205
3	Suisun Bay	4	17
3	Suisun Bay	8	225
3	Suisun Bay	SPB	335
4	Suisun Marsh	2	5
4	Suisun Marsh	3	17
5	Lower San Joaquin River	1	20
5	Lower San Joaquin River	2	105
5	Lower San Joaquin River	6	15
5	Lower San Joaquin River	7	60
6	Mokelumne River[b]	5	15
6	Mokelumne River[b]	7	5
7	Central Delta[c]	5	60
7	Central Delta[c]	6	5
7	Central Delta[c]	9	20
8	Honker Bay	2	205
8	Honker Bay	3	225
9	South Delta[d]	7	20
SPB	San Pablo Bay	3	335

Note: cfs = cubic feet per second.

[a] Receives Sacramento River inflow.
[b] Receives Mokelumne River inflow.
[c] Receives San Joaquin River inflow past Stockton.
[d] Receives San Joaquin River inflow through upper Old River.

Appendix A, Table 4. Optimal Salinity Ranges for Estuarine Fishes and Invertebrates

Species or Taxon	Life Stage	Lower Salinity Limit (ppt)	Upper Salinity Limit (ppt)
Delta smelt	Larvae and early juveniles	0.3	1.8
Longfin smelt	Larvae and early juveniles (<50 mm)	1.1	18.5
Striped bass	Larvae (5-9 mm)	0.1	2.5

Notes: ppt = parts per thousand
mm = millimeter

Sources: Obrebski et al. 1992, Hieb and Baxter pers. comms.

Appendix A, Table 5. Equations for Calculating Chinook Salmon Mortality during Migration through the Delta (for Fish Entering the Delta from the Sacramento River)

Step 1. Calculate mortality for the Sacramento River between Sacramento and Walnut Grove

$$M1 = -2.459 + (0.042 \times \text{Temperature})$$

Note: Water temperature is measured at Freeport in degrees Fahrenheit.

Step 2. Calculate mortality between Walnut Grove and Chipps Island via the Delta Cross Channel (DCC) and Georgiana Slough

$$M2 = -05916 + (0.0180 \times \text{Temperature}) + (0.0000434 \times \text{Export})$$

Notes: Export is the total monthly diversions for the Central Valley Project at Tracy and State Water Project at Banks in cubic feet per second.

Water temperature is measured at Freeport in degrees Fahrenheit.

Step 3. Calculate mortality between Walnut Grove and Chipps Island via the Sacramento River

$$M3 = -1.613 + (0.0320 \times \text{Temperature})$$

Note: Water temperature is measured at Freeport in degrees Fahrenheit.

Step 4. Calculate total monthly mortalities

$$\text{Monthly Mortality} = M1 + (M2 \times DCC) + (M3 \times [1\text{-}DCC]) - \{M1 \times ([M2 \times DCC] + [M3 \times (1\text{-}DCC)])\}$$

Note: DCC is the proportion of Sacramento River discharge (at the DCC) drawn through the DCC and Georgiana Slough.

Step 5. Calculate total annual mortality

$$\text{Annual Mortality} = \sum_{i=1}^{n} (\text{Month}_i \times A_i)$$

Note: The month term represents the monthly mortality: A_i is the monthly proportion of the annual chinook salmon brood migrating through the Delta during April through June.

Sources: Kjelson et al. 1989, 40 CFR 131.

Appendix A, Table 6. Monthly Weighting Factors for Estuarine Species

Species or Taxon	Life Stage	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Delta smelt	Larvae and early juveniles	.00	.05	.10	.20	.30	.20	.10	.05	.00	.00	.00	.00
Longfin smelt	Larvae and early juveniles (<50 mm)	.04	.44	.42	.09	.01	.00	.00	.00	.00	.00	.00	.00
Striped bass	Larvae (5-9 mm)	.00	.00	.00	.12	.52	.34	.02	.00	.00	.00	.00	.00
Decapod shrimp *Crangon franciscorum*	Juveniles (<26 mm)	.02	.01	.00	.02	.10	.24	.23	.16	.12	.05	.03	.02

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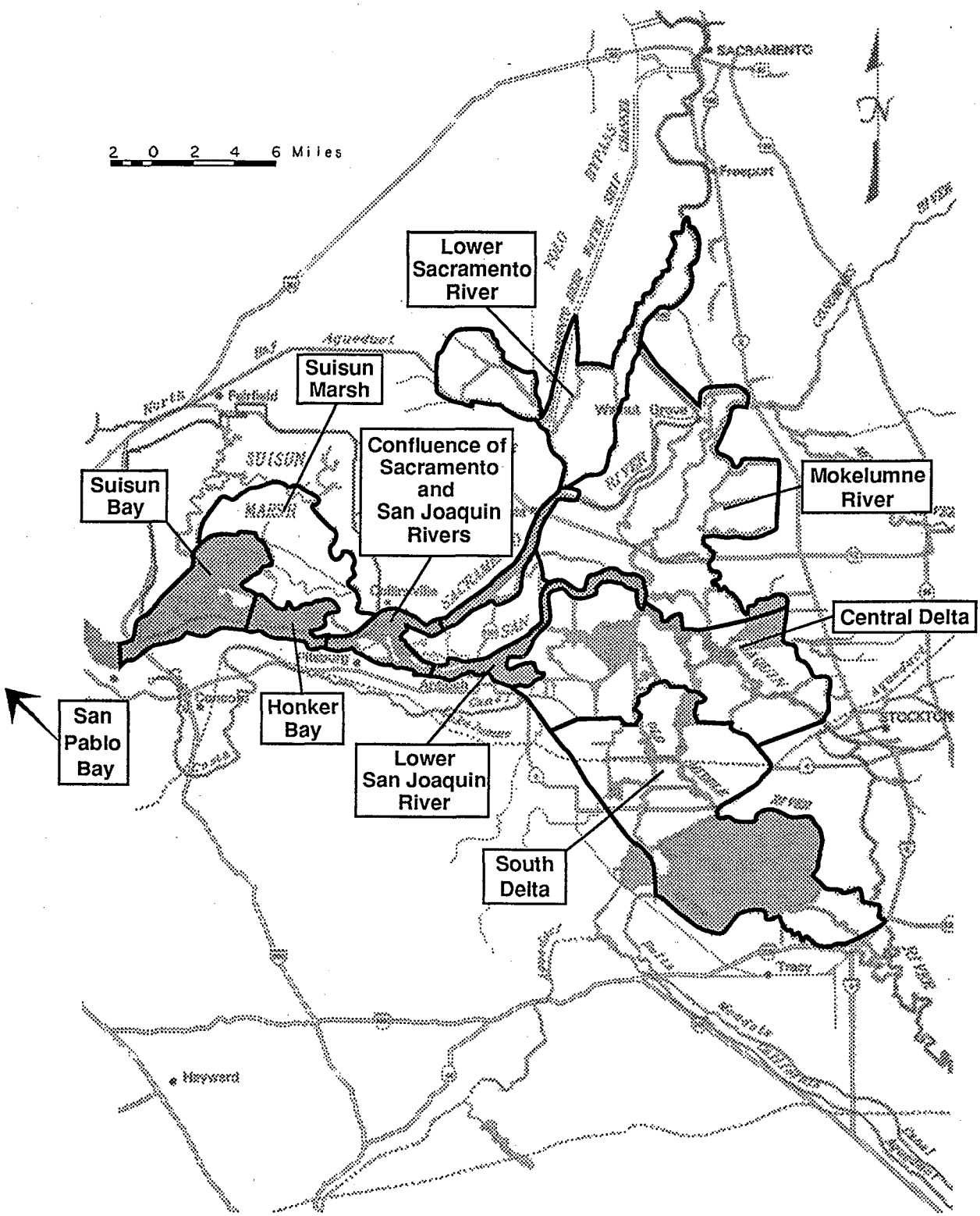
Appendix A, Table 7. Coefficients of Determination and Regression Equations for Selected Species

Species	Years	r^2	p	Regression Equation[a]
Delta smelt	1967-1993	0.19	< 0.05	Y = 1.713 + 0.019 (OSHA)
Longfin smelt	1967-1993	0.70	< 0.05	Y = 0.156 + 0.018 (OSHA)
Striped bass	1959-1993	0.40	< 0.05	Y = -36.705 + 1.069 (OSHA)
Crangon franciscorum	1980-1993	0.75	< 0.05	Y = -322.357 + 2.532 (OSHA)

[a] OSHA = Optimal Salinity Habitat Area.
Striped bass: Y = 38-millimeter index.
Delta and longfin smelt: Y = $\log_{10}$(Midwater Trawl Index + 1).
Crangon franciscorum: Y = Bay Survey Juvenile Index.



Appendix A, Figure 1.
Habitat Units of the Transport Model

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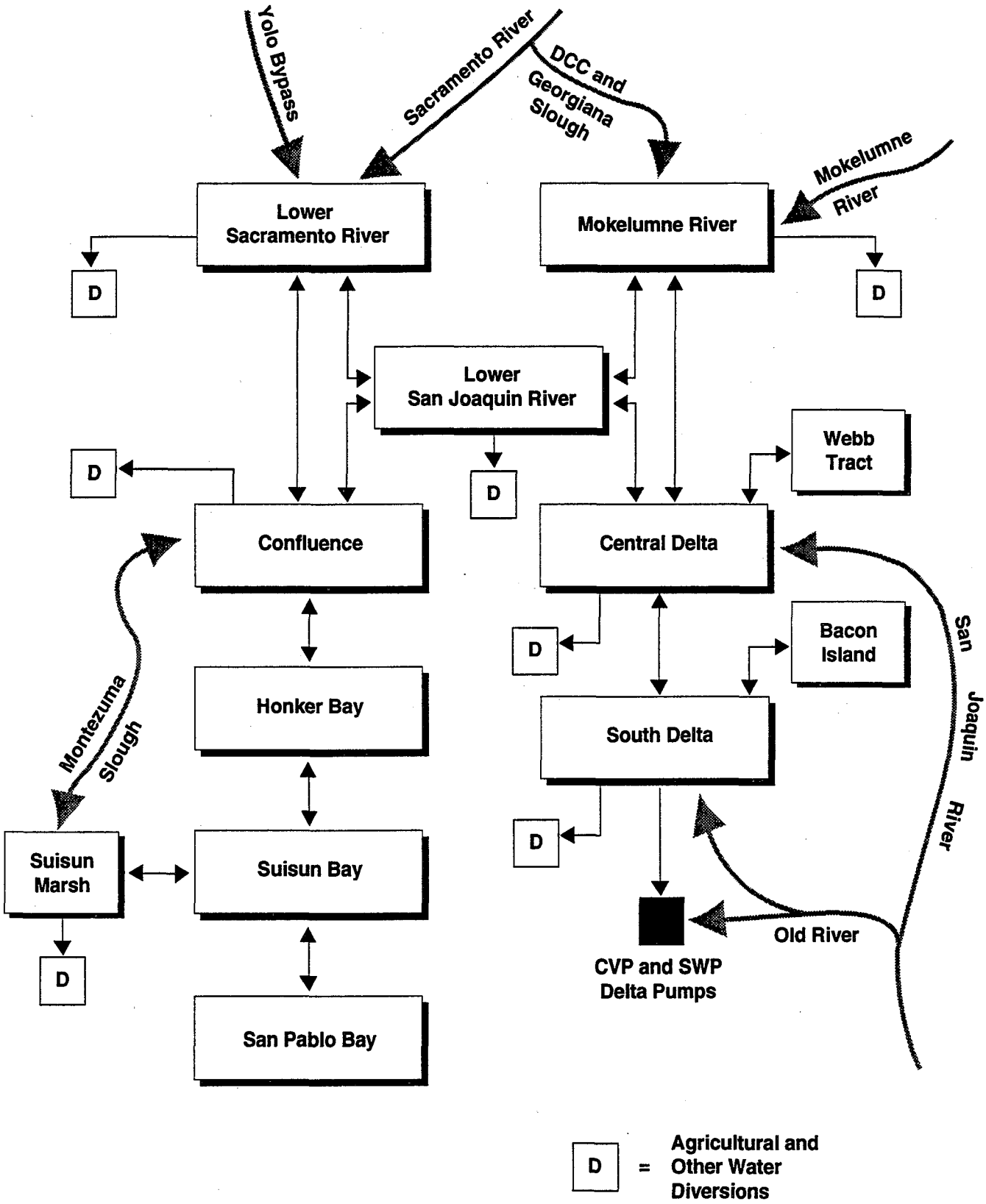

Appendix A, Figure 2.
Transport Model Structure

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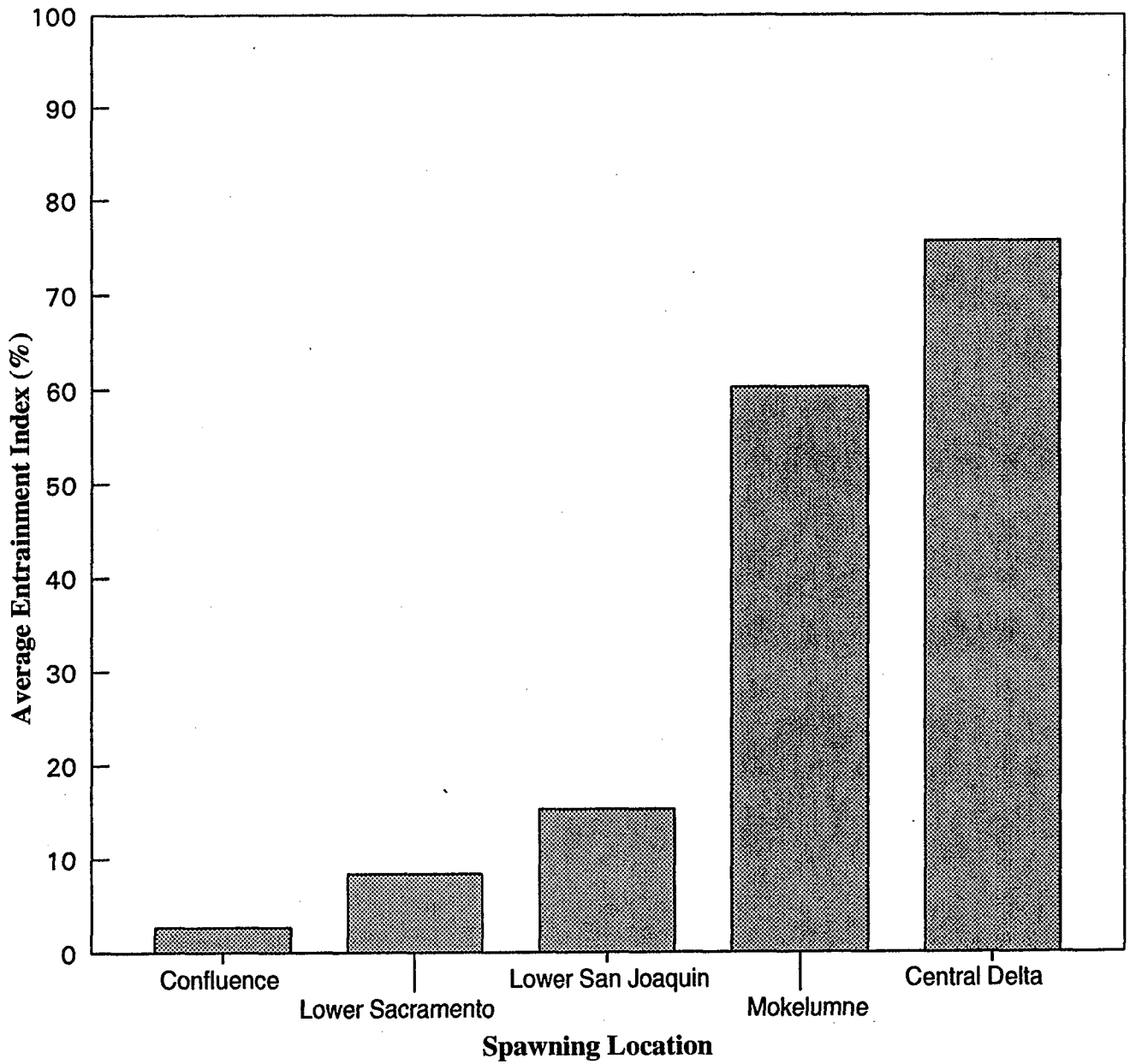

Appendix A, Figure 3.
Effects of Spawning Location on Transport (Average for 1922–1991 Simulation of Delta Conditions)

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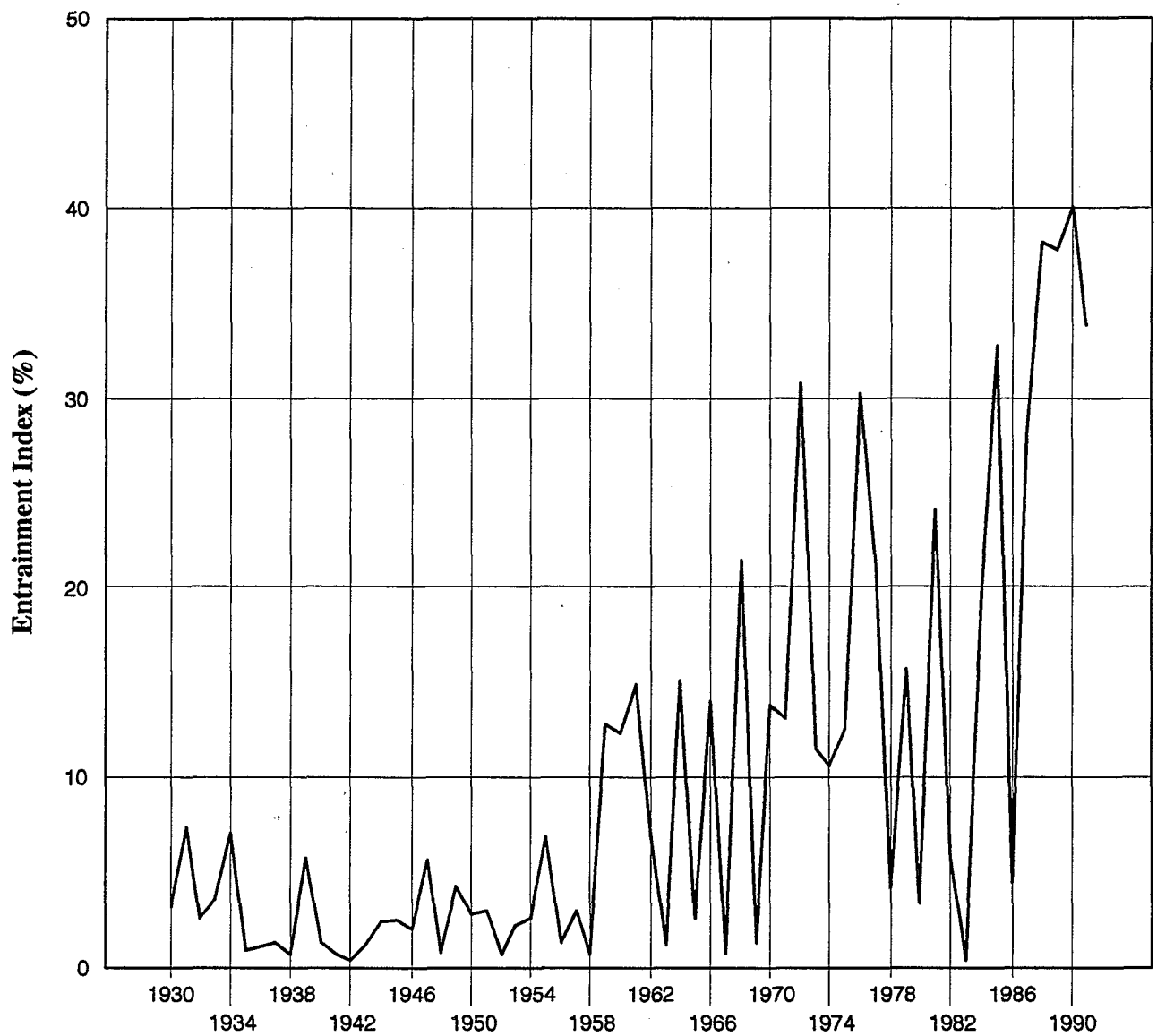

Appendix A, Figure 4.
Annual Entrainment Index for Delta Smelt for Historical Delta Conditions, 1930–1991

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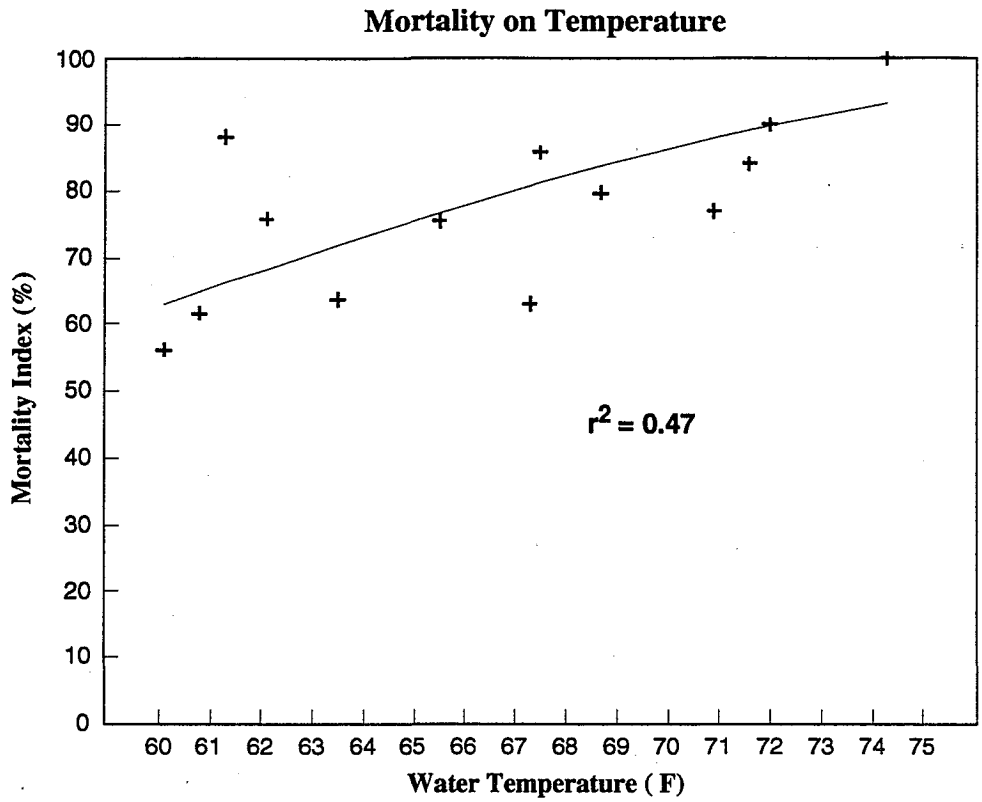

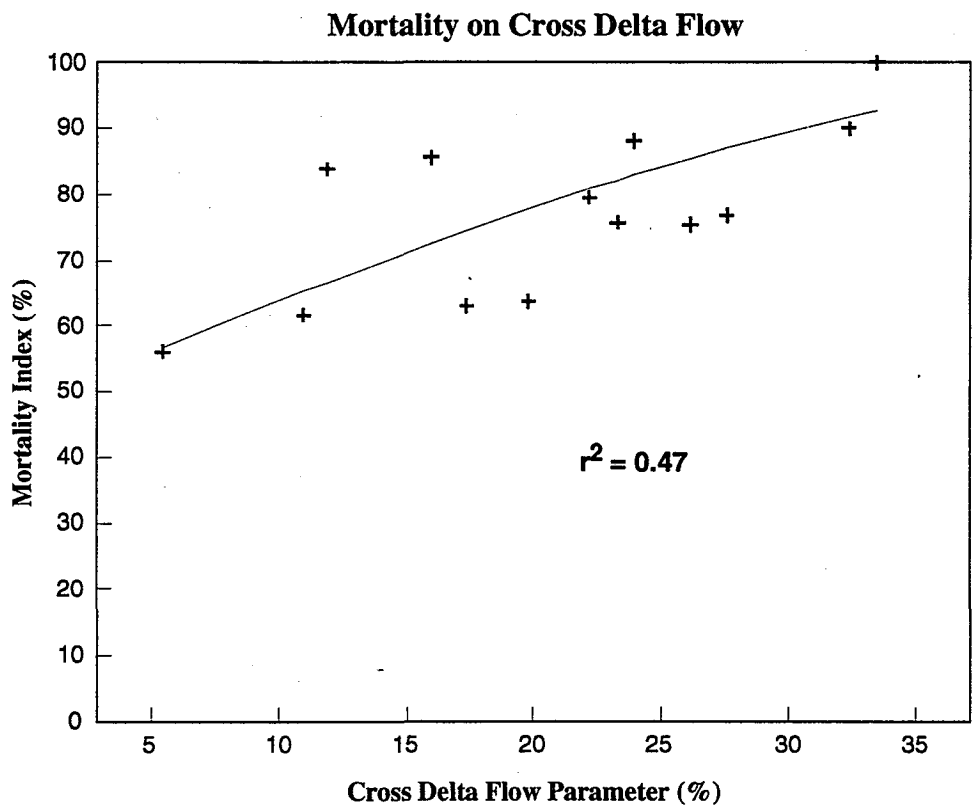

Appendix A, Figure 5.
Juvenile Chinook Salmon Mortality Relationships with Water Temperature and the Cross Delta Flow Parameter

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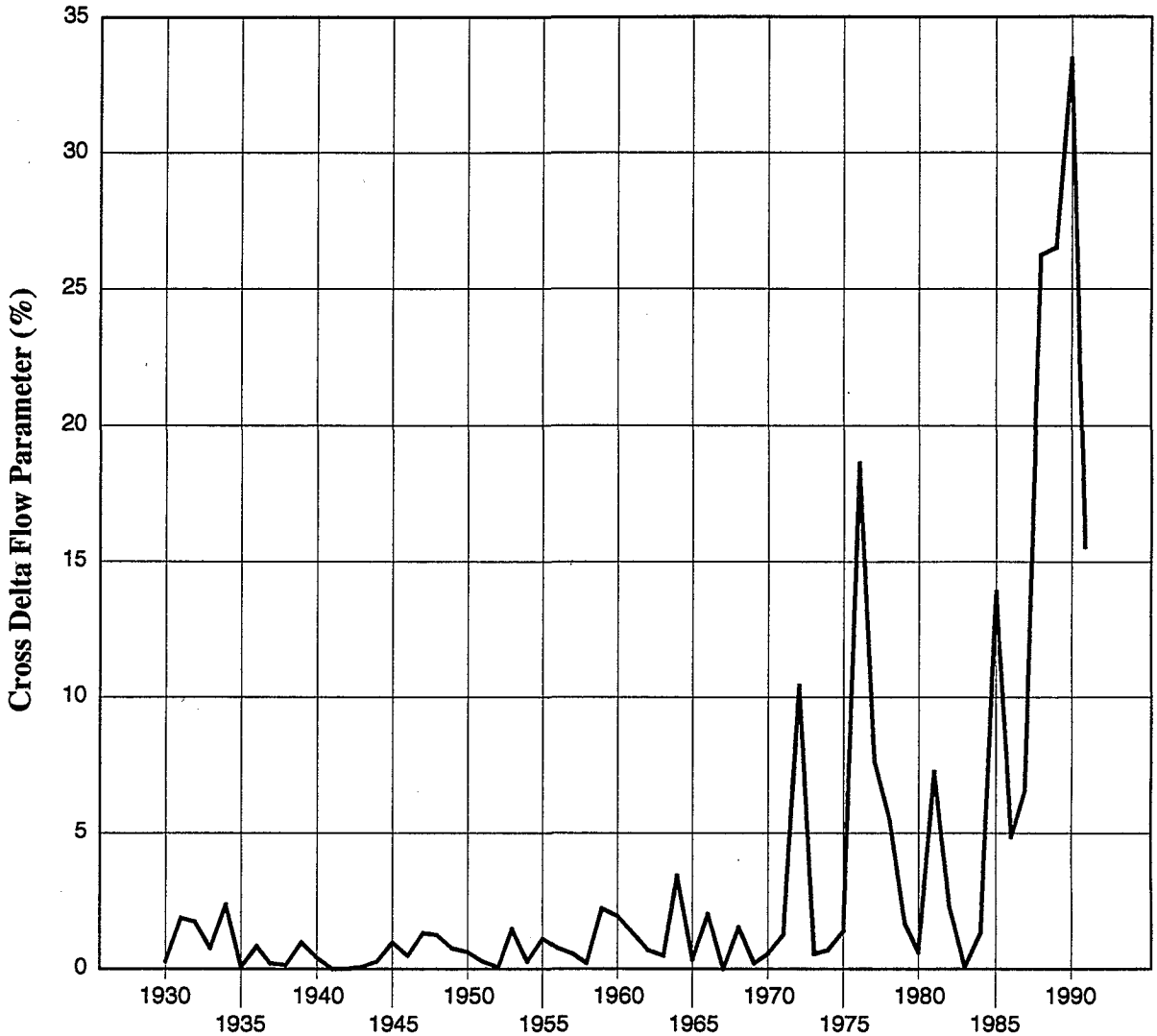

Appendix A, Figure 6.
Annual Cross Delta Flow Parameter for Winter-Run Chinook Salmon for Historical Delta Conditions, 1930–1991

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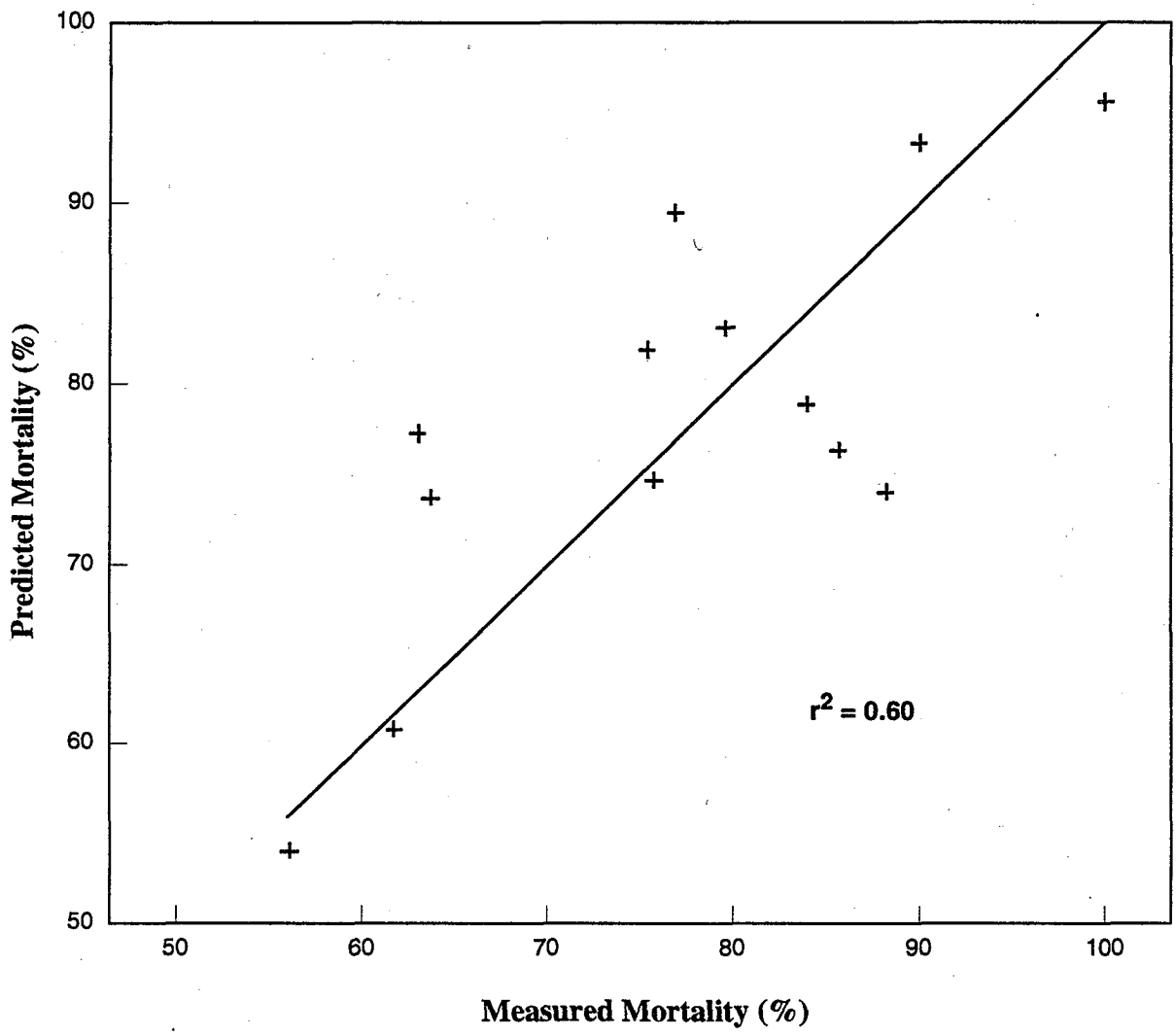
Prepared by: Jones & Stokes Associates



Appendix A, Figure 7.
Relationship between Measured Juvenile Chinook Salmon Mortality and Mortality Predicted by the Regression Equation Including Temperature and Cross Delta Flow Parameter

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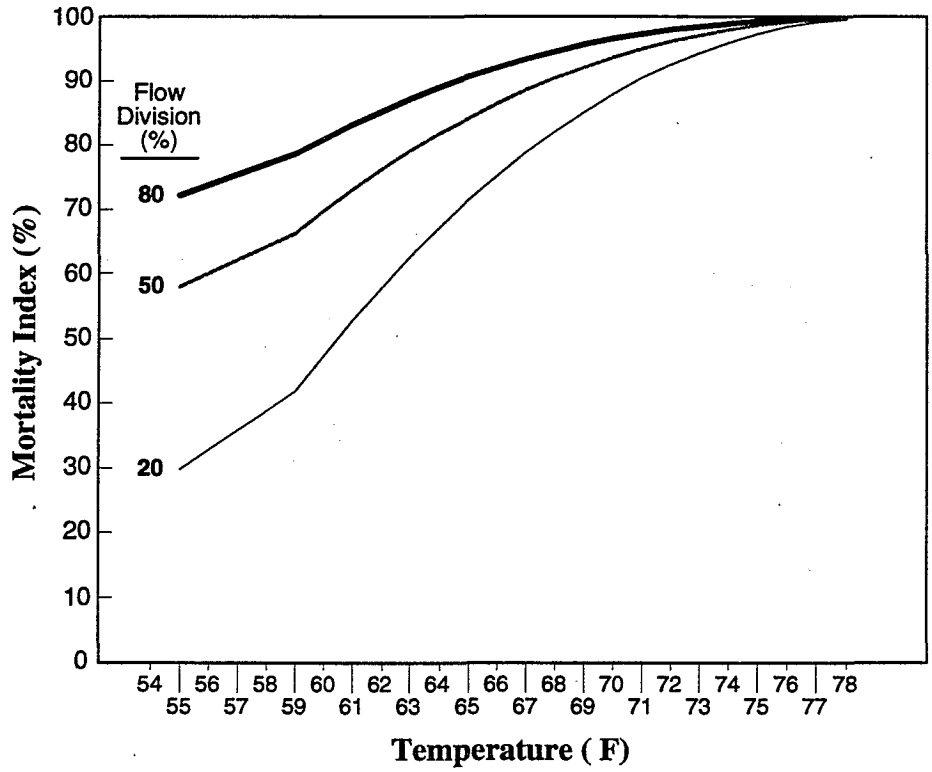

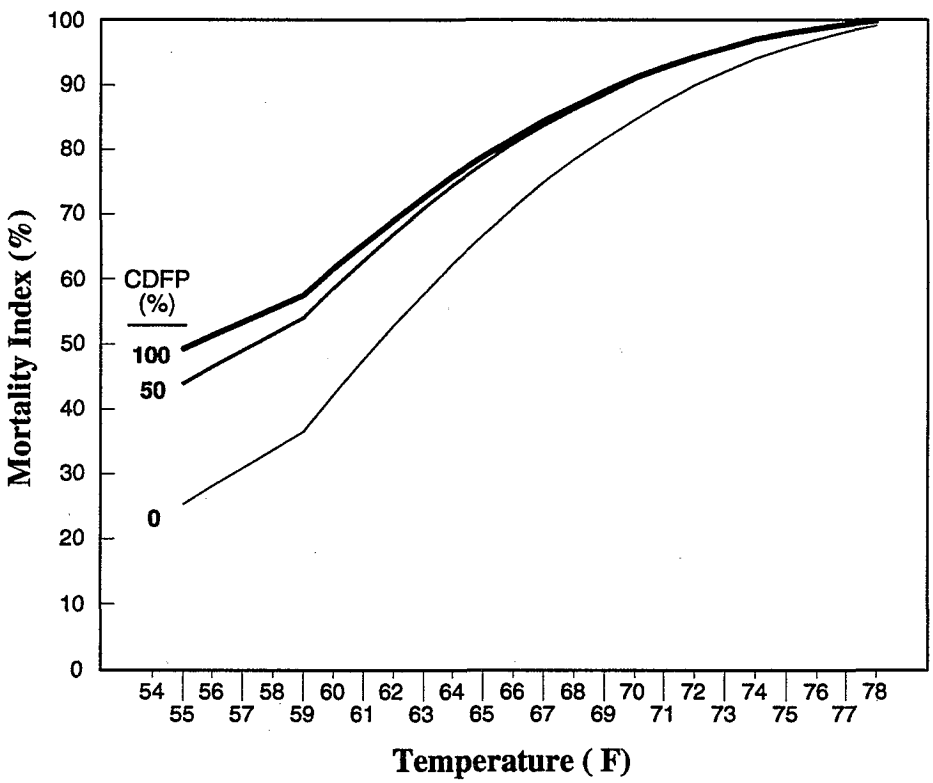

Appendix A, Figure 8.
Model Predictions of Juvenile Chinook Salmon Mortality for Variable Temperature, Flow Division off the Sacramento River at the DCC and Georgiana Slough, and Cross Delta Flow Conditions

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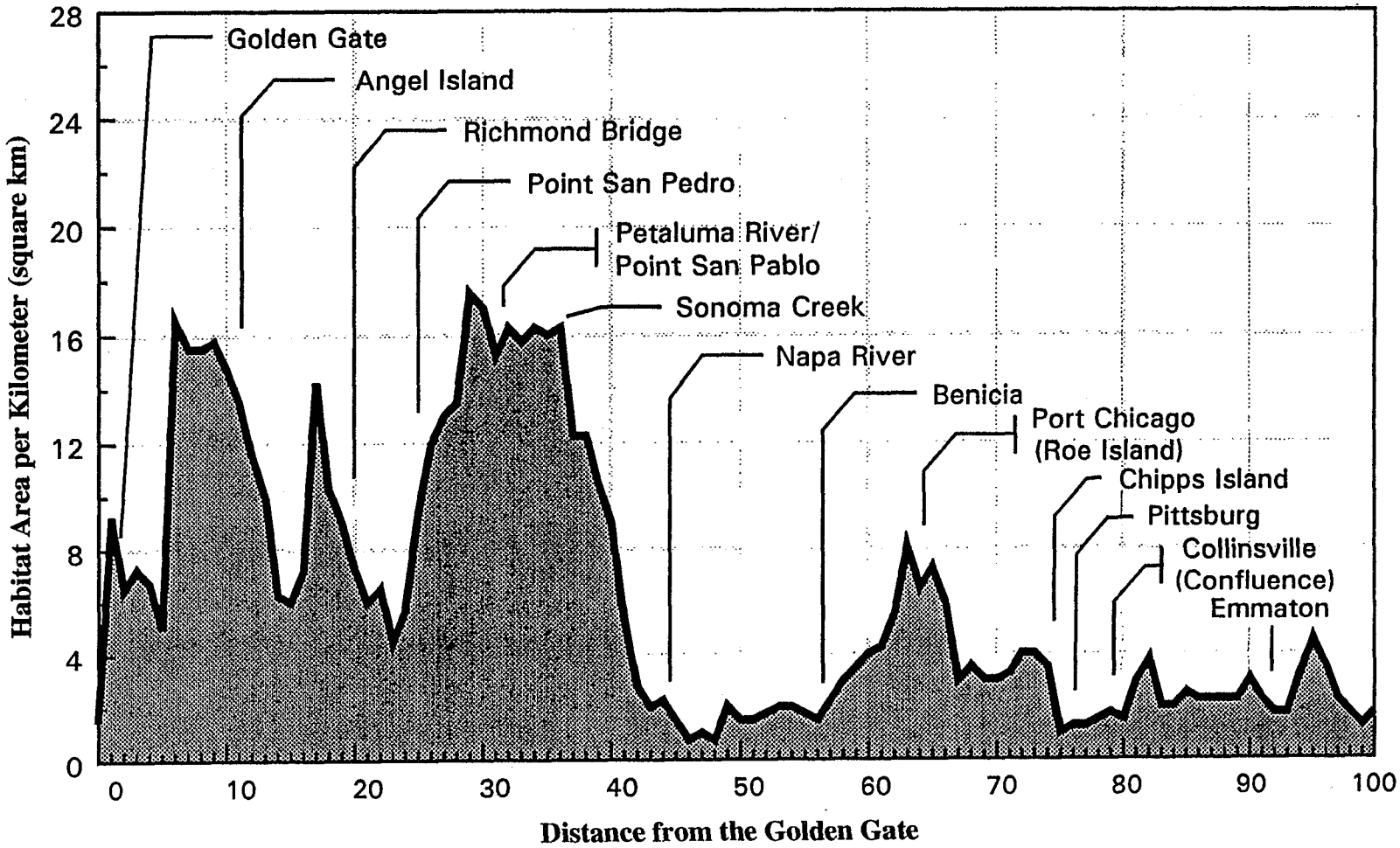

Appendix A, Figure 9.
Estuarine Habitat Area per Kilometer Upstream of the Golden Gate

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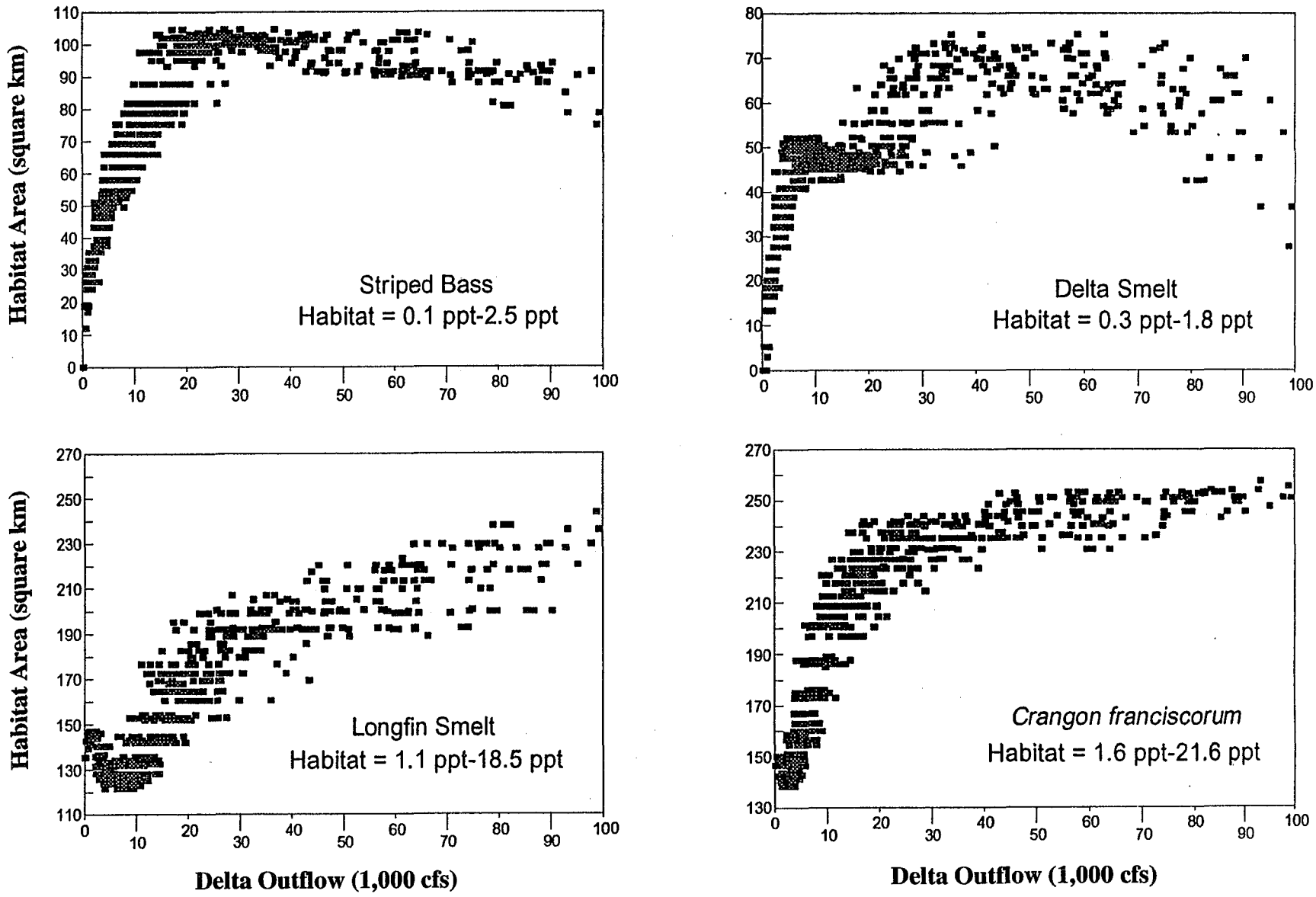

Appendix A, Figure 10.
Optimal Salinity Habitat Area Versus Delta Outflow

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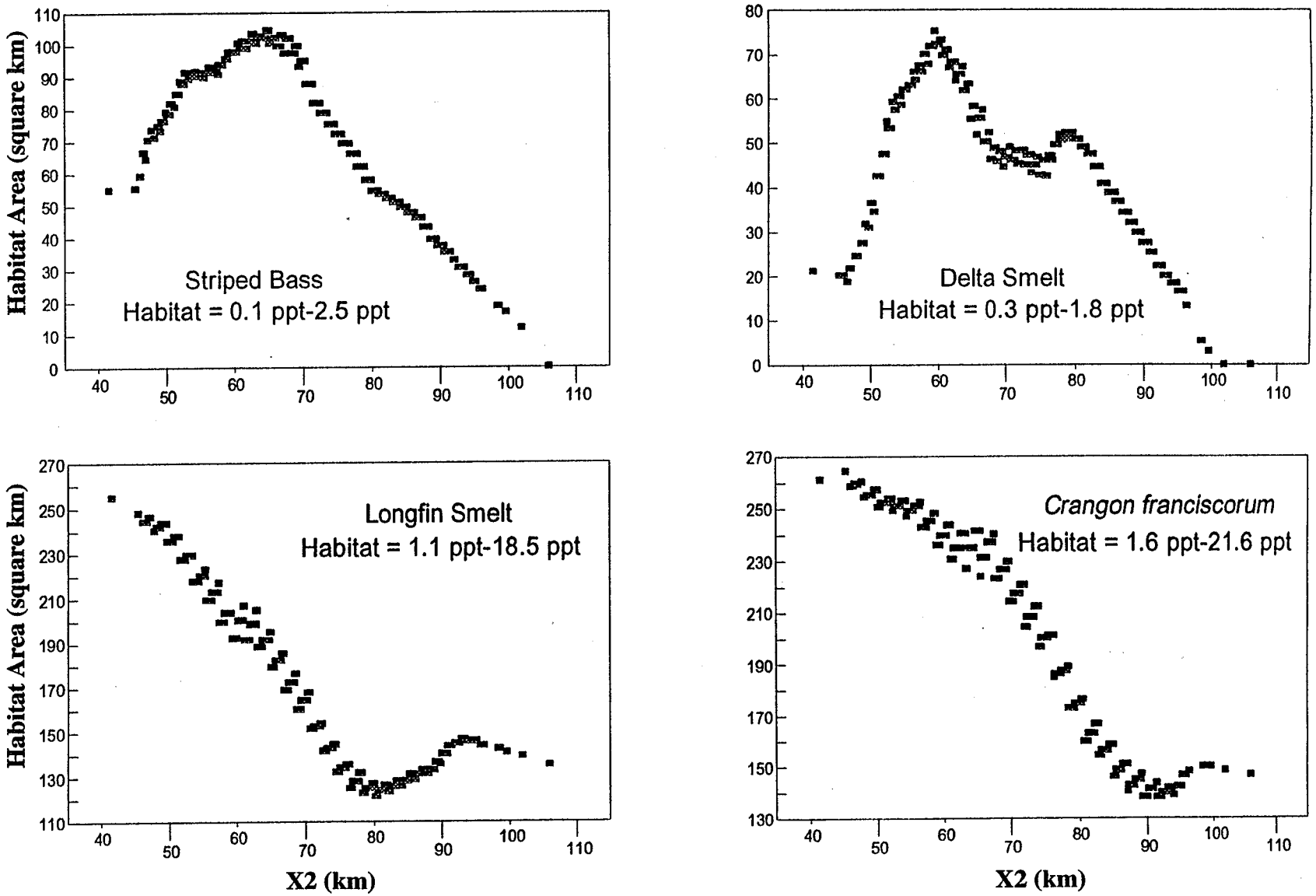

Appendix A, Figure 11.
Optimal Salinity Habitat Area Versus X2

DELTA WETLANDS PROJECT

Prepared by: Jones & Stokes Associates

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Appendix B. Flow and Salinity Conditions under the No-Project Alternative

Appendix B. Flow and Salinity Conditions under the No-Project Alternative

This appendix presents results of simulations of the No-Project Alternative, representing the baseline with which conditions under DW project operations are compared for impact assessment. Tables 1-10 show the following simulated No-Project Alternative conditions:

- Sacramento River inflow at Freeport,
- San Joaquin River inflowat Vernalis,
- total Delta inflow,
- Delta Cross Channel (DCC) and Georgiana Slough flow,
- QWEST flow,
- Old and Middle River flow,
- Old River flow at Mossdale,
- total CVP and SWP exports,
- total Delta outflow, and
- monthly values for X2 (distance of the 2-ppt isohaline from the Golden Gate Bridge).

Appendix B, Table 1. Sacramento River Inflow (cfs) under the No–Project Alternative

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	10,066	10,216	15,464	16,765	35,899	29,686	21,030	46,063	33,542	13,545	10,526	10,089
1923	BN	21,687	20,159	32,528	29,936	19,733	13,181	22,538	14,307	15,890	21,369	18,798	10,353
1924	C	11,298	11,476	16,229	15,423	15,271	13,909	8,048	8,724	10,293	14,209	10,232	7,402
1925	D	12,532	10,534	11,709	10,686	37,305	18,965	22,119	13,005	16,344	20,901	15,621	10,515
1926	D	14,049	10,261	11,511	16,568	33,084	14,909	17,674	14,642	13,589	20,917	15,120	10,438
1927	W	13,235	20,705	15,395	31,201	71,079	38,408	45,968	24,266	15,688	17,523	12,493	9,646
1928	AN	13,903	28,190	15,225	24,291	26,608	88,293	27,043	17,278	15,789	23,127	15,549	11,017
1929	C	10,269	12,040	14,318	12,551	15,361	12,418	9,356	9,805	14,181	18,784	8,116	7,128
1930	D	11,821	10,557	14,735	21,394	15,973	28,811	12,563	11,728	13,465	19,503	9,348	8,827
1931	C	8,521	7,808	9,882	12,872	11,098	10,037	10,404	7,034	10,033	11,790	5,837	7,128
1932	D	9,226	7,891	14,683	16,846	14,330	12,393	13,058	11,071	14,380	10,912	8,916	9,332
1933	C	8,545	8,705	9,735	14,414	13,420	11,652	12,562	8,379	13,907	10,813	5,799	7,128
1934	C	7,061	6,551	13,212	17,189	14,196	16,989	13,380	8,869	14,332	10,788	5,953	7,127
1935	BN	7,107	11,084	11,717	25,114	14,471	22,470	20,471	32,262	16,651	21,254	15,611	9,197
1936	BN	11,248	10,994	11,567	28,507	36,270	31,067	19,175	13,395	15,793	21,204	12,653	9,449
1937	BN	10,537	10,496	13,976	13,204	33,032	36,627	20,992	13,832	18,108	15,523	10,687	9,228
1938	W	10,269	33,431	57,571	30,781	81,652	77,641	46,029	54,986	32,939	13,527	11,241	17,631
1939	D	24,401	17,722	14,446	13,544	12,882	12,852	12,871	10,840	13,828	20,845	14,169	9,392
1940	AN	12,683	11,141	12,482	23,855	43,354	65,427	39,755	17,342	15,466	23,068	18,360	9,818
1941	W	11,358	11,957	31,823	67,764	74,485	57,181	42,239	39,466	19,539	13,200	10,955	14,725
1942	W	22,314	21,117	65,493	63,181	79,077	23,987	44,096	36,373	26,443	13,144	11,006	14,558
1943	W	22,295	23,628	30,087	57,143	51,815	63,524	27,910	18,327	15,111	16,978	11,821	9,447
1944	D	14,215	15,585	11,046	14,386	30,665	22,299	10,423	9,948	16,591	20,808	12,877	10,175
1945	BN	13,786	13,839	16,255	13,074	42,643	26,866	11,824	12,450	18,565	17,952	11,484	9,833
1946	BN	12,995	19,589	57,928	42,826	25,238	20,876	12,044	14,190	17,456	21,495	13,439	10,418
1947	D	11,985	11,358	15,340	14,586	19,556	20,090	13,660	10,927	13,328	20,906	19,230	10,763
1948	BN	14,157	12,470	13,258	15,883	16,535	14,622	21,097	30,496	20,583	21,536	19,439	17,319
1949	D	16,315	14,400	12,967	11,496	12,853	46,423	12,245	14,608	15,412	19,335	11,670	11,337
1950	BN	13,833	11,072	11,222	19,248	33,851	21,344	17,676	14,433	17,593	21,574	19,768	11,024
1951	AN	16,245	42,371	55,037	56,843	60,212	29,013	14,312	18,262	15,364	23,297	17,359	11,394
1952	W	13,700	16,748	46,777	66,163	64,256	56,066	57,567	60,752	38,552	17,255	12,278	19,981
1953	W	23,363	17,513	43,755	64,068	26,157	21,584	18,213	25,632	26,974	18,069	12,565	14,787
1954	AN	20,271	24,743	15,833	32,831	57,775	47,536	41,007	21,629	15,521	23,169	18,112	11,413
1955	D	11,291	16,575	25,041	19,818	18,043	10,907	8,690	10,562	16,438	20,920	19,130	12,574

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C-062092

C-062093

Table 1. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	11,668	12,539	29,807	74,472	68,672	34,601	18,590	41,361	21,943	18,340	12,628	16,677
1957	AN	21,817	16,316	11,898	15,674	38,076	42,687	17,418	15,112	16,778	23,113	20,168	11,438
1958	W	19,739	18,590	26,185	36,379	63,001	93,876	52,539	41,227	35,563	15,548	13,305	19,997
1959	BN	22,815	17,188	12,563	37,038	50,708	20,389	10,511	10,862	14,467	21,311	14,990	11,401
1960	D	13,100	11,968	17,948	12,430	24,717	19,166	13,962	10,657	13,826	21,096	18,285	11,038
1961	D	12,990	12,398	17,273	11,510	30,413	18,816	13,125	11,026	13,674	21,360	17,180	10,432
1962	BN	12,362	10,624	16,260	12,065	41,915	24,120	11,349	15,102	14,997	21,494	13,583	11,470
1963	W	29,964	20,912	27,841	15,997	55,700	30,282	68,830	29,282	15,853	21,000	12,649	13,784
1964	D	18,559	31,259	14,630	25,839	16,249	12,711	9,432	10,858	13,807	20,874	19,147	12,400
1965	W	10,810	15,451	34,819	79,759	32,995	19,999	45,150	24,383	15,189	22,338	12,978	10,098
1966	BN	15,586	25,947	15,472	27,227	26,032	26,551	13,059	15,045	14,458	21,149	18,858	11,341
1967	W	12,599	14,986	39,985	34,299	42,864	52,467	38,491	45,174	40,192	15,166	12,454	19,477
1968	BN	23,545	17,983	16,174	28,229	61,379	34,432	12,159	10,609	14,457	21,061	13,673	11,372
1969	W	13,932	12,473	22,663	72,606	67,092	43,846	43,157	44,408	24,948	12,587	11,644	23,339
1970	W	21,825	18,756	51,679	91,517	56,215	33,273	13,131	10,290	14,734	22,569	12,891	10,674
1971	W	13,625	22,080	59,077	47,425	28,709	50,628	19,323	31,190	22,755	22,883	13,337	16,509
1972	BN	18,767	16,451	21,067	18,239	25,328	32,274	11,474	10,598	14,216	20,984	19,341	10,516
1973	AN	14,964	22,305	27,226	46,559	71,663	45,792	16,912	17,833	19,410	22,533	12,298	11,305
1974	W	14,977	57,052	60,493	78,775	42,016	97,768	36,823	24,439	21,148	17,717	13,531	20,973
1975	W	22,708	17,806	17,880	16,032	61,624	74,091	21,535	32,215	24,875	19,683	12,690	18,106
1976	C	22,960	20,504	15,624	13,398	19,051	15,023	9,755	10,224	14,636	16,465	8,227	7,675
1977	C	8,134	11,087	18,098	8,254	13,432	10,289	8,892	6,120	6,807	8,808	6,218	7,128
1978	AN	7,130	6,109	15,370	44,069	50,420	47,850	37,669	19,632	14,216	12,930	10,740	13,677
1979	BN	18,420	15,857	10,622	25,053	40,292	30,623	16,639	15,506	20,505	17,624	11,156	9,951
1980	AN	10,574	18,058	19,749	69,421	69,057	35,876	16,641	13,874	12,244	12,732	10,987	14,383
1981	D	17,237	14,220	16,221	25,220	28,023	32,372	14,636	10,824	13,587	20,715	14,156	10,095
1982	W	12,785	32,339	71,377	53,073	70,537	62,008	78,803	35,743	22,539	15,018	13,802	23,119
1983	W	29,962	40,150	58,262	57,238	82,605	87,187	64,475	56,196	51,139	23,363	15,542	24,376
1984	W	27,488	64,593	85,103	45,529	38,969	33,026	14,102	12,536	15,378	21,356	12,137	15,062
1985	D	17,217	34,863	26,254	14,297	19,640	17,774	9,809	13,703	13,422	20,916	17,852	10,656
1986	W	12,678	10,779	15,273	18,731	108,473	67,672	19,089	11,015	12,412	16,305	11,377	10,851
1987	D	10,589	12,099	9,414	12,797	19,140	31,898	13,323	11,414	13,589	21,212	16,093	10,204
1988	C	10,336	9,844	15,966	25,075	17,056	11,941	9,123	9,509	14,268	15,721	10,209	7,239
1989	D	7,130	9,396	11,596	12,906	13,896	39,162	22,181	14,571	13,397	21,621	19,234	10,466
1990	C	9,151	8,058	14,230	17,203	15,179	11,050	12,816	7,835	14,576	16,029	10,331	7,518
1991	C	7,061	7,716	9,315	10,492	13,852	28,554	14,063	7,993	13,747	12,393	9,480	8,270
Mean		14,883	17,738	24,595	30,990	38,331	34,402	22,815	19,775	18,021	18,504	13,419	12,052

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP).

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Appendix B, Table 2. San Joaquin River Inflow (cfs) under the No–Project Alternative

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	12,008	12,837	20,248	21,765	49,399	39,977	28,771	55,323	42,317	15,883	13,060	12,292
1923	BN	23,964	23,987	42,423	38,708	26,556	17,414	29,780	20,545	19,864	23,604	21,073	11,884
1924	C	13,607	13,868	18,894	17,862	17,867	15,474	10,574	11,135	12,465	15,957	11,500	8,766
1925	D	14,557	12,647	14,691	12,781	54,225	22,709	28,006	18,174	19,178	22,967	17,043	11,893
1926	D	15,939	12,900	14,008	18,943	39,651	17,862	25,030	18,673	15,783	22,970	16,481	11,776
1927	W	15,178	23,718	19,166	34,387	125,022	45,162	54,756	30,380	19,629	19,903	14,824	11,550
1928	AN	15,875	31,612	18,937	28,011	32,343	107,097	32,577	21,764	18,489	25,190	16,886	12,383
1929	C	12,457	15,007	17,227	15,189	18,804	14,734	12,100	12,428	16,303	20,541	9,383	8,454
1930	D	13,629	12,068	16,533	24,470	18,956	32,310	15,872	14,254	15,772	21,433	10,695	10,287
1931	C	10,447	10,041	11,705	15,456	14,181	12,179	12,879	9,429	12,189	13,566	7,131	8,635
1932	D	10,995	10,569	18,521	20,031	21,658	15,418	17,967	16,026	17,131	12,955	10,731	10,836
1933	C	10,732	10,689	11,721	17,508	16,188	13,743	16,043	11,909	16,371	12,872	7,452	8,633
1934	C	8,779	8,437	15,791	20,729	18,265	18,990	15,890	11,280	16,496	12,596	7,266	8,599
1935	BN	8,764	13,808	13,972	30,768	18,989	30,083	44,586	38,794	20,661	23,571	17,891	11,116
1936	BN	12,943	13,095	13,885	33,910	73,880	36,098	26,518	19,471	19,835	23,475	14,899	11,226
1937	BN	12,184	12,550	16,942	17,078	47,572	52,849	28,918	21,059	22,066	17,836	13,032	11,305
1938	W	12,497	37,142	82,125	37,714	145,290	168,396	73,916	71,148	46,876	17,434	13,752	21,674
1939	D	28,098	20,577	17,881	16,979	17,231	15,409	16,385	14,042	16,043	22,903	15,620	10,663
1940	AN	14,430	12,680	14,038	29,276	57,669	112,108	73,130	23,695	19,323	25,290	20,572	11,722
1941	W	13,586	13,964	50,773	106,137	125,709	103,906	87,643	48,905	24,138	15,577	13,496	17,402
1942	W	25,715	23,961	73,114	86,262	150,187	32,351	57,887	45,064	32,178	15,615	13,499	18,309
1943	W	27,303	27,272	34,826	85,889	67,174	86,884	36,105	25,407	19,052	19,278	14,077	11,343
1944	D	16,670	17,853	13,539	17,572	37,128	27,035	15,144	13,768	18,925	22,897	14,429	11,768
1945	BN	15,530	17,768	20,077	17,363	56,406	33,425	18,562	18,532	21,334	20,317	13,831	11,878
1946	BN	16,605	22,901	79,761	56,838	29,595	25,760	18,580	20,191	20,074	23,620	15,412	12,238
1947	D	14,085	14,558	18,753	17,137	23,232	23,476	18,225	14,162	15,521	22,972	20,622	12,289
1948	BN	16,161	14,700	14,693	17,426	18,366	17,203	26,413	35,462	23,616	23,642	21,290	18,725
1949	D	18,010	16,400	15,144	13,948	15,640	53,476	17,258	19,415	17,721	21,398	13,101	12,747
1950	BN	15,831	13,324	12,834	22,850	38,797	24,697	23,277	19,325	20,003	23,652	21,343	12,399
1951	AN	18,168	55,658	88,997	70,891	73,509	36,060	20,781	24,468	19,271	25,358	19,086	12,910
1952	W	15,530	19,652	52,362	95,602	86,910	68,537	72,080	71,462	47,063	20,961	14,859	24,121
1953	W	27,312	20,161	50,006	105,949	31,097	24,856	23,395	30,931	30,145	20,201	14,853	16,585
1954	AN	22,373	27,425	18,130	35,401	67,276	53,085	47,684	26,895	18,339	25,346	19,853	13,102
1955	D	13,549	19,102	28,305	24,457	21,133	12,929	12,473	14,399	18,713	22,975	20,629	14,209

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Table 2. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	13,760	14,463	82,600	163,295	100,119	42,802	26,230	49,857	28,601	20,999	15,295	19,436
1957	AN	26,747	18,606	14,008	18,541	42,938	49,928	22,398	20,444	19,713	25,348	22,089	13,267
1958	W	21,369	21,078	29,266	40,192	160,586	130,799	110,402	50,503	45,078	18,415	16,147	23,281
1959	BN	27,812	19,861	15,003	40,911	59,684	23,564	14,707	14,340	16,923	23,594	16,772	12,940
1960	D	15,326	13,449	19,349	14,619	31,518	22,731	17,170	13,508	16,051	23,001	19,729	12,750
1961	D	15,126	14,554	18,878	13,931	33,868	20,857	15,930	13,567	15,909	23,039	18,634	12,481
1962	BN	14,506	12,807	18,260	13,472	57,254	29,116	16,187	18,987	16,921	23,619	15,779	13,247
1963	W	41,153	22,600	30,449	18,345	78,387	35,743	97,707	36,724	20,102	23,529	15,082	15,515
1964	D	20,254	34,577	17,490	29,954	18,943	14,493	13,013	14,339	16,037	22,947	20,551	13,987
1965	W	12,424	17,866	83,232	123,362	39,315	24,573	54,673	31,659	19,348	25,131	15,803	12,344
1966	BN	19,032	30,537	19,968	33,242	31,821	30,081	17,934	19,478	16,896	23,570	20,486	12,978
1967	W	14,843	17,758	45,926	53,473	66,721	62,425	56,130	55,784	51,509	25,100	14,949	23,321
1968	BN	27,701	20,307	19,009	32,290	72,042	40,615	16,584	14,839	16,923	23,533	15,507	13,035
1969	W	15,719	15,106	25,706	124,671	139,123	64,238	55,486	69,640	40,619	19,101	14,381	26,775
1970	W	30,222	23,014	62,825	205,607	96,048	42,386	19,230	16,600	17,905	25,169	15,346	12,556
1971	W	15,574	26,706	74,280	56,955	32,304	55,575	24,421	36,343	25,792	25,258	15,661	18,277
1972	BN	21,125	18,655	24,246	20,764	28,491	35,107	16,051	14,321	16,768	23,650	21,387	12,958
1973	AN	16,733	26,126	30,147	78,804	99,340	67,212	24,019	24,218	23,536	25,005	14,706	13,139
1974	W	17,632	70,653	75,685	136,452	51,398	114,185	79,738	31,812	25,327	20,313	15,934	22,780
1975	W	25,059	21,023	20,961	17,970	72,380	92,116	30,385	40,126	29,827	22,373	15,083	20,393
1976	C	25,643	23,552	18,070	14,535	20,409	17,251	12,281	12,692	16,848	17,902	9,810	9,045
1977	C	9,904	12,720	19,320	9,430	14,850	12,144	11,557	9,037	9,118	10,301	7,520	8,458
1978	AN	8,958	7,771	17,975	64,530	64,181	70,978	47,494	26,762	19,546	15,363	13,056	15,554
1979	BN	21,999	18,704	12,410	30,135	50,020	38,024	22,990	21,907	24,429	19,843	13,135	11,707
1980	AN	12,977	21,875	23,599	117,639	136,982	75,977	23,878	21,133	17,386	15,562	13,456	18,073
1981	D	21,764	18,313	19,614	29,218	32,166	36,718	18,792	14,859	15,810	22,900	15,662	11,555
1982	W	14,382	38,289	98,929	85,670	106,984	88,142	151,507	60,410	32,333	21,112	17,205	28,904
1983	W	43,518	54,521	97,317	109,676	190,420	263,354	117,261	91,967	86,357	44,354	23,144	36,258
1984	W	45,971	88,631	162,658	88,628	53,835	43,183	20,941	18,797	19,037	23,872	14,862	18,056
1985	D	21,998	40,499	31,969	18,149	23,538	21,164	14,290	17,051	15,655	22,974	19,347	12,254
1986	W	14,841	13,823	18,757	21,328	226,805	159,453	40,830	20,555	18,059	18,954	14,073	14,035
1987	D	17,307	15,626	13,413	14,948	21,685	35,220	16,211	13,825	15,810	23,014	17,445	11,727
1988	C	12,012	11,806	18,515	27,877	18,226	13,495	11,632	11,937	16,477	17,307	11,555	8,672
1989	D	9,168	10,984	13,313	14,071	15,191	42,569	25,574	17,543	15,713	23,061	20,610	11,635
1990	C	10,721	9,408	15,346	18,782	17,356	12,768	15,645	10,214	16,582	17,405	11,639	9,012
1991	C	9,167	9,123	10,622	11,490	15,193	31,836	17,119	10,600	15,819	13,730	10,752	9,717
Mean		17,942	21,262	32,702	44,832	56,800	48,179	33,651	26,204	22,395	21,216	15,461	14,198

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP).

C-062095

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Appendix B, Table 3. Total Delta Inflow (cfs) under the No–Project Alternative

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	12,008	12,837	20,248	21,765	49,399	39,977	28,771	55,323	42,317	15,883	13,060	12,292
1923	BN	23,964	23,987	42,423	38,708	26,556	17,414	29,780	20,545	19,864	23,604	21,073	11,884
1924	C	13,607	13,868	18,894	17,862	17,867	15,474	10,574	11,135	12,465	15,957	11,500	8,766
1925	D	14,557	12,647	14,691	12,781	54,225	22,709	28,006	18,174	19,178	22,967	17,043	11,893
1926	D	15,939	12,900	14,008	18,943	39,651	17,862	25,030	18,673	15,783	22,970	16,481	11,776
1927	W	15,178	23,718	19,166	34,387	125,022	45,162	54,756	30,380	19,629	19,903	14,824	11,550
1928	AN	15,875	31,612	18,937	28,011	32,343	107,097	32,577	21,764	18,489	25,190	16,886	12,383
1929	C	12,457	15,007	17,227	15,189	18,804	14,734	12,100	12,428	16,303	20,541	9,383	8,454
1930	D	13,629	12,068	16,533	24,470	18,956	32,310	15,872	14,254	15,772	21,433	10,695	10,287
1931	C	10,447	10,041	11,705	15,456	14,181	12,179	12,879	9,429	12,189	13,566	7,131	8,635
1932	D	10,995	10,569	18,521	20,031	21,658	15,418	17,967	16,026	17,131	12,955	10,731	10,836
1933	C	10,732	10,689	11,721	17,508	16,188	13,743	16,043	11,909	16,371	12,872	7,452	8,633
1934	C	8,779	8,437	15,791	20,729	18,265	18,990	15,890	11,280	16,496	12,596	7,266	8,599
1935	BN	8,764	13,808	13,972	30,768	18,989	30,083	44,586	38,794	20,661	23,571	17,891	11,116
1936	BN	12,943	13,095	13,885	33,910	73,880	36,098	26,518	19,471	19,835	23,475	14,899	11,226
1937	BN	12,184	12,550	16,942	17,078	47,572	52,849	28,918	21,059	22,066	17,836	13,032	11,305
1938	W	12,497	37,142	82,125	37,714	145,290	168,396	73,916	71,148	46,876	17,434	13,752	21,674
1939	D	28,098	20,577	17,881	16,979	17,231	15,409	16,385	14,042	16,043	22,903	15,620	10,663
1940	AN	14,430	12,680	14,038	29,276	57,669	112,108	73,130	23,695	19,323	25,290	20,572	11,722
1941	W	13,586	13,964	50,773	106,137	125,709	103,906	87,643	48,905	24,138	15,577	13,496	17,402
1942	W	25,715	23,961	73,114	86,262	150,187	32,351	57,887	45,064	32,178	15,615	13,499	18,309
1943	W	27,303	27,272	34,826	85,889	67,174	86,884	36,105	25,407	19,052	19,278	14,077	11,343
1944	D	16,670	17,853	13,539	17,572	37,128	27,035	15,144	13,768	18,925	22,897	14,429	11,768
1945	BN	15,530	17,768	20,077	17,363	56,406	33,425	18,562	18,532	21,334	20,317	13,831	11,878
1946	BN	16,605	22,901	79,761	56,838	29,595	25,760	18,580	20,191	20,074	23,620	15,412	12,238
1947	D	14,085	14,558	18,753	17,137	23,232	23,476	18,225	14,162	15,521	22,972	20,622	12,289
1948	BN	16,161	14,700	14,693	17,426	18,366	17,203	26,413	35,462	23,616	23,642	21,290	18,725
1949	D	18,010	16,400	15,144	13,948	15,640	53,476	17,258	19,415	17,721	21,398	13,101	12,747
1950	BN	15,831	13,324	12,834	22,850	38,797	24,697	23,277	19,325	20,003	23,652	21,343	12,399
1951	AN	18,168	55,658	88,997	70,891	73,509	36,060	20,781	24,468	19,271	25,358	19,086	12,910
1952	W	15,530	19,652	52,362	95,602	86,910	68,537	72,080	71,462	47,063	20,961	14,859	24,121
1953	W	27,312	20,161	50,006	105,949	31,097	24,856	23,395	30,931	30,145	20,201	14,853	16,585
1954	AN	22,373	27,425	18,130	35,401	67,276	53,085	47,684	26,895	18,339	25,346	19,853	13,102
1955	D	13,549	19,102	28,305	24,457	21,133	12,929	12,473	14,399	18,713	22,975	20,629	14,209

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C-062096

Table 3. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	13,760	14,463	82,600	163,295	100,119	42,802	26,230	49,857	28,601	20,999	15,295	19,436
1957	AN	26,747	18,606	14,008	18,541	42,938	49,928	22,398	20,444	19,713	25,348	22,089	13,267
1958	W	21,369	21,078	29,266	40,192	160,586	130,799	110,402	50,503	45,078	18,415	16,147	23,281
1959	BN	27,812	19,861	15,003	40,911	59,684	23,564	14,707	14,340	16,923	23,594	16,772	12,940
1960	D	15,326	13,449	19,349	14,619	31,518	22,731	17,170	13,508	16,051	23,001	19,729	12,750
1961	D	15,126	14,554	18,878	13,931	33,868	20,857	15,930	13,567	15,909	23,039	18,634	12,481
1962	BN	14,506	12,807	18,260	13,472	57,254	29,116	16,187	18,987	16,921	23,619	15,779	13,247
1963	W	41,153	22,600	30,449	18,345	78,387	35,743	97,707	36,724	20,102	23,529	15,082	15,515
1964	D	20,254	34,577	17,490	29,954	18,943	14,493	13,013	14,339	16,037	22,947	20,551	13,987
1965	W	12,424	17,866	83,232	123,362	39,315	24,573	54,673	31,659	19,348	25,131	15,803	12,344
1966	BN	19,032	30,537	19,968	33,242	31,821	30,081	17,934	19,478	16,896	23,570	20,486	12,978
1967	W	14,843	17,758	45,926	53,473	66,721	62,425	56,130	55,784	51,509	25,100	14,949	23,321
1968	BN	27,701	20,307	19,009	32,290	72,042	40,615	16,584	14,839	16,923	23,533	15,507	13,035
1969	W	15,719	15,106	25,706	124,671	139,123	64,238	55,486	69,640	40,619	19,101	14,381	26,775
1970	W	30,222	23,014	62,825	205,607	96,048	42,386	19,230	16,600	17,905	25,169	15,346	12,556
1971	W	15,574	26,706	74,280	56,955	32,304	55,575	24,421	36,343	25,792	25,258	15,661	18,277
1972	BN	21,125	18,655	24,246	20,764	28,491	35,107	16,051	14,321	16,768	23,650	21,387	12,958
1973	AN	16,733	26,126	30,147	78,804	99,340	67,212	24,019	24,218	23,536	25,005	14,706	13,139
1974	W	17,632	70,653	75,685	136,452	51,398	114,185	79,738	31,812	25,327	20,313	15,934	22,780
1975	W	25,059	21,023	20,961	17,970	72,380	92,116	30,385	40,126	29,827	22,373	15,083	20,393
1976	C	25,643	23,552	18,070	14,535	20,409	17,251	12,281	12,692	16,848	17,902	9,810	9,045
1977	C	9,904	12,720	19,320	9,430	14,850	12,144	11,557	9,037	9,118	10,301	7,520	8,458
1978	AN	8,958	7,771	17,975	64,530	64,181	70,978	47,494	26,762	19,546	15,363	13,056	15,554
1979	BN	21,999	18,704	12,410	30,135	50,020	38,024	22,990	21,907	24,429	19,843	13,135	11,707
1980	AN	12,977	21,875	23,599	117,639	136,982	75,977	23,878	21,133	17,386	15,562	13,456	18,073
1981	D	21,764	18,313	19,614	29,218	32,166	36,718	18,792	14,859	15,810	22,900	15,662	11,555
1982	W	14,382	38,289	98,929	85,670	106,984	88,142	151,507	60,410	32,333	21,112	17,205	28,904
1983	W	43,518	54,521	97,317	109,676	190,420	263,354	117,261	91,967	86,357	44,354	23,144	36,258
1984	W	45,971	88,631	162,658	88,628	53,835	43,183	20,941	18,797	19,037	23,872	14,862	18,056
1985	D	21,998	40,499	31,969	18,149	23,538	21,164	14,290	17,051	15,655	22,974	19,347	12,254
1986	W	14,841	13,823	18,757	21,328	226,805	159,453	40,830	20,555	18,059	18,954	14,073	14,035
1987	D	17,307	15,626	13,413	14,948	21,685	35,220	16,211	13,825	15,810	23,014	17,445	11,727
1988	C	12,012	11,806	18,515	27,877	18,226	13,495	11,632	11,937	16,477	17,307	11,555	8,672
1989	D	9,168	10,984	13,313	14,071	15,191	42,569	25,574	17,543	15,713	23,061	20,610	11,635
1990	C	10,721	9,408	15,346	18,782	17,356	12,768	15,645	10,214	16,582	17,405	11,639	9,012
1991	C	9,167	9,123	10,622	11,490	15,193	31,836	17,119	10,600	15,819	13,730	10,752	9,717
Mean		17,942	21,262	32,702	44,832	56,800	48,179	33,651	26,204	22,395	21,216	15,461	14,198

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP).

C-062097

C-062097

Appendix B, Table 4. DCC and Georgiana Slough Flow (cfs) under the No–Project Alternative

Water Year	Year Type [a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	5,571	2,528	3,184	3,347	5,854	5,012	3,884	7,282	5,531	6,748	5,744	5,580
1923	BN	8,930	3,773	5,394	5,045	3,719	2,900	4,077	3,040	7,425	8,850	8,199	5,680
1924	C	6,021	2,687	3,280	3,179	3,160	2,991	2,249	2,337	5,657	6,946	5,634	4,023
1925	D	6,432	2,569	2,716	2,588	6,048	3,623	4,023	2,878	7,550	8,733	7,350	5,740
1926	D	6,899	2,534	2,692	3,322	5,469	3,115	3,460	3,082	6,761	8,737	7,210	5,712
1927	W	6,653	3,843	3,176	5,215	10,991	6,201	7,268	4,299	7,369	7,866	6,420	5,407
1928	AN	6,856	4,813	3,155	4,303	4,605	13,651	4,662	3,411	7,397	9,287	7,330	5,922
1929	C	5,648	2,758	3,042	2,822	3,172	2,805	2,419	2,476	6,938	8,195	4,743	3,763
1930	D	6,199	2,571	3,094	3,930	3,248	4,895	2,823	2,719	6,724	8,380	5,286	5,066
1931	C	4,345	2,218	2,486	2,862	2,640	2,506	2,552	2,116	5,558	6,189	3,471	3,764
1932	D	5,235	2,229	3,087	3,357	3,043	2,802	2,885	2,636	6,997	5,885	5,104	5,279
1933	C	4,281	2,335	2,467	3,054	2,930	2,709	2,823	2,293	6,857	5,849	3,445	3,767
1934	C	3,922	2,052	2,904	3,400	3,027	3,375	2,925	2,356	6,983	5,840	3,548	3,790
1935	BN	3,906	2,638	2,717	4,409	3,061	4,068	3,813	5,358	7,633	8,822	7,348	5,223
1936	BN	6,003	2,627	2,699	4,855	5,905	5,197	3,649	2,927	7,398	8,809	6,471	5,327
1937	BN	5,748	2,564	2,999	2,903	5,462	5,954	3,879	2,981	8,020	7,323	5,803	5,236
1938	W	5,648	5,516	8,959	5,158	12,617	11,997	7,277	8,578	5,449	6,743	6,001	7,895
1939	D	9,601	3,466	3,058	2,945	2,863	2,859	2,862	2,607	6,833	8,719	6,935	5,304
1940	AN	6,480	2,645	2,813	4,246	6,896	10,134	6,389	3,419	7,307	9,272	8,086	5,475
1941	W	6,042	2,747	5,298	10,487	11,512	8,902	6,738	6,348	8,389	6,642	5,900	7,097
1942	W	9,086	3,895	10,144	9,796	12,219	4,263	7,001	5,919	4,583	6,625	5,918	7,048
1943	W	9,081	4,217	5,065	8,896	8,113	9,848	4,776	3,542	7,207	7,721	6,199	5,326
1944	D	6,948	3,200	2,633	3,050	5,143	4,046	2,554	2,494	7,617	8,710	6,542	5,613
1945	BN	6,821	2,982	3,283	2,887	6,795	4,638	2,731	2,809	8,139	7,979	6,085	5,481
1946	BN	6,579	3,701	9,012	6,821	4,425	3,864	2,758	3,026	7,848	8,882	6,716	5,704
1947	D	6,254	2,672	3,169	3,075	3,697	3,765	2,960	2,618	6,682	8,734	8,310	5,831
1948	BN	6,931	2,812	2,910	3,237	3,318	3,080	3,892	5,120	8,653	8,892	8,363	7,812
1949	D	7,542	3,052	2,874	2,690	2,859	7,333	2,783	3,078	7,292	8,337	6,148	6,034
1950	BN	6,835	2,636	2,655	3,658	5,573	3,924	3,461	3,056	7,885	8,901	8,447	5,925
1951	AN	7,523	6,757	8,585	8,852	9,352	4,922	3,041	3,534	7,278	9,329	7,823	6,054
1952	W	6,795	3,345	7,384	10,245	9,958	8,737	8,959	9,433	6,221	7,795	6,350	8,501
1953	W	9,345	3,440	6,953	9,929	4,545	3,955	3,528	4,477	4,653	8,010	6,443	7,114
1954	AN	8,575	4,361	3,230	5,435	8,990	7,493	6,564	3,960	7,323	9,297	8,021	6,061
1955	D	6,018	3,323	4,400	3,730	3,507	2,616	2,333	2,572	7,575	8,738	8,284	6,446

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Table 4. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	6,148	2,820	5,028	11,510	10,625	5,676	3,575	6,614	8,993	8,080	6,463	7,640
1957	AN	8,962	3,291	2,740	3,211	6,155	6,801	3,428	3,141	7,667	9,283	8,549	6,069
1958	W	8,440	3,575	4,549	5,920	9,769	14,528	8,219	6,595	5,808	7,330	6,675	8,505
1959	BN	9,210	3,400	2,823	6,011	7,952	3,803	2,566	2,610	7,022	8,836	7,173	6,056
1960	D	6,611	2,749	3,495	2,807	4,358	3,648	2,998	2,584	6,833	8,782	8,066	5,929
1961	D	6,577	2,803	3,410	2,691	5,109	3,604	2,893	2,631	6,787	8,848	7,775	5,709
1962	BN	6,377	2,580	3,284	2,761	6,692	4,280	2,671	3,139	7,175	8,882	6,760	6,080
1963	W	5,049	3,869	4,767	3,251	8,683	5,091	10,649	4,958	7,415	8,758	6,470	6,820
1964	D	8,137	5,223	3,081	4,504	3,282	2,842	2,428	2,609	6,827	8,726	8,289	6,390
1965	W	5,848	3,183	5,706	12,324	5,457	3,753	7,151	4,314	7,229	9,091	6,573	5,583
1966	BN	7,341	4,518	3,185	4,686	4,529	4,597	2,885	3,132	7,019	8,795	8,214	6,036
1967	W	6,454	3,125	6,421	5,635	6,826	8,208	6,212	7,155	6,450	7,223	6,407	8,373
1968	BN	9,390	3,499	3,273	4,818	9,526	5,653	2,773	2,578	7,019	8,773	6,787	6,046
1969	W	6,864	2,812	4,093	11,224	10,385	6,966	6,868	7,045	9,735	6,450	6,140	9,339
1970	W	8,964	3,596	8,093	14,157	8,759	5,495	2,894	2,538	7,099	9,149	6,546	5,799
1971	W	6,772	4,018	9,183	7,477	4,882	7,940	3,668	5,213	9,195	9,226	6,685	7,595
1972	BN	8,191	3,307	3,889	3,531	4,437	5,359	2,687	2,577	6,948	8,754	8,338	5,741
1973	AN	7,165	4,047	4,686	7,353	11,080	7,243	3,365	3,480	8,356	9,140	6,357	6,023
1974	W	7,169	8,883	9,394	12,172	6,706	15,142	5,981	4,322	8,795	7,917	6,744	8,751
1975	W	9,183	3,477	3,486	3,255	9,563	11,451	3,948	5,351	9,717	8,426	6,483	8,019
1976	C	9,245	3,817	3,204	2,927	3,633	3,130	2,470	2,529	7,071	7,583	4,796	4,489
1977	C	4,752	2,638	3,514	2,276	2,932	2,538	2,359	1,994	4,067	5,057	3,717	3,833
1978	AN	3,898	1,992	3,173	6,997	7,910	7,538	6,098	3,707	6,948	6,558	5,823	6,788
1979	BN	8,101	3,233	2,580	4,401	6,464	5,137	3,331	3,190	8,634	7,893	5,971	5,527
1980	AN	5,762	3,509	3,721	10,739	10,683	5,851	3,331	2,987	6,339	6,496	5,911	6,997
1981	D	7,790	3,030	3,279	4,423	4,791	5,373	3,081	2,605	6,761	8,686	6,931	5,582
1982	W	6,513	5,368	11,036	8,297	10,908	9,620	12,176	5,832	9,141	7,181	6,826	9,285
1983	W	5,049	6,444	9,062	8,910	12,765	13,478	9,991	8,756	8,015	9,345	7,328	9,595
1984	W	4,720	10,008	13,153	7,205	6,279	5,461	3,015	2,820	7,282	8,847	6,304	7,193
1985	D	7,785	5,712	4,558	3,039	3,708	3,473	2,477	2,965	6,711	8,737	7,953	5,792
1986	W	6,479	2,599	3,161	3,593	16,843	10,473	3,638	2,629	6,394	7,539	6,048	5,863
1987	D	5,768	2,765	2,426	2,852	3,645	5,309	2,918	2,679	6,761	8,811	7,481	5,624
1988	C	5,674	2,481	3,247	4,404	3,383	2,745	2,389	2,438	6,964	7,378	5,626	3,866
1989	D	3,893	2,424	2,702	2,866	2,989	6,306	4,031	3,073	6,703	8,913	8,311	5,722
1990	C	4,908	2,251	3,031	3,401	3,149	2,634	2,855	2,222	7,054	7,463	5,672	4,138
1991	C	3,887	2,206	2,413	2,563	2,984	4,861	3,010	2,242	6,809	6,387	5,340	4,816
Mean		6,683	3,497	4,434	5,313	6,322	5,774	4,186	3,772	7,164	8,073	6,589	6,080

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP). Negative values shown in parentheses.

C-062099

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Appendix B, Table 5. QWEST Flow (cfs) under the No–Project Alternative

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	(108)	(2,599)	(4,203)	(3,414)	7,159	2,634	1,612	4,915	169	2,630	1,501	(276)
1923	BN	(1,194)	(4,488)	3,436	1,631	5,986	251	2,103	924	842	(3,292)	(3,106)	(549)
1924	C	(835)	(3,244)	(5,901)	(6,099)	(2,764)	(269)	520	(323)	646	(878)	(210)	240
1925	D	(1,088)	(2,736)	(3,843)	(2,507)	1,797	(1,410)	1,763	820	705	(3,578)	(1,933)	(489)
1926	D	(1,525)	(2,618)	(3,270)	(5,914)	(930)	(980)	2,054	335	574	(3,576)	(1,684)	(475)
1927	W	(1,409)	(5,629)	(6,596)	(3,201)	8,484	(664)	4,901	208	957	(230)	649	(372)
1928	AN	(1,511)	(3,909)	(5,437)	(4,129)	(2,700)	9,137	822	331	472	(3,027)	(1,196)	(578)
1929	C	(183)	(3,727)	(5,195)	(4,253)	(2,393)	370	836	(97)	949	(2,697)	1,012	257
1930	D	(681)	(2,671)	(5,007)	(4,555)	(598)	(3,200)	853	(19)	658	(2,797)	970	(166)
1931	C	147	(901)	(2,241)	(4,566)	(803)	(284)	429	219	744	(188)	2,017	256
1932	D	(230)	(1,272)	(4,123)	(4,986)	1,291	1,834	1,486	1,717	4,447	1,390	1,235	(158)
1933	C	179	(1,611)	(2,371)	(5,026)	(2,015)	(552)	1,156	635	1,052	450	2,031	255
1934	C	145	(561)	(4,267)	(5,270)	878	(1,988)	399	(175)	765	465	1,978	242
1935	BN	161	(2,963)	(3,709)	(2,455)	(482)	(630)	4,539	1,607	1,543	(3,239)	(1,656)	(304)
1936	BN	(692)	(2,972)	(3,376)	(1,490)	11,956	(1,687)	1,642	1,205	1,042	(3,297)	(533)	(357)
1937	BN	(413)	(2,655)	(4,629)	(3,958)	6,996	11,267	1,608	1,887	2,444	(270)	765	(293)
1938	W	(283)	(3,819)	1,662	(1,573)	28,153	30,753	6,864	11,387	4,778	2,642	1,482	(855)
1939	D	918	(5,830)	(5,738)	(4,753)	(723)	(348)	834	95	565	(3,600)	(1,423)	(379)
1940	AN	(1,093)	(2,984)	(3,822)	(1,587)	4,358	6,579	3,194	831	704	(2,883)	(2,235)	(424)
1941	W	(915)	(3,496)	(1,283)	6,457	11,945	13,431	9,333	1,906	1,737	2,869	1,667	(1,487)
1942	W	37	(5,358)	3,805	8,618	12,305	(2,476)	5,901	2,472	(3,747)	2,908	1,634	(1,412)
1943	W	1,641	(4,150)	(2,715)	9,051	8,375	16,953	1,507	2,133	959	170	1,100	(344)
1944	D	(1,527)	(5,810)	(3,062)	(5,263)	(668)	(2,116)	1,356	775	612	(3,578)	(970)	(436)
1945	BN	(1,554)	(4,771)	(4,657)	(4,290)	5,132	(529)	2,044	272	583	(1,850)	250	(401)
1946	BN	(1,355)	(5,033)	5,510	(146)	1,114	(766)	2,116	774	572	(3,360)	(709)	(473)
1947	D	(1,070)	(3,201)	(5,554)	(5,501)	(3,380)	(1,547)	964	69	705	(3,577)	(3,878)	(725)
1948	BN	(1,763)	(3,741)	(4,240)	(6,376)	(1,682)	(581)	1,848	400	809	(3,379)	(3,366)	(3,113)
1949	D	(2,892)	(4,941)	(4,303)	(3,806)	(1,707)	1,702	956	375	542	(2,722)	(487)	(652)
1950	BN	(1,481)	(2,993)	(3,125)	(4,042)	(1,462)	(1,795)	1,233	749	425	(3,398)	(3,558)	(668)
1951	AN	(2,567)	3,999	13,969	8,756	5,231	(695)	1,612	639	766	(2,987)	(1,811)	(737)
1952	W	(1,618)	(5,750)	1,803	13,580	6,523	7,087	7,805	8,413	515	(71)	745	(330)
1953	W	757	(5,948)	(293)	4,610	(2,329)	(2,411)	993	(271)	(5,589)	(648)	328	(1,725)
1954	AN	(1,862)	(5,031)	(5,915)	(3,812)	391	(117)	2,230	(39)	523	(3,017)	(2,472)	(841)
1955	D	(896)	(6,299)	(4,333)	(2,556)	(3,249)	(543)	1,097	229	476	(3,584)	(3,943)	(1,328)

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Table 5. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	(994)	(3,838)	3,831	24,880	8,760	(2,037)	1,487	3,025	2,507	(1,060)	151	(2,645)
1957	AN	1,421	(6,017)	(3,391)	(5,361)	(1,716)	(678)	1,391	676	570	(3,005)	(3,468)	(1,001)
1958	W	(2,117)	(6,009)	(4,378)	(835)	10,402	17,943	21,459	3,642	924	819	(396)	(1,462)
1959	BN	1,626	(6,034)	(4,027)	(2,135)	2,254	(551)	907	(83)	450	(3,485)	(1,675)	(1,173)
1960	D	(1,435)	(3,408)	(6,967)	(4,308)	(3,235)	(1,613)	679	(78)	582	(3,690)	(3,369)	(727)
1961	D	(1,266)	(3,928)	(6,754)	(3,797)	(4,318)	(2,233)	433	(156)	585	(3,850)	(2,794)	(647)
1962	BN	(1,188)	(2,830)	(6,034)	(3,407)	3,745	(2,892)	1,356	100	308	(3,409)	(939)	(861)
1963	W	(4,316)	(6,506)	(4,616)	(5,249)	3,993	(1,414)	10,570	902	1,629	(2,277)	104	(1,456)
1964	D	(2,505)	(3,617)	(5,305)	(3,340)	(1,499)	(1,140)	1,036	164	861	(3,567)	(3,909)	(1,196)
1965	W	(689)	(5,534)	3,509	13,548	(1,680)	(1,109)	4,584	863	825	(2,781)	(115)	(593)
1966	BN	(1,724)	(2,877)	(4,062)	(2,180)	(2,031)	(3,629)	869	(71)	484	(3,466)	(3,395)	(819)
1967	W	(1,229)	(5,682)	(225)	3,783	859	2,833	8,549	5,167	3,254	2,405	480	(905)
1968	BN	1,062	(6,229)	(5,923)	(3,326)	2,396	(2,206)	1,324	161	457	(3,538)	(1,301)	(796)
1969	W	(1,611)	(3,841)	(4,936)	14,975	27,845	6,135	7,609	18,944	10,949	2,884	828	(298)
1970	W	5,072	(4,214)	1,343	25,459	6,436	(153)	1,784	224	763	(3,116)	(46)	(659)
1971	W	(1,453)	(3,703)	5,365	(327)	(1,363)	(190)	989	153	222	(3,036)	(206)	(2,458)
1972	BN	(1,924)	(6,388)	(4,763)	(5,550)	(2,659)	(3,979)	1,448	109	509	(3,542)	(3,895)	(841)
1973	AN	(2,069)	(4,000)	(4,249)	5,235	11,326	6,274	1,474	473	318	(2,985)	(64)	(786)
1974	W	(1,927)	1,491	4,272	9,523	(1,332)	11,431	3,790	306	1,120	(892)	(341)	(2,441)
1975	W	(699)	(5,380)	(5,487)	(6,303)	5,599	9,359	1,631	1,377	1,052	(2,118)	176	(2,659)
1976	C	(222)	(5,208)	(5,785)	(4,596)	(4,607)	(1,883)	612	(423)	563	(1,759)	440	177
1977	C	(6)	(2,946)	(7,117)	(1,543)	(2,265)	(670)	709	376	2,385	1,511	1,827	220
1978	AN	170	(481)	(6,044)	4,365	3,348	3,411	4,458	647	2,730	2,779	1,285	(1,118)
1979	BN	(776)	(5,918)	(2,741)	(1,827)	4,303	488	1,471	790	301	(1,965)	464	(403)
1980	AN	(533)	(4,727)	(4,910)	16,324	24,362	18,844	2,111	1,727	2,617	2,863	1,028	(1,325)
1981	D	(128)	(4,834)	(5,504)	(3,470)	(3,133)	(1,680)	1,120	125	582	(3,620)	(1,429)	(443)
1982	W	(1,163)	(3,585)	4,250	10,798	12,801	20,576	36,876	17,191	4,852	1,492	(194)	2,682
1983	W	6,438	8,177	26,133	30,579	51,361	67,257	35,947	28,435	28,215	15,959	1,372	8,875
1984	W	10,848	17,092	33,500	22,573	7,505	2,897	1,931	7	1,421	(2,271)	883	(1,612)
1985	D	(937)	(1,031)	(1,642)	(4,913)	(865)	(357)	994	34	661	(3,582)	(3,111)	(528)
1986	W	(1,128)	(3,016)	(5,561)	(4,421)	36,564	36,224	12,112	3,546	2,851	655	1,393	(421)
1987	D	71	(3,480)	(2,161)	(4,340)	(3,550)	(2,931)	500	(356)	580	(3,764)	(2,222)	(440)
1988	C	(271)	(2,421)	(6,108)	(4,450)	(2,249)	(1,152)	916	78	779	(1,436)	(197)	251
1989	D	172	(2,112)	(3,256)	(4,371)	(2,794)	(1,918)	(8)	(412)	692	(4,016)	(3,842)	(578)
1990	C	121	(1,059)	(4,486)	(6,323)	(1,463)	(862)	556	669	579	(1,572)	(247)	231
1991	C	164	(1,013)	(2,124)	(2,921)	(2,546)	(3,317)	663	271	1,110	(380)	218	164
Mean		(456)	(3,212)	(1,848)	570	4,011	3,450	3,614	1,914	1,475	(1,357)	(604)	(540)

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP). Negative values shown in parentheses.

C-062101

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Appendix B, Table 6. Old and Middle River Flow (cfs) under the No–Project Alternative

Water Year	Year Type [a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	(7,174)	(5,541)	(9,253)	(8,883)	(7,396)	(7,104)	(9,274)	(10,722)	(8,757)	(3,674)	(4,173)	(5,890)
1923	BN	(11,852)	(9,491)	(7,824)	(8,457)	(784)	(4,037)	(8,481)	(7,453)	(5,794)	(11,659)	(11,133)	(6,038)
1924	C	(8,693)	(6,213)	(9,630)	(9,891)	(6,495)	(3,270)	(3,569)	(4,172)	(4,572)	(7,166)	(5,354)	(3,552)
1925	D	(9,033)	(5,631)	(7,527)	(5,848)	(8,957)	(6,345)	(7,467)	(6,218)	(6,360)	(11,765)	(8,832)	(5,995)
1926	D	(9,842)	(5,563)	(6,393)	(9,821)	(9,027)	(4,816)	(6,531)	(6,017)	(5,766)	(11,767)	(8,433)	(5,943)
1927	W	(9,454)	(10,201)	(10,159)	(9,746)	(8,308)	(9,196)	(9,270)	(9,349)	(5,665)	(7,668)	(5,621)	(5,698)
1928	AN	(9,873)	(9,536)	(9,531)	(9,519)	(8,994)	(9,144)	(8,623)	(6,748)	(6,258)	(11,767)	(8,056)	(6,259)
1929	C	(7,524)	(7,168)	(8,892)	(7,879)	(6,623)	(2,974)	(3,743)	(4,354)	(5,745)	(10,250)	(3,256)	(3,264)
1930	D	(8,223)	(5,150)	(8,302)	(9,583)	(4,797)	(9,760)	(4,054)	(4,538)	(5,709)	(10,589)	(3,858)	(5,041)
1931	C	(5,694)	(3,386)	(4,763)	(8,290)	(4,409)	(3,060)	(3,929)	(3,605)	(4,405)	(5,730)	(972)	(3,311)
1932	D	(6,802)	(3,949)	(9,034)	(9,655)	(6,690)	(1,822)	(5,646)	(5,046)	(2,453)	(3,929)	(3,521)	(5,231)
1933	C	(5,790)	(4,001)	(5,000)	(9,254)	(5,621)	(3,734)	(4,480)	(4,449)	(5,619)	(4,848)	(1,024)	(3,319)
1934	C	(5,041)	(2,652)	(7,864)	(9,890)	(3,962)	(5,647)	(4,394)	(4,102)	(5,831)	(4,738)	(1,091)	(3,359)
1935	BN	(4,953)	(6,072)	(6,878)	(8,968)	(4,041)	(7,416)	(8,907)	(9,182)	(6,532)	(11,608)	(8,834)	(5,456)
1936	BN	(7,888)	(5,756)	(6,391)	(9,162)	(7,203)	(9,228)	(8,179)	(6,966)	(5,639)	(11,636)	(6,821)	(5,568)
1937	BN	(7,339)	(5,357)	(8,323)	(8,426)	(7,008)	(4,652)	(9,252)	(7,347)	(5,102)	(7,139)	(4,893)	(5,511)
1938	W	(7,651)	(9,842)	(9,418)	(8,924)	(1,343)	1,432	(10,112)	(4,615)	(5,889)	(4,331)	(4,440)	(9,583)
1939	D	(11,787)	(9,775)	(9,577)	(8,825)	(5,188)	(3,994)	(4,825)	(4,903)	(5,850)	(11,770)	(7,914)	(5,411)
1940	AN	(8,894)	(5,546)	(6,637)	(8,699)	(7,767)	(8,591)	(9,458)	(7,661)	(5,608)	(11,667)	(10,125)	(5,823)
1941	W	(8,669)	(6,339)	(8,634)	(7,911)	(6,511)	(3,561)	(4,462)	(10,618)	(7,486)	(3,344)	(4,166)	(8,802)
1942	W	(11,793)	(9,758)	(8,759)	(8,076)	(7,702)	(8,986)	(9,631)	(10,585)	(9,963)	(3,344)	(4,198)	(9,151)
1943	W	(11,771)	(9,600)	(9,439)	(8,196)	(7,013)	(6,289)	(10,128)	(7,552)	(5,337)	(7,092)	(4,920)	(5,587)
1944	D	(10,353)	(9,205)	(6,103)	(9,366)	(8,670)	(7,963)	(4,388)	(4,838)	(6,753)	(11,750)	(7,094)	(5,868)
1945	BN	(9,547)	(9,104)	(9,337)	(8,631)	(8,425)	(8,792)	(6,359)	(6,527)	(7,500)	(9,395)	(5,691)	(5,851)
1946	BN	(11,007)	(9,720)	(8,760)	(9,530)	(4,961)	(6,750)	(6,406)	(6,164)	(7,066)	(11,721)	(7,142)	(6,072)
1947	D	(8,882)	(6,676)	(9,551)	(9,191)	(8,302)	(6,470)	(4,940)	(4,965)	(5,590)	(11,765)	(11,730)	(6,321)
1948	BN	(10,167)	(6,831)	(7,115)	(9,849)	(5,304)	(4,626)	(6,996)	(9,071)	(8,051)	(11,760)	(11,404)	(10,702)
1949	D	(11,637)	(8,095)	(7,520)	(7,134)	(5,451)	(9,201)	(6,064)	(5,845)	(6,424)	(10,524)	(6,195)	(6,464)
1950	BN	(9,837)	(5,847)	(5,819)	(9,496)	(9,707)	(7,015)	(7,036)	(6,353)	(7,178)	(11,757)	(11,594)	(6,291)
1951	AN	(11,534)	(9,467)	(6,554)	(8,055)	(9,025)	(9,189)	(7,042)	(8,261)	(5,576)	(11,768)	(9,272)	(6,558)
1952	W	(9,666)	(9,730)	(9,127)	(7,238)	(9,261)	(8,617)	(10,088)	(10,680)	(8,532)	(8,024)	(5,534)	(9,631)
1953	W	(11,905)	(9,805)	(8,918)	(8,923)	(8,660)	(7,194)	(6,882)	(8,782)	(10,394)	(8,140)	(5,859)	(8,640)
1954	AN	(11,946)	(9,819)	(9,461)	(9,924)	(9,848)	(9,508)	(8,756)	(7,720)	(6,148)	(11,767)	(10,037)	(6,664)
1955	D	(8,532)	(9,963)	(9,833)	(9,216)	(7,681)	(3,564)	(4,247)	(5,197)	(6,773)	(11,772)	(11,760)	(7,527)

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Table 6. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	(8,658)	(6,770)	(8,479)	(3,180)	(7,595)	(9,378)	(8,510)	(10,663)	(8,244)	(8,733)	(6,135)	(10,422)
1957	AN	(11,748)	(9,545)	(6,322)	(9,435)	(9,523)	(9,658)	(6,149)	(6,641)	(6,573)	(11,750)	(11,602)	(6,882)
1958	W	(11,805)	(9,895)	(9,672)	(8,816)	(7,317)	(6,038)	(2,935)	(10,592)	(8,051)	(6,141)	(6,949)	(10,269)
1959	BN	(11,841)	(9,807)	(7,125)	(9,525)	(8,922)	(4,971)	(4,326)	(5,054)	(6,155)	(11,772)	(8,390)	(6,686)
1960	D	(9,680)	(6,049)	(10,365)	(7,778)	(9,465)	(6,398)	(4,354)	(4,420)	(5,851)	(11,870)	(10,967)	(6,438)
1961	D	(9,410)	(7,030)	(10,148)	(7,336)	(10,003)	(6,151)	(4,112)	(4,450)	(5,801)	(12,024)	(10,092)	(6,237)
1962	BN	(9,140)	(5,644)	(9,422)	(6,396)	(7,951)	(8,594)	(4,732)	(5,963)	(6,411)	(11,752)	(7,402)	(6,731)
1963	W	(11,604)	(10,380)	(9,838)	(9,333)	(9,136)	(8,796)	(8,806)	(9,885)	(6,301)	(10,520)	(6,090)	(8,063)
1964	D	(11,831)	(9,757)	(8,841)	(9,530)	(4,841)	(4,160)	(4,274)	(5,055)	(5,674)	(11,754)	(11,744)	(7,353)
1965	W	(7,726)	(9,154)	(9,208)	(8,192)	(9,711)	(6,298)	(10,027)	(9,497)	(5,623)	(11,503)	(6,625)	(6,109)
1966	BN	(11,911)	(8,902)	(8,920)	(9,063)	(8,551)	(9,073)	(6,172)	(5,872)	(6,129)	(11,735)	(11,135)	(6,611)
1967	W	(9,395)	(9,412)	(8,827)	(7,595)	(9,264)	(8,760)	(9,698)	(10,728)	(7,323)	(7,694)	(5,765)	(9,879)
1968	BN	(11,876)	(10,048)	(9,799)	(9,427)	(9,595)	(9,521)	(5,186)	(4,852)	(6,149)	(11,765)	(7,769)	(6,611)
1969	W	(9,721)	(7,168)	(9,884)	(7,531)	(539)	(6,945)	(10,140)	13	(4,713)	(4,797)	(5,168)	(10,099)
1970	W	(11,530)	(8,942)	(8,846)	(4,230)	(7,935)	(9,228)	(6,454)	(6,039)	(6,168)	(11,736)	(6,330)	(6,292)
1971	W	(9,679)	(9,337)	(8,635)	(9,692)	(7,409)	(9,658)	(7,113)	(9,176)	(8,945)	(11,734)	(6,634)	(9,867)
1972	BN	(11,936)	(9,995)	(9,858)	(9,843)	(8,274)	(9,931)	(5,127)	(5,045)	(6,064)	(11,766)	(11,765)	(6,620)
1973	AN	(10,568)	(9,223)	(9,646)	(7,856)	(8,208)	(7,402)	(7,856)	(8,374)	(7,089)	(11,585)	(6,158)	(6,642)
1974	W	(11,362)	(9,530)	(9,091)	(9,017)	(9,711)	(8,856)	(10,054)	(10,248)	(8,105)	(8,413)	(6,857)	(11,030)
1975	W	(11,838)	(9,677)	(9,833)	(10,036)	(8,625)	(8,571)	(9,462)	(10,780)	(9,734)	(10,076)	(6,099)	(10,695)
1976	C	(11,728)	(9,659)	(9,300)	(7,582)	(8,361)	(5,192)	(3,769)	(4,534)	(6,094)	(8,592)	(3,867)	(4,017)
1977	C	(6,092)	(5,551)	(10,486)	(3,901)	(5,177)	(3,299)	(3,565)	(3,293)	(1,260)	(2,787)	(1,403)	(3,421)
1978	AN	(5,098)	(2,504)	(9,710)	(7,752)	(8,657)	(8,262)	(9,974)	(9,284)	(5,272)	(3,266)	(4,351)	(7,786)
1979	BN	(11,887)	(9,677)	(5,366)	(8,855)	(8,120)	(8,687)	(7,582)	(7,904)	(7,401)	(9,326)	(5,226)	(5,799)
1980	AN	(8,303)	(9,239)	(9,518)	(5,975)	(1,198)	597	(7,794)	(7,288)	(4,550)	(3,339)	(4,717)	(8,977)
1981	D	(11,848)	(9,027)	(9,548)	(9,409)	(9,020)	(9,197)	(5,526)	(4,862)	(5,764)	(11,762)	(7,926)	(5,841)
1982	W	(8,901)	(10,061)	(9,656)	(7,904)	(8,601)	(2,946)	2,269	(1,057)	(8,326)	(7,398)	(7,624)	(8,560)
1983	W	(4,528)	(5,920)	(646)	1,546	9,262	15,315	6,363	3,811	4,599	(2,658)	(8,752)	(5,770)
1984	W	(1,992)	(4,483)	313	879	(6,217)	(7,582)	(7,172)	(6,888)	(6,296)	(10,931)	(5,677)	(9,426)
1985	D	(11,742)	(8,725)	(8,687)	(9,277)	(6,179)	(5,399)	(4,532)	(5,460)	(5,674)	(11,770)	(10,631)	(6,151)
1986	W	(9,331)	(6,314)	(9,627)	(9,539)	(3,781)	3,228	(1,612)	(7,524)	(5,009)	(6,674)	(4,816)	(6,928)
1987	D	(11,723)	(7,248)	(5,729)	(7,752)	(8,151)	(9,522)	(4,435)	(4,581)	(5,754)	(11,927)	(9,223)	(5,863)
1988	C	(7,212)	(5,169)	(10,072)	(9,682)	(5,645)	(3,868)	(3,472)	(4,055)	(5,846)	(8,107)	(5,348)	(3,396)
1989	D	(5,285)	(4,672)	(6,241)	(7,387)	(5,997)	(9,819)	(6,690)	(5,156)	(5,658)	(12,193)	(11,711)	(6,222)
1990	C	(6,026)	(3,301)	(7,311)	(10,098)	(5,044)	(3,715)	(4,331)	(3,426)	(6,053)	(8,281)	(5,441)	(3,713)
1991	C	(5,320)	(3,151)	(4,461)	(5,372)	(5,649)	(9,803)	(4,425)	(3,841)	(5,449)	(5,991)	(4,639)	(4,428)
Mean		(9,300)	(7,596)	(8,216)	(8,176)	(6,861)	(6,252)	(6,219)	(6,418)	(6,160)	(9,168)	(6,942)	(6,660)

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP). Negative values shown in parentheses.

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Appendix B, Table 7. Old River Flow (cfs) at Mossdale under the No–Project Alternative

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	87	1,893	2,384	2,685	4,313	4,880	310	305	4,348	1,680	1,819	1,642
1923	BN	100	2,213	3,067	3,703	3,515	2,530	267	264	2,530	1,617	1,662	1,257
1924	C	100	1,818	1,887	1,702	1,692	1,341	100	100	1,581	1,311	980	1,074
1925	D	73	1,511	1,504	1,326	1,881	1,881	199	197	1,881	1,510	1,089	1,085
1926	D	85	1,885	1,738	1,532	1,881	1,884	184	181	1,584	1,502	1,041	1,054
1927	W	82	1,363	1,392	1,260	2,679	2,530	267	264	2,530	1,706	1,696	1,452
1928	AN	75	2,201	2,015	2,057	2,415	1,881	199	197	1,881	1,508	1,023	1,076
1929	C	99	1,939	1,800	1,803	1,993	1,463	100	100	1,506	1,306	966	1,045
1930	D	81	1,336	1,267	1,501	1,676	1,374	122	100	1,633	1,422	1,030	1,146
1931	C	87	1,660	1,480	1,581	2,034	1,660	100	100	1,581	1,331	1,001	1,181
1932	D	81	1,927	1,552	1,499	2,531	1,792	203	200	1,811	1,506	1,378	1,178
1933	C	99	1,631	1,501	1,784	1,935	1,345	140	138	1,626	1,517	1,268	1,179
1934	C	77	1,580	1,356	1,579	2,053	1,416	100	100	1,565	1,352	1,016	1,167
1935	BN	73	1,895	1,486	2,037	2,530	2,896	267	264	2,531	1,668	1,665	1,462
1936	BN	75	1,620	1,698	2,210	3,923	2,530	267	264	2,530	1,639	1,644	1,391
1937	BN	75	1,643	1,968	2,357	4,701	5,979	310	305	2,530	1,665	1,705	1,563
1938	W	100	1,902	1,972	3,022	9,293	12,486	386	7,775	7,216	2,575	1,805	2,698
1939	D	152	2,049	2,330	2,238	2,706	1,585	140	138	1,597	1,505	1,110	960
1940	AN	79	1,333	1,234	1,939	2,531	2,530	267	264	2,530	1,609	1,623	1,430
1941	W	100	1,571	2,320	3,183	5,126	8,078	6,903	305	2,755	1,704	1,823	1,927
1942	W	139	2,033	2,909	3,260	4,807	2,530	310	305	3,091	1,742	1,794	2,537
1943	W	220	2,117	2,257	3,369	5,639	5,240	310	305	2,530	1,657	1,650	1,447
1944	D	100	1,732	1,746	2,030	2,937	1,881	194	154	1,608	1,525	1,185	1,242
1945	BN	75	2,260	2,208	2,643	3,831	2,530	267	261	1,792	1,697	1,706	1,543
1946	BN	100	2,071	2,550	2,387	2,531	2,530	267	261	1,792	1,548	1,472	1,397
1947	D	94	2,151	2,161	1,829	2,199	1,881	182	138	1,594	1,510	1,066	1,095
1948	BN	75	1,699	1,171	1,178	1,401	1,548	199	197	1,899	1,515	1,392	1,106
1949	D	75	1,651	1,446	1,539	1,677	1,885	199	194	1,603	1,508	1,095	1,096
1950	BN	89	1,753	1,285	1,688	1,881	1,881	199	197	1,655	1,518	1,201	1,030
1951	AN	75	2,096	4,617	3,988	3,481	2,530	267	264	2,530	1,507	1,308	1,074
1952	W	75	2,000	1,806	3,719	3,283	2,651	310	379	4,560	2,418	1,818	2,677
1953	W	151	1,959	2,304	2,959	2,232	1,881	199	197	1,881	1,532	1,507	1,196
1954	AN	90	1,979	1,735	1,562	1,881	1,881	199	197	1,881	1,508	1,059	1,091
1955	D	95	1,788	1,620	1,814	1,881	1,343	140	138	1,582	1,503	1,035	1,076

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Table 7. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	90	1,519	1,793	7,901	5,230	2,530	310	305	3,565	1,738	1,653	1,766
1957	AN	198	1,797	1,661	1,986	2,340	1,881	199	197	1,881	1,525	1,193	1,145
1958	W	75	1,944	2,045	2,120	3,355	5,009	8,181	305	4,987	1,746	1,721	2,026
1959	BN	202	2,032	1,850	2,228	2,903	1,881	182	138	1,600	1,504	1,066	959
1960	D	96	1,316	1,228	1,475	1,935	1,881	122	100	1,592	1,406	1,030	1,134
1961	D	92	1,538	1,200	1,316	1,744	1,322	122	100	1,599	1,252	1,025	1,359
1962	BN	93	1,681	1,426	1,197	2,719	1,881	194	154	1,343	1,517	1,448	1,157
1963	W	81	1,431	1,667	1,493	2,531	2,535	267	264	2,534	1,536	1,485	1,122
1964	D	75	1,947	1,935	1,753	1,881	1,345	140	138	1,596	1,515	1,024	1,077
1965	W	75	1,669	1,819	3,903	2,531	2,530	310	305	2,530	1,759	1,799	1,444
1966	BN	138	2,768	2,667	2,787	2,596	1,889	201	194	1,610	1,508	1,008	1,051
1967	W	100	1,588	2,566	2,300	3,661	2,530	310	305	5,641	5,581	1,677	2,429
1968	BN	167	1,756	1,986	2,000	2,219	1,881	183	179	1,606	1,510	1,055	1,109
1969	W	76	1,841	1,604	3,058	10,853	5,058	406	12,441	8,392	3,775	1,706	2,190
1970	W	382	2,863	2,925	6,838	4,826	2,530	267	261	1,891	1,540	1,510	1,256
1971	W	87	2,111	2,178	1,782	1,881	1,881	199	197	1,881	1,541	1,520	1,223
1972	BN	100	1,652	1,658	1,765	1,881	1,881	183	138	1,597	1,510	1,030	1,581
1973	AN	75	2,044	1,609	1,700	2,958	4,308	267	264	2,530	1,520	1,480	1,234
1974	W	75	1,986	1,975	2,514	2,531	2,532	310	305	2,531	1,537	1,570	1,285
1975	W	101	2,141	1,873	1,438	3,529	2,530	310	305	2,531	1,556	1,584	1,621
1976	C	100	2,180	1,825	1,045	1,107	1,552	100	101	1,574	1,037	959	959
1977	C	78	1,429	1,109	1,062	1,267	1,437	101	101	1,583	1,018	968	1,074
1978	AN	82	1,302	1,341	2,227	3,215	2,619	310	305	3,173	1,568	1,637	1,435
1979	BN	168	2,074	1,489	2,259	3,733	3,127	267	264	2,530	1,515	1,476	1,354
1980	AN	113	2,545	1,905	5,795	10,195	12,509	310	305	2,951	1,811	1,671	2,503
1981	D	201	2,661	2,324	2,225	2,422	2,127	183	179	1,602	1,513	1,140	1,146
1982	W	75	1,482	1,480	2,467	3,936	7,749	13,728	11,326	4,746	3,185	2,014	3,493
1983	W	7,319	5,253	10,903	12,562	20,705	25,321	17,802	16,135	17,698	10,617	4,030	6,404
1984	W	10,012	7,039	11,400	13,638	6,537	4,454	267	261	2,193	1,569	1,688	1,846
1985	D	138	2,650	3,165	2,481	2,120	1,921	182	138	1,597	1,505	1,143	1,269
1986	W	100	1,994	1,862	1,390	6,668	14,392	10,230	376	3,144	1,761	1,750	2,075
1987	D	296	2,251	2,554	1,513	1,503	1,716	122	100	1,611	1,348	1,047	1,192
1988	C	74	1,435	1,314	1,099	959	1,301	100	100	1,614	1,198	1,042	1,126
1989	D	91	1,214	1,102	989	973	1,378	122	122	1,649	1,077	1,053	959
1990	C	73	1,126	1,053	1,059	1,045	1,268	100	100	1,453	1,041	1,012	1,171
1991	C	94	1,253	1,125	959	1,052	1,166	122	100	1,485	1,023	997	1,149
Mean		352	1,968	2,134	2,561	3,323	3,259	1,011	877	2,597	1,774	1,398	1,484

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP). Negative values shown in parentheses.

C-062105

C-062105

Appendix B, Table 8. Total CVP and SWP Exports (cfs) under the No–Project Alternative

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	6,551	6,936	11,417	12,101	12,700	11,700	8,921	9,950	11,280	3,359	4,477	6,503
1923	BN	11,280	11,280	11,627	12,700	4,073	6,095	8,428	6,581	6,526	11,280	11,280	6,368
1924	C	8,063	7,486	11,005	11,534	8,040	4,125	2,791	2,970	4,361	6,479	4,893	3,592
1925	D	8,500	6,640	8,870	7,295	11,633	7,948	7,380	5,650	6,543	11,280	8,405	6,051
1926	D	9,170	6,930	7,644	11,444	11,633	6,252	6,610	5,128	5,524	11,280	7,966	5,969
1927	W	8,909	11,280	11,134	11,309	12,097	11,461	9,150	8,523	6,457	7,379	5,802	6,115
1928	AN	9,387	11,280	11,307	11,732	11,320	11,268	8,180	5,835	6,313	11,280	7,563	6,299
1929	C	6,854	8,670	10,447	9,695	8,462	4,050	3,042	3,207	5,705	9,560	2,784	3,271
1930	D	7,525	5,920	9,098	11,428	6,635	11,129	3,589	3,538	5,520	10,026	3,390	5,195
1931	C	5,125	4,536	5,711	10,046	6,381	4,263	3,169	2,668	4,266	5,067	537	3,456
1932	D	6,132	5,385	11,176	11,427	9,746	3,147	5,097	4,103	2,463	3,427	3,448	5,359
1933	C	5,086	5,070	6,015	11,380	7,285	4,810	3,759	3,490	5,464	4,369	854	3,468
1934	C	4,431	3,666	8,873	11,469	6,393	6,515	3,660	2,996	5,676	4,096	671	3,537
1935	BN	4,288	7,523	8,069	11,721	6,331	10,529	9,150	8,356	7,231	11,280	8,984	5,890
1936	BN	7,317	6,838	7,642	11,820	12,700	11,461	7,857	6,206	6,491	11,280	6,950	5,971
1937	BN	6,716	6,435	9,922	11,101	12,700	11,700	8,946	6,490	5,820	6,809	5,083	6,039
1938	W	7,040	11,280	11,294	12,304	12,700	11,700	9,950	11,280	11,280	4,910	4,730	11,280
1939	D	11,280	11,280	11,400	11,036	7,754	5,393	4,175	3,873	5,615	11,280	7,509	5,362
1940	AN	8,282	6,314	7,372	11,665	12,009	11,461	9,150	6,835	6,313	11,280	10,233	6,245
1941	W	8,071	7,372	11,397	12,401	12,700	11,700	11,280	9,950	8,448	3,053	4,474	9,693
1942	W	11,280	11,280	11,578	12,448	12,700	11,323	9,950	9,950	11,262	3,091	4,477	10,666
1943	W	11,280	11,280	11,379	12,514	12,700	11,700	9,950	6,754	6,042	6,754	5,055	5,999
1944	D	9,710	10,399	7,368	11,422	12,252	9,462	4,020	3,973	6,623	11,280	6,764	6,075
1945	BN	8,970	10,940	11,364	11,286	12,700	11,461	5,910	5,685	7,467	9,097	5,882	6,359
1946	BN	10,559	11,280	11,468	11,924	7,309	9,016	5,916	5,355	7,026	11,280	7,098	6,441
1947	D	8,226	8,383	11,303	10,935	10,454	8,217	4,338	3,896	5,432	11,280	11,280	6,380
1948	BN	9,681	7,999	7,767	10,910	6,428	6,021	6,822	8,380	8,266	11,280	11,280	10,786
1949	D	11,027	9,194	8,590	8,686	7,038	11,269	5,499	4,852	6,202	10,057	5,789	6,545
1950	BN	9,169	7,074	6,629	11,526	11,633	8,644	6,552	5,395	7,001	11,280	11,280	6,346
1951	AN	11,029	11,280	11,700	12,700	12,582	11,461	6,686	7,487	6,294	11,280	9,072	6,610
1952	W	9,089	11,280	11,246	12,700	12,462	11,499	9,950	9,950	11,280	8,453	5,837	11,280
1953	W	11,280	11,280	11,393	12,266	10,608	8,700	6,573	7,882	10,551	7,677	5,864	8,801
1954	AN	11,280	11,280	10,684	11,460	11,633	11,268	8,380	6,762	6,250	11,280	9,587	6,720
1955	D	7,851	11,280	11,194	11,595	9,443	4,525	3,940	4,310	6,550	11,280	11,280	7,615

C-062106

C-062106

Table 8. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	7,992	7,771	11,243	12,700	12,700	11,461	8,332	9,950	10,010	8,475	6,273	11,280
1957	AN	11,280	10,777	7,451	11,375	11,896	11,268	5,786	6,047	6,742	11,280	11,280	7,039
1958	W	11,280	11,280	11,315	11,768	12,506	11,700	11,280	9,950	11,280	5,891	7,174	11,280
1959	BN	11,280	11,280	8,456	11,831	12,232	6,425	3,764	3,927	5,923	11,280	7,940	6,959
1960	D	9,000	6,800	11,093	9,363	11,663	7,956	3,799	3,398	5,618	11,280	10,482	6,543
1961	D	8,733	8,171	10,868	9,055	11,557	7,300	3,571	3,408	5,568	11,280	9,615	6,601
1962	BN	8,463	6,874	10,368	7,554	12,121	10,191	4,189	4,916	5,922	11,280	7,335	6,859
1963	W	11,280	11,280	11,207	11,424	12,009	11,463	9,150	9,150	7,036	10,061	6,060	8,197
1964	D	11,280	11,280	10,270	11,562	6,438	5,073	3,624	3,928	5,613	11,280	11,280	7,409
1965	W	7,201	10,359	11,250	12,700	12,009	8,486	9,950	8,673	6,321	11,280	6,993	6,518
1966	BN	11,280	11,280	11,503	12,162	11,137	10,528	5,623	4,859	5,914	11,280	10,628	6,633
1967	W	8,719	10,670	11,472	11,873	12,692	11,461	9,950	9,950	11,280	11,280	5,927	11,280
1968	BN	11,280	11,280	11,298	11,699	11,826	11,268	4,666	3,869	5,923	11,280	7,537	6,685
1969	W	9,074	8,545	11,190	12,325	12,700	11,700	9,950	11,280	11,280	6,577	5,359	11,280
1970	W	11,280	11,280	11,583	12,700	12,700	11,461	5,991	5,086	6,267	11,280	6,324	6,526
1971	W	9,055	11,280	11,355	11,578	9,028	11,268	6,650	8,380	9,027	11,280	6,639	10,062
1972	BN	11,280	11,116	11,205	11,568	9,972	11,268	4,580	3,924	5,869	11,280	11,280	7,294
1973	AN	10,115	11,280	11,191	11,533	12,265	11,700	7,420	7,443	7,787	11,110	6,123	6,867
1974	W	10,863	11,280	11,295	11,999	12,009	11,462	9,950	9,437	8,864	8,065	6,912	11,280
1975	W	11,280	11,280	11,265	11,396	12,611	11,461	9,203	9,950	10,439	9,669	6,240	11,280
1976	C	11,280	11,280	10,586	8,477	9,184	6,038	3,072	3,267	5,896	7,623	3,547	4,042
1977	C	5,434	6,432	11,058	4,844	6,067	4,198	2,825	2,395	1,076	1,818	941	3,580
1978	AN	4,414	3,326	10,813	11,830	12,420	11,489	9,950	8,486	6,613	2,839	4,473	8,219
1979	BN	11,280	11,280	6,330	11,849	12,700	11,646	7,240	7,039	8,099	8,865	5,186	6,118
1980	AN	7,829	11,280	11,275	12,700	12,700	11,700	7,509	6,516	5,682	3,233	4,873	10,445
1981	D	11,280	11,130	11,399	11,829	11,258	11,340	5,027	3,873	5,534	11,280	7,550	6,006
1982	W	8,382	11,280	11,157	11,971	12,700	11,700	11,280	11,280	11,280	8,588	8,123	11,280
1983	W	11,280	11,280	11,700	12,700	12,700	11,700	11,280	11,280	11,280	11,280	11,280	11,280
1984	W	11,280	11,280	11,700	12,700	12,700	11,700	6,742	5,949	6,663	10,505	5,857	10,243
1985	D	11,280	11,280	11,658	11,797	8,238	7,407	4,018	4,417	5,479	11,280	10,259	6,439
1986	W	8,727	7,911	11,262	11,372	12,700	11,700	11,280	6,810	6,321	6,446	5,051	8,075
1987	D	11,250	8,934	7,784	9,199	9,758	11,221	3,800	3,455	5,534	11,280	8,755	6,020
1988	C	6,588	6,113	11,114	11,236	6,370	4,723	2,965	3,114	5,766	7,320	4,886	3,497
1989	D	4,629	5,403	6,929	8,317	6,836	11,130	6,052	4,049	5,500	11,280	11,280	6,500
1990	C	5,470	3,927	7,842	11,219	6,075	4,469	3,621	2,804	5,803	7,331	5,020	3,858
1991	C	4,666	3,855	5,072	6,170	6,384	11,079	3,789	2,873	5,452	5,022	4,228	4,543
Mean		8,965	9,107	10,138	11,205	10,487	9,420	6,666	6,191	6,974	8,952	6,847	7,147

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP).

C-062107

C-062107

Appendix B, Table 9. Total Delta Outflow (cfs) under the No–Project Alternative

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	4,001	4,931	8,499	11,178	39,331	27,716	18,358	43,011	26,895	8,002	5,302	3,614
1923	BN	11,326	11,922	32,855	27,539	22,072	10,286	20,717	11,455	8,046	7,802	6,512	3,593
1924	C	4,039	5,295	6,825	6,362	9,614	10,429	5,841	5,215	4,000	4,968	3,415	3,008
1925	D	4,904	5,044	5,684	6,001	44,820	14,216	20,075	10,942	8,327	7,165	5,357	3,667
1926	D	5,199	4,950	5,365	7,907	29,984	10,637	18,321	11,200	6,117	7,185	5,252	3,632
1927	W	5,023	12,002	7,207	24,018	115,855	33,188	44,803	19,462	8,068	8,002	5,741	3,243
1928	AN	5,362	19,463	7,249	16,850	20,954	96,585	22,955	13,485	7,579	9,388	6,042	3,892
1929	C	4,001	5,518	6,383	5,707	10,111	10,012	7,313	6,432	7,107	6,478	3,415	3,008
1930	D	4,519	5,023	6,523	14,115	12,968	21,319	10,545	8,269	6,118	6,910	4,066	3,008
1931	C	4,001	4,504	4,881	6,029	7,800	7,068	7,819	4,505	4,000	4,001	3,415	3,008
1932	D	3,347	4,248	9,087	9,501	13,465	11,400	11,259	9,427	10,540	4,993	4,066	3,270
1933	C	4,001	4,504	4,756	7,198	8,469	8,555	10,399	6,036	6,829	4,001	3,415	3,008
1934	C	2,992	3,647	6,315	9,472	13,060	11,400	10,399	5,573	6,896	4,001	3,415	3,008
1935	BN	2,992	5,466	5,432	21,050	11,400	20,245	35,540	28,043	9,271	7,769	5,626	3,051
1936	BN	4,289	5,186	5,342	23,393	65,270	24,043	17,354	11,034	8,282	7,673	4,668	3,181
1937	BN	4,001	4,977	6,314	6,955	37,504	43,970	18,598	11,995	11,259	6,505	4,668	3,074
1938	W	4,001	24,976	70,808	26,485	137,905	158,460	62,760	57,424	31,454	8,002	5,741	8,286
1939	D	15,492	8,210	5,433	6,059	9,282	9,699	10,399	7,579	6,269	7,101	4,830	3,176
1940	AN	4,741	5,228	5,635	20,361	50,093	101,647	62,706	14,465	7,579	9,488	7,058	3,352
1941	W	4,092	5,521	40,703	97,186	115,821	92,507	76,316	36,853	11,632	8,002	5,741	5,517
1942	W	13,126	11,678	61,529	76,776	138,120	20,694	48,126	33,093	16,858	8,002	5,741	5,485
1943	W	14,567	15,173	22,871	75,930	54,747	75,761	25,100	16,226	7,579	8,002	5,741	3,152
1944	D	5,423	6,383	5,188	6,396	26,644	16,768	9,132	7,579	8,378	7,095	4,384	3,501
1945	BN	5,207	6,043	8,478	6,290	44,969	22,460	11,026	9,189	9,725	6,698	4,668	3,327
1946	BN	4,997	10,618	68,904	45,111	21,983	16,231	10,937	11,259	8,889	7,834	5,033	3,622
1947	D	4,306	5,340	6,646	6,171	12,817	15,072	11,259	7,579	6,132	7,170	6,061	3,717
1948	BN	5,354	5,647	5,846	6,404	11,401	10,946	18,822	25,191	11,561	7,840	6,729	5,781
1949	D	5,583	6,102	5,832	5,475	8,533	42,811	10,013	11,124	7,378	6,869	4,066	4,061
1950	BN	5,091	5,209	5,233	12,361	27,430	15,573	15,183	11,373	8,843	7,850	6,782	4,012
1951	AN	5,965	43,946	78,835	60,014	61,272	24,103	12,704	14,716	7,579	9,556	6,750	4,142
1952	W	5,132	7,520	42,117	87,441	74,397	57,761	61,176	59,068	31,674	8,002	5,741	10,666
1953	W	14,414	7,945	39,257	94,823	19,934	15,367	15,716	20,638	15,704	8,002	5,741	5,592
1954	AN	9,523	15,125	6,382	24,057	55,556	41,662	38,030	17,576	7,579	9,544	7,002	4,190
1955	D	4,080	6,919	16,681	14,458	11,400	7,599	7,579	7,857	8,071	7,173	6,068	4,520

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Table 9. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	4,198	5,672	74,001	154,825	87,260	30,373	16,843	37,691	14,516	8,002	5,741	6,283
1957	AN	14,125	6,691	5,444	7,233	31,279	38,131	15,372	12,750	8,664	9,546	7,528	4,154
1958	W	8,893	8,677	17,164	30,687	152,819	120,880	99,697	38,516	29,824	8,002	5,741	9,860
1959	BN	14,946	7,460	5,467	29,456	48,625	16,220	8,416	7,579	6,841	7,792	5,551	4,358
1960	D	4,708	5,511	7,225	5,713	20,668	14,116	11,400	7,579	6,291	7,199	5,966	4,032
1961	D	4,791	5,665	7,027	6,065	21,990	13,272	10,265	7,579	6,182	7,237	5,771	3,789
1962	BN	4,441	5,081	6,909	6,001	48,917	18,364	9,569	11,400	6,840	7,833	5,164	4,213
1963	W	29,182	10,266	18,715	8,598	67,389	24,760	88,914	25,407	8,991	8,946	5,741	5,244
1964	D	7,686	22,512	6,172	19,272	11,400	8,486	7,579	7,579	6,704	7,162	6,057	4,421
1965	W	4,001	6,622	72,757	112,356	26,878	15,379	43,920	20,494	7,579	9,361	5,741	3,634
1966	BN	6,150	18,556	8,474	22,041	20,813	18,618	10,600	11,124	6,840	7,849	6,577	4,170
1967	W	4,506	6,538	34,870	46,725	53,600	51,541	46,200	43,456	36,440	9,298	5,741	9,866
1968	BN	14,835	7,990	6,712	21,455	60,399	29,160	10,325	7,579	6,841	7,731	5,259	4,158
1969	W	5,157	5,675	13,989	116,869	129,847	51,928	44,212	55,819	25,197	8,002	5,741	13,370
1970	W	17,681	10,697	50,991	197,170	83,351	30,331	11,579	7,579	7,580	9,367	5,741	3,872
1971	W	5,063	15,280	64,496	45,818	22,775	43,778	16,279	25,812	12,690	9,456	5,741	6,040
1972	BN	8,275	6,485	12,481	9,279	18,216	22,627	9,811	7,579	6,841	7,848	6,826	3,791
1973	AN	5,618	15,153	19,014	72,396	89,977	55,634	15,006	14,120	10,301	9,373	5,302	4,147
1974	W	5,615	59,059	65,180	125,805	38,960	103,056	68,918	19,915	12,455	8,002	5,741	9,308
1975	W	12,453	8,672	8,811	6,560	61,068	81,704	19,925	27,667	15,246	8,263	5,741	6,921
1976	C	13,314	11,151	6,355	5,865	10,670	9,744	7,475	6,366	6,897	5,750	3,415	3,008
1977	C	2,992	5,211	7,186	4,505	8,083	6,897	6,897	4,505	4,000	4,001	3,415	3,008
1978	AN	2,992	3,537	6,832	57,543	53,376	61,156	36,875	15,849	8,774	8,002	5,302	5,227
1979	BN	9,101	6,521	4,984	20,305	39,592	26,109	14,392	12,376	10,882	6,505	4,668	3,397
1980	AN	4,001	9,608	12,171	107,445	127,706	63,895	15,045	12,255	7,579	8,002	5,302	5,436
1981	D	8,882	6,062	7,249	18,058	20,605	25,565	12,223	7,579	6,118	7,098	4,831	3,492
1982	W	4,793	26,627	88,042	77,881	94,845	79,101	139,945	46,703	16,995	8,002	5,801	16,088
1983	W	31,140	43,784	86,212	101,369	181,018	256,037	105,749	78,406	70,952	28,552	8,616	23,139
1984	W	33,203	77,020	152,708	75,962	41,156	30,792	12,623	8,946	8,232	8,845	5,741	5,638
1985	D	9,539	29,257	20,044	6,630	15,303	14,123	7,863	10,012	6,118	7,172	5,807	3,758
1986	W	4,675	5,194	7,147	11,243	219,888	149,241	28,310	11,350	7,579	8,002	5,741	4,037
1987	D	4,455	5,554	4,598	5,767	12,344	24,104	10,473	7,579	6,118	7,212	5,409	3,515
1988	C	4,001	4,740	6,939	17,960	11,400	7,804	7,300	6,496	6,897	5,491	3,415	3,008
1989	D	2,992	4,648	5,565	5,788	8,176	31,422	17,776	10,268	6,117	7,272	6,127	3,818
1990	C	4,001	4,504	6,416	7,898	11,400	7,310	10,251	5,910	6,897	5,584	3,447	3,008
1991	C	2,992	4,187	4,532	5,025	8,258	21,327	11,259	5,362	7,037	4,215	3,415	3,008
Mean		7,578	11,288	22,257	34,981	47,215	38,703	25,665	17,458	11,175	7,758	5,373	4,951

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP).

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Appendix B, Table 10. Monthly Values for X2 (Distance of the 2 ppt Isohaline from the Golden Gate [kilometers])

Water Year	Year Type[a]	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1922	AN	86.5	85.4	80.8	77.2	66.4	65.6	68.4	62.8	64.6	74.5	80.9	85.9
1923	BN	78.8	76.1	67.4	65.9	67.1	73.4	70.1	73.5	77.4	78.9	80.7	85.9
1924	C	86.7	84.9	82.4	82.1	78.8	77.1	81.0	83.1	85.9	85.1	87.7	89.6
1925	D	86.4	85.2	83.9	83.0	67.3	71.0	69.5	73.7	77.2	79.4	82.4	86.3
1926	D	84.9	84.8	84.2	81.0	69.7	74.0	71.2	74.1	79.6	80.2	82.8	86.5
1927	W	85.2	78.1	79.7	71.0	56.1	60.8	60.0	66.2	74.9	77.9	81.4	86.9
1928	AN	84.9	74.3	78.4	73.3	70.0	57.1	64.0	70.3	76.8	77.2	80.8	85.3
1929	C	86.6	84.5	82.8	83.0	78.7	77.4	79.4	81.0	80.8	81.4	86.5	89.2
1930	D	86.9	85.4	82.9	76.1	74.6	70.2	74.2	77.4	80.7	80.9	85.0	88.7
1931	C	87.7	86.5	85.4	83.5	80.9	80.8	80.0	83.9	86.1	86.9	88.3	89.8
1932	D	89.4	87.5	81.0	78.5	75.1	75.2	75.3	76.7	76.4	82.0	85.4	88.2
1933	C	87.5	86.4	85.6	82.2	79.8	79.0	77.2	80.8	81.0	85.2	87.8	89.6
1934	C	90.2	88.9	84.3	79.6	75.7	75.4	76.0	81.0	81.0	85.2	87.8	89.6
1935	BN	90.2	85.8	84.4	73.6	74.7	70.7	65.0	65.0	73.5	77.6	81.5	87.4
1936	BN	86.7	85.1	84.3	72.7	61.1	64.9	68.6	73.3	77.1	78.9	83.3	87.7
1937	BN	87.4	85.6	83.2	81.6	68.2	62.6	67.4	72.3	74.4	79.3	83.4	88.0
1938	W	87.5	73.3	60.6	64.0	52.5	47.6	53.1	55.6	61.0	73.3	79.9	79.2
1939	D	74.2	77.4	81.7	82.2	79.1	77.8	76.8	78.9	81.0	80.8	83.7	87.8
1940	AN	86.1	84.8	83.8	73.6	63.4	54.6	55.4	66.9	75.7	76.8	79.4	86.0
1941	W	86.6	84.6	68.6	56.6	51.4	51.4	52.9	58.9	69.8	76.2	80.8	82.7
1942	W	76.6	75.5	62.4	56.4	50.0	62.4	60.0	62.1	68.0	75.6	80.6	82.6
1943	W	75.8	73.3	69.3	58.8	57.8	55.0	62.6	68.4	76.1	78.3	81.5	87.2
1944	D	84.9	82.9	83.8	82.5	71.1	71.0	75.6	78.5	78.7	80.0	84.2	87.2
1945	BN	85.2	83.4	80.2	81.4	66.8	67.3	72.9	76.1	76.8	79.8	83.6	87.4
1946	BN	85.6	79.2	62.8	60.6	65.4	69.3	73.6	74.8	77.0	78.7	82.7	86.5
1947	D	86.4	84.7	82.5	82.3	76.7	73.6	74.8	78.2	81.0	80.7	81.9	86.0
1948	BN	84.6	83.7	83.2	82.3	77.6	76.3	71.8	68.0	72.8	77.3	80.0	82.0
1949	D	83.0	82.6	82.8	83.4	80.1	66.7	73.5	74.9	78.5	80.2	84.8	86.3
1950	BN	85.1	84.5	84.3	77.6	69.3	70.9	71.6	74.1	76.8	78.6	80.4	84.9
1951	AN	83.4	67.6	57.9	56.9	56.3	63.3	70.5	71.8	77.2	77.3	79.9	84.6
1952	W	84.4	81.5	67.3	57.0	54.9	56.2	56.1	56.4	61.2	73.4	79.9	77.3
1953	W	74.1	77.7	66.6	56.2	64.7	69.5	70.9	69.3	70.9	76.5	80.9	82.6
1954	AN	79.0	74.3	79.4	70.9	61.7	60.9	61.3	67.4	75.8	76.8	79.5	84.3
1955	D	86.1	82.7	74.8	73.3	74.6	78.2	79.3	79.5	79.3	80.1	81.7	84.5

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Table 10. Continued

Water Year	Year Type	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956	W	85.9	84.1	63.8	51.5	51.9	60.1	67.3	63.5	69.6	76.1	80.8	81.6
1957	AN	75.7	79.5	82.3	81.1	69.4	64.1	69.3	72.5	76.5	77.0	79.0	84.2
1958	W	80.1	78.9	73.3	67.0	52.7	49.8	50.3	57.7	62.2	73.7	80.0	77.9
1959	BN	74.1	78.1	81.8	70.1	62.5	68.4	75.3	78.4	80.2	79.8	82.3	84.9
1960	D	85.2	84.1	81.7	82.7	73.1	72.9	74.5	78.1	80.8	80.6	82.0	85.4
1961	D	85.2	83.9	81.8	82.2	72.5	73.2	75.4	78.4	81.0	80.6	82.2	86.0
1962	BN	86.0	85.0	82.3	82.5	66.5	68.7	74.5	75.0	79.1	79.4	82.7	85.3
1963	W	71.4	74.8	71.3	76.1	61.9	65.0	56.1	62.9	73.0	76.4	80.9	83.1
1964	D	80.8	71.9	78.9	72.4	74.3	77.2	79.0	79.6	80.8	80.6	81.9	84.7
1965	W	86.4	83.1	63.6	53.9	61.7	68.5	62.7	66.7	75.6	76.9	81.1	85.9
1966	BN	83.5	74.2	77.2	70.8	69.2	69.5	73.9	75.0	79.1	79.4	80.8	84.8
1967	W	85.5	82.9	69.2	62.5	59.2	58.4	59.0	59.7	61.3	72.2	79.5	77.8
1968	BN	74.1	77.6	80.1	72.0	61.4	63.5	72.2	77.4	79.9	79.8	82.7	85.4
1969	W	84.7	83.7	76.5	57.8	50.9	55.7	58.5	57.6	63.4	74.1	80.1	75.6
1970	W	72.0	74.7	63.6	49.6	51.6	60.0	70.1	76.7	78.9	78.0	81.4	85.6
1971	W	84.9	76.2	62.3	60.3	65.1	61.6	68.1	66.6	71.6	75.5	80.6	81.9
1972	BN	79.9	81.1	76.5	77.2	72.3	69.0	74.4	78.1	80.1	79.7	80.7	85.5
1973	AN	84.0	76.0	71.6	59.9	54.4	56.3	66.9	70.9	74.6	76.6	81.6	85.1
1974	W	83.9	65.5	58.7	51.4	58.0	52.7	54.1	64.1	70.9	76.6	80.9	78.7
1975	W	75.7	77.5	78.0	80.4	64.1	56.5	64.8	65.1	69.7	75.9	80.7	80.9
1976	C	75.9	75.7	79.9	81.9	77.9	77.3	79.2	81.0	81.0	82.4	86.8	89.3
1977	C	90.1	86.1	82.4	84.7	81.0	81.0	81.0	84.3	86.2	86.9	88.3	89.8
1978	AN	90.3	89.2	83.7	65.6	60.3	57.5	60.4	67.9	74.9	77.8	82.0	83.4
1979	BN	79.7	81.0	83.5	73.5	65.2	65.6	70.3	73.0	74.9	79.4	83.5	87.2
1980	AN	87.2	80.5	76.5	58.5	51.2	54.2	66.2	71.8	77.2	78.6	82.2	83.2
1981	D	79.8	81.6	80.8	73.6	70.2	67.4	72.2	77.4	80.7	80.7	83.6	87.1
1982	W	85.8	72.2	58.6	55.1	52.4	52.9	48.7	55.8	65.8	74.9	80.3	74.3
1983	W	67.2	62.3	55.5	52.0	46.5	42.0	47.3	51.3	53.4	61.1	72.8	69.0
1984	W	65.0	57.3	49.5	52.3	57.9	62.0	70.1	75.4	77.8	78.1	81.4	82.7
1985	D	79.1	69.3	69.0	77.4	73.7	73.1	77.4	77.0	80.6	80.6	82.2	86.0
1986	W	85.6	84.7	81.9	77.6	53.3	48.4	59.5	70.1	76.7	78.5	81.6	85.3
1987	D	85.8	84.2	85.2	83.7	77.4	70.2	74.3	78.1	81.0	80.6	82.7	86.7
1988	C	87.1	85.9	82.5	74.2	74.9	78.1	79.6	81.0	81.0	82.7	87.0	89.3
1989	D	90.1	87.0	84.6	83.5	80.5	69.2	69.9	74.3	79.7	80.2	81.6	85.7
1990	C	86.7	86.1	83.2	80.7	77.0	79.3	77.4	81.0	81.0	82.6	86.8	89.3
1991	C	90.1	87.8	86.5	85.2	81.0	72.3	74.4	80.8	80.8	84.7	87.6	89.5
Mean		83.1	80.3	76.3	71.7	66.4	66.1	68.8	72.0	75.8	78.7	82.3	84.9

[a] Note: W = wet, AN = above normal, BN = below normal, D = dry, C = critically dry (Sacramento Valley water–year hydrologic classification as specified in the 1995 WQCP).

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