Appendix C5. Modeling Trihalomethane Concentrations at a Typical Water Treatment Plant Using Delta Export Water

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SUMMARY

This appendix describes the modeling performed to estimate Delta Wetlands (DW) project effects on Delta export water used as influent to a typical water treatment plant. The selected impact assessment model was developed by Malcolm Pirnie, Inc. (Malcolm Pirnie), for the U.S. Environmental Protection Agency (EPA) to simulate trihalomethane (THM) concentrations in water that has been treated at water treatment plants. The EPA water treatment plant (WTP) model was confirmed with available measurements from the Penitencia Water Treatment Plant, operated by Santa Clara Valley Water District. Export water quality for the No-Project Alternative and the DW project alternatives simulated with the Delta Drainage Water Quality model (DeltaDWQ) was used as input for the EPA WTP model to evaluate the likely changes in THM resulting from DW project operations. The analysis estimates changes in THM concentrations at a representative water treatment plant that could result from changes in concentrations of dissolved organic carbon (DOC) and bromide (Br^-) in Delta export water attributable to operations under each DW project alternative. The appendix describes the model formulation, presents confirmation of model results, and presents results of water quality simulations for the No-Project Alternative and each of the DW project alternatives.

INTRODUCTION

THMs, produced during the primary disinfection of water by chlorination, are considered a human health risk by EPA and are subject to federal drinking water standards. EPA has established a maximum contaminant level (MCL) of 100 micrograms per liter (μg/l) for total THMs in drinking water; this standard is under review by EPA and may be reduced to 80 μg/l or less.

Among the constituents of raw water that are treated in the disinfection process are DOC and Br^-, both of which may be increased in Delta exports by operation of the proposed DW project. DW project water may be diverted for municipal use from the Delta at the Rock Slough intake of Contra Costa Water District (CCWD) or exported at Banks Pumping Plant of the State Water Project (SWP) or Tracy Pumping Plant of the Central Valley Project (CVP); this water may subsequently be treated for domestic consumption at municipal water treatment plants. The DW project may therefore contribute to increasing the concentration of THMs in water used for domestic consumption by increasing the concentrations of DOC and Br^- in Delta water that may be exported and subsequently treated for domestic use.

This appendix describes modeling of relationships between DOC and Br^- in Delta export water used as raw water influent to a typical water treatment plant and THM concentrations in treated water produced by the plant. The modeling was performed to support assessment of DW project effects on treated municipal water quality and compliance of treated drinking water with the current EPA drinking water standard for THMs.

The analysis estimated the incremental changes in THM concentrations at a representative water treatment plant that could result from changes in DOC and Br^- concentrations in Delta export water attributable to operations under each DW project alternative. Increases in the frequency, magnitude, or duration of exceedances of the current EPA standard were estimated for each DW project alternative.

This assessment of treatment plant effects was suggested by California Department of Water Resources (DWR), Metropolitan Water District of Southern

California (MWD), and CCWD staff members during the peer review process for the 1990 draft environmental impact report/environmental impact statement (EIR/EIS) on the DW project as the most complete method for analyzing potential drinking water impacts of DW project discharges.

Background

Data on contributions of salt and DOC from DW project operations to salt and DOC levels in Delta exports were derived through the use of the Delta Drainage Water Quality model (DeltaDWQ), which is described in Appendix C4, "DeltaDWQ: Delta Drainage Water Quality Model". Jones & Stokes Associates (JSA) developed DeltaDWQ to simulate relationships between water management on Delta islands and salt and DOC concentrations in discharges from the islands to Delta channels.

JSA used results from DeltaDWQ to determine relationships between assumed DOC loading on the DW project islands and levels of DOC in Delta exports (see Appendix C4). DOC levels in Delta exports under the No-Project Alternative and the DW project alternatives were compared. The results of this comparison are presented in Chapter 3C, "Water Quality".

As described in the following sections, possible impacts of changes in DOC concentrations in Delta exports (representative of CCWD diversions and SWP and CVP exports) were then assessed through simulation of expected THM concentrations at a typical water treatment plant using chlorination for primary disinfection.

Objectives of Modeling

JSA contracted with Malcolm Pirnie, Inc. (Malcolm Pirnie) to adapt the EPA Water Treatment Plant (WTP) model to a typical water treatment plant using Delta export water. The WTP model had been developed by Malcolm Pirnie for nationwide use by EPA.

Malcolm Pirnie's subcontract with JSA had three specific objectives:

- to confirm the accuracy of WTP model simulations of THM production using data from a typical conventional water treatment plant that uses Delta export water as influent,
- to modify the WTP model to accept 25-year data sets of monthly Br^-, DOC, and other estimated water quality variables for Delta exports, and
- to apply the WTP model to several data sets representing Delta export water quality to test the sensitivity of the model to changes in the input variables (e.g., DOC, Br^-, and temperature).

JSA used the modified model to assess impacts of Br^- and DOC concentration changes in Delta exports on THM levels for each of the DW project alternatives.

Organization of the Appendix

This appendix is organized into the following sections:

- description of the WTP model developed by Malcolm Pirnie,
- confirmation of the WTP model results for a typical water treatment plant using Delta export water, and
- application of the model to a 25-year estimate of Delta export water quality for each DW project alternative.

DESCRIPTION OF THE WTP SIMULATION MODEL

This section presents a general overview of the WTP simulation model for THMs. Malcolm Pirnie prepared a report for JSA that provides greater detail on model background, predictive equations, and algorithms (Malcolm Pirnie 1992).

Model Development

The WTP simulation model was developed for EPA to support analyses of alternative combinations of the Surface Water Treatment Rule (SWTR) and a new Disinfection By-Products (DBP) Rule (EPA 1992). The SWTR specifies minimum levels of disinfection to protect against human exposure to pathogens. Increased

disinfection may result in higher concentrations of DBP. The new DBP rule may contain more stringent limits for municipal water suppliers. The WTP model was developed to assist water utilities in analyzing various treatment options for meeting the requirements of these rules.

The primary purpose of the WTP model is to jointly simulate DBP formation and disinfection levels in water treatment plants and distribution systems based on specified raw water quality, treatment process characteristics, and treatment chemical dosages. The model predicts THM formation based on data collected nationwide from various water treatment plants and experimental data on the kinetics of THM formation.

Basic Model Formulations

The WTP simulation model is based on a series of predictive regression equations that were developed through several previous studies. Figure C5-1 is a conceptual diagram of the various components of the WTP model.

For a treatment plant to be simulated, treatment process characteristics specific to the plant being modeled must be specified. These characteristics include hydraulic detention times, treatment chemical dosages, and target disinfection residuals. Raw water quality variables (DOC; ultraviolet [254-nm] light absorption [cm^{-1}], referred to as UVA; pH; temperature; Br^-; alkalinity; calcium hardness; ammonia; and turbidity) must also be specified. DOC and UVA are described in Appendix C3, "Water Quality Experiments on Potential Sources of Dissolved Organics and Trihalomethane Precursors for the Delta Wetlands Project".

The major output from the WTP model is an estimate of THM levels resulting from use of existing or proposed treatment technologies. The model reports values for the following variables after each of the treatment plant processes:

- THM precursors (DOC and UVA),
- disinfectant residuals (chlorine),
- THM concentrations, and
- proportion of required disinfection contact time achieved (based on concentration-time [CT] values specified in the EPA SWTR guidance manual).

The model consists of a series of subroutines that simulate removal of organic THM precursor compounds and adjustments of pH that occur as chemicals are added. When free chlorine is added, subroutines for estimating chlorine demand, chlorine decay, and THM formation are invoked. These subroutines proceed until the treatment processes and disinfectant dosage sequence are completed. A more detailed description of the operation of the WTP program is provided in the EPA program user's manual (EPA 1992).

The original WTP program is operated interactively, specifying inputs through screen prompts. For the DW impact assessment, however, the model was reprogrammed to permit prediction of THM formation for 300 monthly water quality conditions (i.e., 12 months per year for the 25-year period) using a specified treatment process train, DOC removal target, and chlorine residual targets.

The model predicts total THM concentration and then determines the concentrations of different types of THM molecules by estimating relative concentrations from separate regression equations for each of the four types of THM molecules (chloroform [$CHCl_3$], dichlorobromomethane [$CHCl_2Br$], dibromochloromethane [$CHClBr_2$], and bromoform [$CHBr_3$]). All of the multiple-logarithmic regressions are similar but vary in the coefficient values for the independent variables. For example, the total THM equation is as follows:

$$THM\ (\mu g/l) = 0.3254 \cdot DOC^{0.44} \cdot UVA^{0.351} \cdot Cl_2^{0.409} \cdot hours^{0.265} \cdot Temp^{1.06} \cdot (pH\text{-}2.6)^{0.715} \cdot (Br^- + 1)^{0.516}$$

The magnitude of the coefficient for each independent variable indicates the degree to which THM concentrations will respond to a change in that variable when other conditions remain the same. For example, a temperature change from 10°C to 25 °C will increase THM by a factor of 2.6. Doubling DOC from 3 milligrams per liter (mg/l) to 6 mg/l will also double the UVA value because the two variables are linearly related (see "Raw Water Quality", below); this combination of DOC and UVA changes will increase THM by about 75%.

Higher DOC levels may require higher chlorine doses. Increasing the chlorine dose from 2 mg/l to 3 mg/l will increase THM by about 20%. According to the THM regression equation used in the model, increasing Br^- from 0.2 mg/l to 0.4 mg/l will increase THM by about 10%.

CONFIRMATION OF THE WTP SIMULATION MODEL RESULTS

Malcolm Pirnie selected the Penitencia Water Treatment Plant, operated by the Santa Clara Valley Water District, to represent a typical plant that uses chlorine for primary disinfection of water exported from the Delta. This section describes the Penitencia Water Treatment Plant and the data from the plant used to confirm WTP simulation model predictions (Malcolm Pirnie 1992).

Penitencia Water Treatment Plant

Delta exports are supplied to the Penitencia Water Treatment Plant through the South Bay Aqueduct and Del Valle Reservoir. Monthly measurements of raw water quality from January 1991 to August 1992 indicated moderate to high levels of DOC (3.0-6.7 mg/l) and Br^- (0.1-0.56 mg/l) in raw water from the Delta and relatively high levels of alkalinity and hardness because of drought conditions. Raw water during this period, therefore, had DOC and Br^- concentrations that were higher than normal.

General Description of the Penitencia Water Treatment Plant Process

The Penitencia Water Treatment Plant has a design capacity of 42 million gallons per day (mgd) and an average production of 25 mgd. Between January 1991 and August 1992, flows fluctuated seasonally from 20 mgd to 40 mgd. Figure C5-2 shows a schematic diagram of the Penitencia Water Treatment Plant process. The treatment process consists of conventional alum coagulation with flocculation, sedimentation, and dual-media filtration. The simulated alum dosage, required to match the effluent DOC concentrations, averaged 36 mg/l with a range of 25-52 mg/l (actual daily alum dosage was not recorded).

Highest THM concentrations are generally produced by conventional chlorination. Chlorine can be added at various points in the water treatment process for a variety of purposes. The term "prechlorination" refers to the addition of chlorine to raw water at the initial treatment stage, typically before flocculation and sedimentation occur. Chlorine (Cl_2) is also added before the water is filtered. Chlorine or chloramine (chlorine and ammonia) can also be added at the end of the treatment process to provide a "chlorine residual" in the distribution system; this process is commonly referred to as "postchlorination". Chlorine residual is maintained to provide disinfection while the water is transported through the distribution system.

At the Penitencia Water Treatment Plant, chlorine is used for primary disinfection and ammonia is added to the filtered water for chloramine secondary disinfection in the delivery system. During the period of record obtained by Malcolm Pirnie from the Penitencia Water Treatment Plant, raw water was prechlorinated at an average dosage of 2.75 mg/l, producing a settled water chlorine residual of 0.65 mg/l (actual daily chlorine dosage was not recorded). Chlorine was also applied to the settled water at a dosage of approximately 1 mg/l, producing a filtered water chlorine residual of about 1.5 mg/l. Ammonia was added to the filtered water at an average dosage of 0.5 mg/l before it reached the finished water reservoir. Small amounts of chlorine were also added as a "trimming dosage" to maintain a combined chlorine residual of 1.5 mg/l at the end of the distribution system.

The theoretical detention times for the various processes as a function of water treatment plant flow are summarized in Figure C5-2. Under average flow conditions (25 mgd) at the Penitencia Water Treatment Plant, the theoretical detention times for flocculation-sedimentation basins, filters, and finished water reservoir are approximately 140, 20, and 170 minutes, respectively.

Raw Water Quality

To confirm the WTP model results, Malcolm Pirnie used average monthly values for observed water quality data from the Penitencia Water Treatment Plant for 17 months between January 1991 and August 1992. These data are given in Table C5-1. Both water quality and plant flows varied significantly during this period. Following are the average values for selected raw water quality variables for the period of record:

- DOC = 4.6 mg/l,
- pH = 7.9,
- turbidity = 10.1 NTU,
- temperature = 17.1°C,
- alkalinity = 82 mg/l,
- calcium hardness = 57 mg/l as $CaCO_3$,
- total hardness = 122 mg/l as $CaCO_3$,
- ammonia nitrogen = 0.05 mg/l as N,
- chloride (Cl^-) = 107 mg/l, and
- Br^- = 0.34 mg/l.

Although the WTP model uses UVA in its predictive equations, the Penitencia Water Treatment Plant does not routinely monitor UVA in the raw water. MWD and Malcolm Pirnie (1991) found raw water UVA and DOC concentrations to be strongly correlated ($r^2 = 0.96$) in a study of SWP water (Figure C5-3):

$$\text{UVA } (cm^{-1}) = -0.0215 + 0.0382 \cdot \text{DOC } (mg/l)$$

Using this correlation with the confirmation data, raw water UVA at the Penitencia Water Treatment Plant was estimated to average 0.156 cm^{-1} over the period of record.

Model Accuracy and Performance

JSA tested the ability of the WTP model to accurately simulate water treatment plant operations, finished water quality, and THM concentrations by comparing WTP model results with monthly measurements collected from January 1991 to August 1992 at the Penitencia Water Treatment Plant. These comparisons are given in Table C5-1. Each set of values for influent and effluent variables was simulated using a separate run of the model, with the assumed alum and chlorine dosages adjusted to match the effluent DOC and chloramine residuals. Unfortunately, actual alum and chlorine dosages and settled chlorine residual for each sample were not recorded at the Penitencia Water Treatment Plant.

Dissolved Organic Carbon and pH

Figure C5-4 shows measured and predicted DOC and pH values at the Penitencia Water Treatment Plant for the period of record. Measured influent DOC ranged from 3.0 mg/l to 6.7 mg/l. Percentage DOC removal is shown indirectly in Figure C5-4 as the difference between the measured influent raw water DOC concentration and the measured effluent DOC concentration. The model accurately simulated DOC removal because the alum dosage was adjusted in the WTP model to achieve the observed DOC removal for each sample date. Simulated alum doses ranged from 25 mg/l to 52 mg/l and averaged approximately 35 mg/l.

Measured and predicted pH of effluent were similar. These comparisons suggest that the model simulated the physical-chemical treatment processes used at the Penitencia Water Treatment Plant fairly well.

Chlorine Doses and Residuals

Figure C5-5 shows simulated and measured chlorine residual concentrations. Chlorine doses varied according to inflow DOC concentrations, with higher doses required for waters higher in DOC. Higher chlorine doses during prechlorination produce more THM molecules. Chlorine doses simulated for the treatment process before alum coagulation varied from 1.6 mg/l to 3.4 mg/l.

Measured chlorine residuals in filtered water averaged about 1.5 mg/l, with a minimum concentration of 1.3 mg/l and a maximum of 2.1 mg/l. The model overpredicted the settled water chlorine residual concentrations, with a mean of 1.9 mg/l for predicted residuals, suggesting that the estimated prechlorination dosages used by Malcolm Pirnie may be high.

The general relationships between DOC, chlorination dose, and resulting C-THM (the carbon fraction of THM molecules) used to calculate THM concentration described in Appendix C3, "Water Quality Experiments on Potential Sources of Dissolved Organics and THM Precursors for the Delta Wetlands Project", suggest that the chlorine dose has a very important effect on THM concentration. Unfortunately, chlorine dose was not reported in the Penitencia Water Treatment Plant data (chlorine residual is the more important plant operation variable).

Table C5-1 gives the measured yield of C-THM from DOC as a percentage. The Penitencia Water Treatment Plant samples had a C-THM yield of approximately 0.07%-0.18% of the DOC (average of 0.12%). The yield of C-THM simulated by the WTP model was 0.09% of DOC, lower than the measured average.

Because these measured yields of C-THM from DOC are lower than data used to develop the "half-saturation" relationship between C-THM and the chlorination-to-DOC ratio (Cl_2/DOC) and because the Cl_2/DOC value was not calculated, there is some uncertainty regarding the general relationship of these low Cl_2/DOC dose values. The equation for C-THM given in Appendix C3, with a maximum yield of 2% and a half saturation of 5 Cl_2/DOC, suggests that the Cl_2/DOC dose value for a C-THM yield of 0.12% would have been only about 0.3. Typical Cl_2/DOC dose values in treatment plants are in the range of 0.5 to 1.0 and the WTP-simulated dose ratios were in this range. The C-THM yield estimates for the Penitencia Water Treatment Plant samples can be reconciled if the half-saturation value for the Cl_2/DOC dose value is higher than 5. If the half-saturation value is 10, then the estimated Cl_2/DOC dose value to produce a

0.12% yield of C-THM would be 0.6. If this adjustment is made, these Penitencia data are consistent with the other THM data analyzed in Appendix C3.

Trihalomethane Concentrations

Figure C5-6 shows measured and predicted total THM concentrations in treated water at the Penitencia Water Treatment Plant. Measured THM concentrations averaged 72 μg/l, whereas the predicted THM concentrations averaged 50 μg/l. Deviations in THM values in some months may be caused by the model's relative insensitivity to raw water Br^- concentrations. The regression equation used in the WTP model to predict THM was developed from source waters that were generally lower in Br^- concentrations than water from the Delta.

Figure C5-7 shows simulated and measured concentrations of C-THM, Cl-THM, and Br-THM, which are the carbon, chlorine, and bromine portions of the THM molecules, respectively. Comparison of measured and predicted data indicates that the model is able to predict C-THM and Cl-THM concentrations but that its ability to predict the Br-THM portion is relatively poorer.

Figure C5-8 shows the measured influent Br^- concentrations and the measured and simulated bromine incorporation factor, defined as the moles of bromine incorporated per mole of THM, with a maximum value of 3 for pure bromoform (Hutton and Chung 1994). Br^- concentration in raw water ranged from 0.1 mg/l to 0.55 mg/l. The measured bromine incorporation factor ranged from 0.25 to 1.75, and simulated incorporation generally followed the pattern of measured incorporation. Bromine incorporation is generally greater with increased Br^- concentration but is reduced when DOC concentrations and required prechlorination doses are higher, as for the April 1991 sample.

Malcolm Pirnie has recently completed a joint project with MWD and its member agencies to collect additional data and improve the Br-THM regression equations used in the WTP model (MWD 1994). With the new equations, the model simulates substantially higher Br-THM concentrations for raw water Br^- concentrations in the range of 0.1-1.0 mg/l. These recent model improvements are not expected to change the impact assessment results shown in this appendix.

Both the measured Br^- incorporation values and those simulated with the WTP model are consistent with the general relationship between the Br^- saturation ratio (Br^-/C-THM) and bromine incorporation (n) described in Appendix C3. This suggests that the general relationship between Br^- and Br-THM could be used as a reliable assessment method for estimating effects of Br^- concentrations on THM concentrations. This general relationship explains why bromine incorporation is so much greater in THM in treated drinking water than it is in DWR's THMFP assays or MWD's simulated distribution system (SDS) measurements (because the bromine saturation of THM sites is greater).

Some of the largest differences between measured and simulated THM concentrations were found for winter months, when water temperatures were low. In contrast, THM predictions were generally better during summer when water temperatures were higher. Ambient water temperature is a strong predictor variable in the regression equation used for THM formation, with the rate of THM formation increasing with increases in temperature. The model equation may, however, be oversensitive to the temperature effect. Although some uncertainties in the Penitencia Water Treatment Plant data and simulations results were identified, the EPA WTP model was determined to be adequate for impact assessment purposes.

APPLICATION OF THE WTP MODEL TO DELTA EXPORT WATER QUALITY

Estimated Historical Export Water Quality and Trihalomethane Concentrations

Table C5-2 gives the monthly values for Delta export water quality variables estimated from DeltaDWQ results for EC, Cl^-, and DOC for historical inflows and exports for 1967-1991 (see Appendix C4). The WTP model required values for pH, temperature, ammonia, alkalinity, hardness, calcium hardness, turbidity, Br^-, and DOC. Export water quality estimates were developed as follows:

- Export Cl^- concentration was calculated in DeltaDWQ using flow-EC regressions and the following Cl^-/EC ratios (see Appendix C1):
  - Sacramento River and Yolo Bypass, 0.04;
  - eastside streams, 0.05;

- Jersey Point seawater, 0.30; and
- San Joaquin River increasing from 0.08 to 0.15 at 1,000 cubic feet per second (cfs) or greater.

- Export DOC was calculated in DeltaDWQ.
- Export alkalinity, hardness, and calcium hardness were estimated with simple EC regressions based on available data from the Interagency Ecological Program (IEP) and DWR Municipal Water Quality Investigations (MWQI) program (see Appendix C1) and from the EC values calculated in DeltaDWQ.
- pH was set at a constant (7.5); temperature and ammonia were estimated as repeating monthly values based on available IEP and MWQI data (Appendix C1).
- Turbidity was estimated from regressions for Sacramento and San Joaquin River flow and suspended solids and from specified settling fractions, based on MWQI turbidity data.

The water quality variables that cause the greatest change in THM concentrations are DOC, Br^-, and ammonia (because ammonia requires higher chlorine doses). DW project operations may change export DOC concentrations by discharge of DOC that originates from peat oxidation or vegetation decay, and may change Br^- concentrations by increasing salinity intrusion. Because there are many assumptions and uncertainties in the modeling performed by JSA using the Delta Standards and Operations Simulation model (DeltaSOS) and DeltaDWQ to estimate Delta export water quality, it is important to compare the estimated historical export water quality with available MWQI grab samples from the three Delta export/diversion locations: Old River at Rock Slough (near the CCWD diversion), Banks Pumping Plant, and the Delta Mendota Canal (DMC) near Tracy Pumping Plant. Four of the most important export water quality variables are EC, Cl^-, Br^-, and DOC.

Figure C5-9 shows the monthly average DeltaDWQ estimates of Delta export EC (millisiemens per centimeter [mS/cm]) and Cl^- (mg/l) for 1982-1991 with historical inflows and exports. These estimates are compared with DWR's MWQI grab samples for Old River at Rock Slough, Banks Pumping Plant, and the DMC. As discussed in Appendix C1, there are many possible sources of variation in these measured export concentrations. The DeltaDWQ estimates match the seasonal patterns in several of the years (missing the measured EC data in other years) and reproduce the range of observed export EC and Cl^- concentrations. Historical measured EC at the Delta export locations has fluctuated between about 250 microsiemens per centimeter (μS/cm) and 1,250 μS/cm. The DeltaDWQ estimates of EC range from 250 to 1,400 μS/cm.

The historical measured Cl^- concentration at the Delta export locations has fluctuated between about 10 mg/l and 275 mg/l. The DeltaDWQ estimates of Cl^- concentration range from 20 mg/l to 300 mg/l.

Figure C5-10 shows the monthly average DeltaDWQ estimates of Delta export Br^- concentrations (mg/l) and DOC (mg/l) for 1982-1991 with historical inflows and exports. These DeltaDWQ estimates are compared with DWR's MWQI grab samples from Rock Slough, Banks Pumping Plant, and the DMC. The DeltaDWQ estimates match the measured range of observed Br^- and DOC concentrations. Historical measured Br^- concentrations at the Delta export locations have fluctuated from about 0.15 mg/l to about 0.9 mg/l. The DeltaDWQ estimates ($0.0035 \cdot Cl^-$) match this historical range. Historical DOC concentrations at the Delta export locations have fluctuated from about 2 mg/l to 7 mg/l. The DeltaDWQ estimates of DOC concentration match this historical range, with the exception that values of less than 3 mg/l were not estimated (Sacramento inflow DOC concentrations were lower than estimated).

The comparison of historical measurements and DeltaDWQ estimates of export water quality for historical inflows and exports provides an indication of the uncertainty in DeltaDWQ estimates of export water quality. DeltaDWQ estimates of Delta export water quality as a function of inflows, salinity intrusion (governed by outflow), and agricultural drainage are sufficiently accurate to provide a reasonable basis for impact assessment of DW project effects on export water quality and THM concentrations in treated (chlorinated) drinking water from the Delta. Because assessment of the impacts of DW project operations on export water quality and THM concentrations is based on differences in water quality estimates for the No-Project Alternative and each DW project alternative, uncertainties in the estimates of export water quality for the No-Project Alternative will not alter the impact assessment results.

Figure C5-11 shows the simulated THM concentrations as a function of export DOC for the 1967-1991 period with historical inflows and exports. The specified chlorine residual of the filters was 0.5 mg/l, the DOC removal with alum was 30%, and the chloramine residual

was 2.0 mg/l. The monthly THM concentrations ranged from about 30 μg/l to 220 μg/l. The simulated THM concentration increased with increasing DOC, but there was considerable variation in the ratio of THM to DOC caused by temperature, ammonia, or Br^- concentrations.

Figure C5-12 shows that the simulated total chlorination dosage was directly related to raw water DOC. Chlorination for ammonia oxidation is specified in the model to require a chlorine dose of 7.6 times the ammonia concentration. The simulated chlorine dose required for oxidation of DOC was about 40% of the DOC concentration. As a result, THM formation was directly related to DOC levels in raw water, when all other variables were constant, with water high in DOC producing high THM concentrations because of the higher chlorine dosage needed to oxidize the DOC.

Figure C5-13 shows that the simulated THM/DOC yield ratio increases with water temperature. The simulated prechlorination dosage of chlorine also increased with temperature, from 0.3 · DOC at 10°C to 0.4 · DOC at 25 °C. The simulated THM concentration (μg/l) was about seven to eight times the DOC concentration (mg/l) at 10°C and increased to about 16 to 22 times the DOC concentration (mg/l) at 25°C.

Figure C5-14 shows simulated monthly and annual moving-average THM concentrations in treated Delta export water for the 25-year simulation period with historical inflows and exports. Monthly simulated THM concentrations ranged from as low as 20 μg/l to as high as about 120 μg/l. The 1991 Penitencia data are shown for reference.

The simulated monthly THM concentrations meet the existing 100 μg/l drinking water MCL standard for THMs, except for a few months during the 25-year simulation period (Figure C5-14). The MCL drinking water standard is an annual moving average of quarterly samples; the annual average simulated THM concentration ranged between 40 μg/l and 100 μg/l.

Estimation of Delta Export Water Quality and Trihalomethane Concentrations for the No-Project Alternative and the DW Project Alternatives

Simulation Results for the No-Project Alternative

Table C5-3 gives the monthly Delta export water quality values estimated from DeltaDWQ results for EC, Cl^-, and DOC for DeltaSOS-simulated Delta flows for the No-Project Alternative for 1967-1991. These estimates of export water quality under the No-Project Alternative are very similar to estimates of historical export water quality (Table C5-2) because the river inflows, salinity intrusion, and agricultural drainage effects are generally the same. More exports were simulated for the No-Project Alternative than occurred during the 1967-1991 historical period but the sources of export water remained similar (see Appendix B1, "Hydrodynamic Modeling Methods and Results for the Delta Wetlands Project").

Table C5-3 gives the THM concentrations simulated by the WTP model for the No-Project Alternative. Because the export water quality was similar and the specified water treatment processes were identical to those used for the simulation of historical THM concentrations, THM concentrations simulated for the No-Project Alternative were almost the same as simulated historical THM concentrations (Figure C5-14). For the No-Project Alternative, the average estimated export EC value was 486 μS/cm, the average export Cl^- concentration was 62 mg/l, the average export Br^- concentration was 0.22 mg/l, and the average export DOC concentration was 3.86 mg/l. The simulated THM concentration for the No-Project Alternative was 47.4 μg/l for the 1967-1991 period (Table C5-3).

Simulation Results for Alternative 1

Figure C5-15 shows the estimated export DOC and the corresponding simulated THM concentrations for Alternative 1. The export DOC averaged 3.83 mg/l, 0.03 mg/l less than the DOC concentration simulated for the No-Project Alternative. Figure C5-15 also shows the difference in estimated DOC between Alternative 1 and the No-Project Alternative.

For some months (in 1977 and 1991), simulated export Br^- and DOC concentrations were higher for Alternative 1 than for the No-Project Alternative because of increased Br^- concentration from seawater intrusion or increased DOC concentration in DW reservoir island discharge when DOC from vegetation and peat oxidation was simulated. For most months, the estimated export DOC and Br^- concentrations were slightly lower for Alternative 1 than for the No-Project Alternative.

Figure C5-15 shows the simulated THM concentrations for Alternative 1 and the difference between simulated THM concentrations for Alternative 1 and the No-Project Alternative. The average THM concentration for Alternative 1 was 47.30 μg/l, 0.06 μg/l less than the

average THM concentration simulated for the No-Project Alternative. The largest differences in simulated THM concentration occurred during dry periods, when the estimated DOC concentrations in DW discharges were greater than the agricultural drainage DOC concentrations simulated for the No-Project Alternative (i.e., in 1977 and 1991).

Estimated export DOC and THM concentrates were often less for Alternative 1 than for the No-Project Alternative because DW diversions would increase the Sacramento River source contribution (which represents water having a low DOC concentration) (see Appendix B1) and DW discharges would usually have DOC concentrations that are slightly less than export DOC concentrations. The simulated reduction in THM concentrations generally ranges from 1 μg/l to 10 μg/l (Figure C5-15).

Simulation Results for Alternative 2

Figure C5-16 shows the estimated export DOC and the corresponding simulated THM concentrations for Alternative 2. The export DOC averaged 3.83 mg/l, 0.03 mg/l less than the DOC concentration simulated for the No-Project Alternative. Figure C5-16 also shows the difference in estimated DOC between Alternative 2 and the No-Project Alternative.

For some months (in 1977 and 1991), simulated export Br^- and DOC concentrations were higher for Alternative 2 than for the No-Project Alternative because of increased Br^- concentration from seawater intrusion or increased DOC concentration in DW reservoir island discharge when DOC from vegetation and peat oxidation was simulated. For most months, the estimated export DOC and Br^- concentrations were slightly lower for Alternative 2 than for the No-Project Alternative.

Figure C5-16 shows the simulated THM concentrations for Alternative 2 and the difference between simulated THM concentrations for Alternative 2 and the No-Project Alternative. The average THM concentration for Alternative 2 was 47.34 μg/l, 0.02 μg/l less than the average THM concentration simulated for the No-Project Alternative. The largest differences in simulated THM concentration occurred during dry periods, when the estimated DOC concentrations in DW discharges were greater than the agricultural drainage DOC concentrations simulated for the No-Project Alternative (i.e., in 1977 and 1991).

Estimated export DOC and THM concentrates were often less for Alternative 2 than for the No-Project Alternative because DW diversions would increase the Sacramento River source contribution (which represents water having a low DOC concentration) (see Appendix B1) and DW discharges would usually have DOC concentrations that are slightly less than export DOC concentrations. The simulated reduction in THM concentrations generally ranges from 1 μg/l to 10 μg/l (Figure C5-16).

Simulation Results for Alternative 3

Figure C5-17 shows the estimated export DOC and the corresponding simulated THM concentrations for Alternative 3. The export DOC averaged 3.72 mg/l, 0.14 mg/l less than the DOC concentration simulated for the No-Project Alternative. Figure C5-17 also shows the difference in estimated DOC between Alternative 3 and the No-Project Alternative.

For some months (in 1977 and 1991), simulated export Br^- and DOC concentrations were higher for Alternative 3 than for the No-Project Alternative because of increased Br^- concentration from seawater intrusion or increased DOC concentration in DW reservoir island discharge when DOC from vegetation and peat oxidation was simulated. For most months, the estimated export DOC and Br^- concentrations were slightly lower for Alternative 3 than for the No-Project Alternative.

Figure C5-17 shows the simulated THM concentrations for Alternative 3 and the difference between simulated THM concentrations for Alternative 3 and the No-Project Alternative. The average THM concentration for Alternative 3 was 46.27 μg/l, 1.09 μg/l less than the average THM concentration simulated for the No-Project Alternative. The largest differences in simulated THM concentration occurred during dry periods, when the estimated DOC concentrations in DW discharges were greater than the agricultural drainage DOC concentrations simulated for the No-Project Alternative (i.e., in 1977 and 1991).

Estimated export DOC and THM concentrates were often less for Alternative 3 than for the No-Project Alternative because DW diversions would increase the Sacramento River source contribution (which represents water having a low DOC concentration) (see Appendix B1) and DW discharges would usually have DOC concentrations that are slightly less than export DOC concentrations. The simulated reduction in THM concentrations generally ranges from 1 μg/l to 10 μg/l (Figure C5-17).

CONCLUSIONS

The WTP model developed by Malcolm Pirnie is responsive to changes in raw water quality and varying treatment processes that ultimately affect THM production in finished water supplies. Comparison of measured data collected at the Penitencia Water Treatment Plant with values predicted by the model showed that the model can be used as an impact assessment tool for the DW project.

The WTP model tended to underpredict THM concentrations primarily because of uncertain chlorine doses and an insensitivity to Br^- concentrations and Br-THM formation. The prediction of effects of increased DOC concentrations on THM formation, for a given Br^- concentration level, appears to be adequate. Because the DW project will not change export Br^- concentrations substantially (Appendix B2, "Salt Transport Modeling Methods and Results for the Delta Wetlands Project"), the response to changes in export DOC concentrations is the most important response for accurate impact assessment of the DW project.

The WTP model is sensitive to changes in water temperatures, with higher THM production in warm waters. Therefore, natural seasonal variations in raw water temperatures may be partially responsible for increased THM concentrations during summer. The annual moving average MCL for THM is better simulated with annual moving averages of the simulated monthly THM values, a procedure that removes the effects of variable temperature.

The results of simulating DW project operation effects on export concentrations of DOC and Br^- on THM concentrations at a typical water treatment plant (Penitencia) suggest that an increase of 0.5 mg/l in DOC will produce approximately 5-10 μg/l of THM, depending on temperature. The maximum annual average increase attributable to DW project operations was less than 0.2 mg/l of DOC and therefore less than 4 μg/l of THM, which is less than 4% of the MCL for THM in drinking water. In simulations for almost all years, the annual average export DOC concentration was reduced by DW project operations.

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C-061850

Table C5–1. Penitencia Water Treatment Plant Water Quality Data and EPA WTP Model Calibration Results for January 1991 to August 1992

A. Penitencia Water Treatment Plant Data

Month – Year	Temp. (C)	Br^- (mg/l)	NH_3 (mg/l)	Raw TOC (mg/l)	Finished TOC (mg/l)	Chlorine Residual (mg/l)	Chloramine Residual (mg/l)	$CHCl_3$ (µg/l)	$CHCl_2Br$ (µg/l)	$CHClBr_2$ (µg/l)	$CHBr_3$ (µg/l)	Total THM (µg/l)	C–THM (µg/l)	Cl–THM (µg/l)	Br–THM (µg/l)	C–THM/DOC (%)	Bromine Incorporation (n)
Jan '91	5.8	0.56	<0.05	5.3	3.1	1.4	1.42					82					
Feb '91	11.2	0.46	<0.05	5.1	2.6	1.4	1.33	9	22	32	14	77	5	23	49	0.11	1.4
Mar '91	12.0	0.35	<0.05	4.2	3.0	1.6	1.39	9	20	31	10	70	5	22	43	0.12	1.3
Apr '91	15.3	0.50	<0.05	6.7	3.1	1.4	1.40	47	18	5	<1	70	7	50	13	0.10	0.3
Jun '91	17.5	0.29	<0.05	4.2	2.8	1.4	1.40	16	26	33	7	82	6	31	45	0.15	1.1
Jul '91	20.9	0.48	<0.05	4.5	2.7	1.4	1.40	12	24	35	10	81	6	27	48	0.13	1.2
Aug '91	21.8	0.28	<0.05	3.3	2.1	1.4	1.39	12	25	34	9	80	6	27	47	0.18	1.2
Sep '91	21.4	0.27	<0.05	4.7	2.3	1.3	1.37	12	21	23	6	62	5	24	34	0.10	1.1
Oct '91	20.6	0.26	<0.05	3.8	2.4	1.4	1.43	7	16	21	5	49	4	17	29	0.09	1.2
Nov '91	14.4	0.40	<0.05	3.0	2.2	1.4	1.40	5	17	31	16	69	5	17	47	0.15	1.6
Dec '91	10.0	0.50	<0.05	3.5	1.7	1.9	1.94	1	10	13	14	38	2	7	28	0.07	1.8
Jan '92	8.4	0.39	<0.05	5.3	2.5	1.5	1.62	10	21	25	8	64	5	22	37	0.09	1.2
Mar '92	14.4	0.10	<0.05	6.0	4.1	1.4	1.63	31	17	2	5	55	5	35	15	0.09	0.4
May '92	21.4	0.14	<0.05	5.4	3.8	1.8	1.97	34	23	13	2	72	6	42	23	0.12	0.5
Jun '92	24.7	0.43	<0.05	4.8	3.2	1.5	1.66	8	24	46	16	94	6	25	62	0.13	1.5
Jul '92	23.9	0.48	0.08	4.4	3.1	1.3	1.46	7	22	47	20	96	6	24	66	0.14	1.6
Aug '92	26.5	0.50	0.07	4.8	2.9	2.1	2.45	11	34	57	29	131	9	34	88	0.18	1.5

B. EPA WTP Model Calibration Results

Month – Year	Temp. (C)	Br^- (mg/l)	NH_3 (mg/l)	Raw TOC (mg/l)	Finished TOC (mg/l)	Chlorine Residual (mg/l)	Chloramine Residual (mg/l)	$CHCl_3$ (µg/l)	$CHCl_2Br$ (µg/l)	$CHClBr_2$ (µg/l)	$CHBr_3$ (µg/l)	Total THM (µg/l)	C–THM (µg/l)	Cl–THM (µg/l)	Br–THM (µg/l)	C–THM/DOC (%)	Bromine Incorporation (n)
Jan '91	5.8	0.56	<0.05	5.3	3.1	1.7	0.7	2	6	16	2	26	2	8	17	0.03	1.4
Feb '91	11.2	0.46	<0.05	5.1	2.7	1.8	0.9	7	11	18	2	38	3	14	21	0.06	1.1
Mar '91	12.0	0.35	<0.05	4.2	2.9	2.0	0.0	9	13	19	3	43	3	17	23	0.08	1.1
Apr '91	15.3	0.50	<0.05	6.7	3.3	1.7	0.7	23	19	19	1	63	5	32	25	0.08	0.7
Jun '91	17.5	0.29	<0.05	4.2	2.8	1.8	1.2	5	13	33	3	54	4	16	35	0.09	1.4
Jul '91	20.9	0.48	<0.05	4.5	2.7	1.8	1.0	18	18	22	2	60	5	28	28	0.11	0.8
Aug '91	21.8	0.28	<0.05	3.3	2.1	1.9	1.6	11	14	18	2	45	4	19	23	0.11	1.0
Sep '91	21.4	0.27	<0.05	4.7	2.5	1.8	1.3	11	17	32	3	62	5	23	35	0.10	1.1
Oct '91	20.6	0.26	<0.05	3.8	2.4	1.7	0.7	14	16	20	2	52	4	22	25	0.11	0.9
Nov '91	14.4	0.40	<0.05	3.0	2.0	1.8	1.7	2	7	23	3	35	2	9	24	0.08	1.6
Dec '91	10.0	0.50	<0.05	3.5	1.9	2.4	2.2	1	5	16	2	24	2	6	17	0.05	1.6
Jan '92	8.4	0.39	<0.05	5.3	2.7	1.8	0.9	4	8	15	2	29	2	10	17	0.04	1.2
Mar '92	14.4	0.10	<0.05	6.0	3.8	1.6	2.2	44	13	3	0	60	6	45	9	0.10	0.2
May '92	21.4	0.14	<0.05	5.4	3.5	2.1	2.2	57	21	8	1	87	8	61	17	0.16	0.3
Jun '92	24.7	0.43	<0.05	4.8	3.1	1.9	2.2	19	28	51	3	101	8	38	56	0.16	1.1
Jul '92	23.9	0.48	0.08	4.4	2.8	1.7	0.9	10	20	46	4	79	6	25	49	0.13	1.3
Aug '92	26.5	0.50	0.07	4.8	2.9	2.3	1.6	14	25	54	3	95	7	32	57	0.14	1.2

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Table C5–2. Estimated Delta Export Water Quality for Historical Inflows and Exports for 1967–1991

Water Year	pH (units)	Temp. (C)	NH_3–N (mg/l)	Turbidity (NTU)	EC (mS/cm)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Ca^{2+} Hardness (mg/l)	Cl^- (mg/l)	Br^- (mg/l)	TOC (mg/l)	UVA (1/cm)
1967												
OCT	7.5	17.0	0.05	40	732	79	117	59	92	0.32	2.72	0.078
NOV	7.5	14.5	0.10	59	1,026	91	164	82	79	0.28	3.31	0.095
DEC	7.5	12.0	0.15	47	683	77	109	55	54	0.19	4.25	0.121
JAN	7.5	10.0	0.20	50	744	80	119	60	60	0.21	4.22	0.121
FEB	7.5	12.0	0.15	43	602	74	96	48	45	0.16	4.34	0.124
MAR	7.5	14.5	0.10	43	592	74	95	47	45	0.16	4.39	0.125
APR	7.5	17.0	0.05	37	430	67	69	34	32	0.11	5.10	0.146
MAY	7.5	19.5	0.04	34	379	65	61	30	28	0.10	5.48	0.157
JUN	7.5	22.5	0.03	34	381	65	61	30	29	0.10	5.46	0.156
JUL	7.5	25.0	0.02	39	493	70	79	39	37	0.13	4.86	0.139
AUG	7.5	22.5	0.03	29	379	65	61	30	30	0.11	2.98	0.085
SEP	7.5	19.5	0.04	45	517	71	83	41	37	0.13	3.34	0.095
1968												
OCT	7.5	17.0	0.05	51	825	83	132	66	62	0.22	4.31	0.123
NOV	7.5	14.5	0.10	49	797	82	127	64	60	0.21	4.33	0.124
DEC	7.5	12.0	0.15	48	751	80	120	60	56	0.20	3.92	0.112
JAN	7.5	10.0	0.20	51	855	84	137	68	65	0.23	4.60	0.131
FEB	7.5	12.0	0.15	51	849	84	136	68	65	0.23	4.92	0.141
MAR	7.5	14.5	0.10	39	473	69	76	38	34	0.12	3.38	0.097
APR	7.5	17.0	0.05	20	402	66	64	32	32	0.11	2.63	0.075
MAY	7.5	19.5	0.04	15	357	64	57	29	46	0.16	2.71	0.077
JUN	7.5	22.5	0.03	13	606	74	97	48	123	0.43	3.12	0.089
JUL	7.5	25.0	0.02	12	677	77	108	54	145	0.51	3.13	0.090
AUG	7.5	22.5	0.03	15	619	75	99	50	123	0.43	3.19	0.091
SEP	7.5	19.5	0.04	15	549	72	88	44	94	0.33	3.01	0.086
1969												
OCT	7.5	17.0	0.05	17	647	76	104	52	103	0.36	3.70	0.106
NOV	7.5	14.5	0.10	22	465	69	74	37	43	0.15	3.05	0.087
DEC	7.5	12.0	0.15	39	702	78	112	56	58	0.20	5.80	0.166
JAN	7.5	10.0	0.20	37	504	70	81	40	38	0.13	5.61	0.160
FEB	7.5	12.0	0.15	31	327	63	52	26	25	0.09	6.09	0.174
MAR	7.5	14.5	0.10	32	321	63	51	26	24	0.08	5.94	0.170
APR	7.5	17.0	0.05	34	369	65	59	30	28	0.10	5.59	0.160
MAY	7.5	19.5	0.04	33	354	64	57	28	27	0.09	5.71	0.163
JUN	7.5	22.5	0.03	32	337	63	54	27	25	0.09	5.86	0.167
JUL	7.5	25.0	0.02	44	614	75	98	49	46	0.16	4.53	0.129
AUG	7.5	22.5	0.03	29	373	65	60	30	27	0.09	3.36	0.096
SEP	7.5	19.5	0.04	50	666	77	107	53	49	0.17	4.08	0.116
1970												
OCT	7.5	17.0	0.05	47	719	79	115	58	54	0.19	4.36	0.125
NOV	7.5	14.5	0.10	46	712	78	114	57	53	0.19	4.45	0.127
DEC	7.5	12.0	0.15	52	888	86	142	71	67	0.23	4.41	0.126
JAN	7.5	10.0	0.20	39	534	71	86	43	40	0.14	5.69	0.163
FEB	7.5	12.0	0.15	40	521	71	83	42	39	0.14	4.69	0.134
MAR	7.5	14.5	0.10	42	577	73	92	46	43	0.15	4.48	0.128
APR	7.5	17.0	0.05	24	430	67	69	34	32	0.11	3.05	0.087
MAY	7.5	19.5	0.04	35	454	68	73	36	35	0.12	3.36	0.096
JUN	7.5	22.5	0.03	31	503	70	81	40	57	0.20	3.52	0.101
JUL	7.5	25.0	0.02	19	463	69	74	37	75	0.26	3.31	0.095
AUG	7.5	22.5	0.03	19	378	65	60	30	48	0.17	3.33	0.095
SEP	7.5	19.5	0.04	30	428	67	68	34	31	0.11	3.47	0.099
1971												
OCT	7.5	17.0	0.05	37	596	74	95	48	44	0.15	4.15	0.118
NOV	7.5	14.5	0.10	49	762	80	122	61	56	0.20	4.25	0.121
DEC	7.5	12.0	0.15	45	768	81	123	61	58	0.20	5.48	0.157
JAN	7.5	10.0	0.20	45	671	77	107	54	50	0.18	4.38	0.125
FEB	7.5	12.0	0.15	47	650	76	104	52	49	0.17	4.25	0.121
MAR	7.5	14.5	0.10	34	443	68	71	35	31	0.11	3.18	0.091
APR	7.5	17.0	0.05	32	417	67	67	33	29	0.10	3.26	0.093
MAY	7.5	19.5	0.04	29	362	64	58	29	24	0.09	3.12	0.089
JUN	7.5	22.5	0.03	28	323	63	52	26	22	0.08	3.30	0.094
JUL	7.5	25.0	0.02	17	228	59	37	18	15	0.05	3.13	0.089
AUG	7.5	22.5	0.03	16	225	59	36	18	14	0.05	3.11	0.089
SEP	7.5	19.5	0.04	24	331	63	53	26	21	0.07	3.33	0.095

Table C5–2. Continued

Water Year	pH (units)	Temp. (C)	NH_3–N (mg/l)	Turbidity (NTU)	EC (mS/cm)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Ca^{2+} Hardness (mg/l)	Cl^- (mg/l)	Br^- (mg/l)	TOC (mg/l)	UVA (1/cm)
1972												
OCT	7.5	17.0	0.05	35	540	72	86	43	39	0.14	4.28	0.122
NOV	7.5	14.5	0.10	34	579	73	93	46	42	0.15	4.52	0.129
DEC	7.5	12.0	0.15	53	766	81	123	61	57	0.20	5.09	0.146
JAN	7.5	10.0	0.20	50	822	83	131	66	62	0.22	3.95	0.113
FEB	7.5	12.0	0.15	40	539	72	86	43	39	0.14	4.63	0.132
MAR	7.5	14.5	0.10	19	347	64	55	28	22	0.08	3.65	0.104
APR	7.5	17.0	0.05	15	406	66	65	33	42	0.15	3.88	0.111
MAY	7.5	19.5	0.04	12	436	67	70	35	72	0.25	3.01	0.086
JUN	7.5	22.5	0.03	13	760	80	122	61	168	0.59	3.28	0.094
JUL	7.5	25.0	0.02	12	523	71	84	42	96	0.34	3.36	0.096
AUG	7.5	22.5	0.03	11	408	66	65	33	64	0.22	3.16	0.090
SEP	7.5	19.5	0.04	18	372	65	60	30	33	0.12	2.99	0.085
1973												
OCT	7.5	17.0	0.05	21	412	66	66	33	31	0.11	3.09	0.088
NOV	7.5	14.5	0.10	37	630	75	101	50	46	0.16	4.07	0.116
DEC	7.5	12.0	0.15	41	676	77	108	54	53	0.19	5.44	0.155
JAN	7.5	10.0	0.20	47	953	88	153	76	72	0.25	6.32	0.181
FEB	7.5	12.0	0.15	41	603	74	96	48	45	0.16	5.00	0.143
MAR	7.5	14.5	0.10	42	588	74	94	47	44	0.15	4.76	0.136
APR	7.5	17.0	0.05	47	622	75	99	50	46	0.16	3.91	0.112
MAY	7.5	19.5	0.04	27	382	65	61	31	28	0.10	3.10	0.089
JUN	7.5	22.5	0.03	22	387	65	62	31	40	0.14	3.14	0.090
JUL	7.5	25.0	0.02	14	438	68	70	35	76	0.26	3.00	0.086
AUG	7.5	22.5	0.03	14	419	67	67	34	68	0.24	2.99	0.085
SEP	7.5	19.5	0.04	20	371	65	59	30	32	0.11	3.05	0.087
1974												
OCT	7.5	17.0	0.05	26	425	67	68	34	30	0.11	2.99	0.086
NOV	7.5	14.5	0.10	34	440	68	70	35	32	0.11	3.44	0.098
DEC	7.5	12.0	0.15	49	725	79	116	58	55	0.19	5.30	0.151
JAN	7.5	10.0	0.20	42	638	76	102	51	48	0.17	5.25	0.150
FEB	7.5	12.0	0.15	44	502	70	80	40	38	0.13	4.45	0.127
MAR	7.5	14.5	0.10	41	418	67	67	33	31	0.11	3.62	0.103
APR	7.5	17.0	0.05	44	564	73	90	45	42	0.15	4.13	0.118
MAY	7.5	19.5	0.04	32	388	66	62	31	27	0.09	3.35	0.096
JUN	7.5	22.5	0.03	26	324	63	52	26	22	0.08	3.29	0.094
JUL	7.5	25.0	0.02	16	246	60	39	20	19	0.07	2.93	0.084
AUG	7.5	22.5	0.03	17	249	60	40	20	16	0.06	3.00	0.086
SEP	7.5	19.5	0.04	33	427	67	68	34	30	0.10	3.53	0.101
1975												
OCT	7.5	17.0	0.05	40	533	71	85	43	38	0.13	4.19	0.120
NOV	7.5	14.5	0.10	48	779	81	125	62	58	0.20	4.38	0.125
DEC	7.5	12.0	0.15	47	684	77	110	55	51	0.18	4.20	0.120
JAN	7.5	10.0	0.20	36	498	70	80	40	36	0.13	5.19	0.148
FEB	7.5	12.0	0.15	42	533	71	85	43	40	0.14	5.26	0.150
MAR	7.5	14.5	0.10	43	466	69	74	37	34	0.12	4.14	0.118
APR	7.5	17.0	0.05	35	419	67	67	34	30	0.10	3.34	0.095
MAY	7.5	19.5	0.04	38	433	67	69	35	31	0.11	3.62	0.103
JUN	7.5	22.5	0.03	44	535	71	86	43	39	0.14	4.37	0.125
JUL	7.5	25.0	0.02	24	310	62	50	25	22	0.08	3.43	0.098
AUG	7.5	22.5	0.03	17	287	61	46	23	22	0.08	3.06	0.087
SEP	7.5	19.5	0.04	23	346	64	55	28	23	0.08	3.22	0.092
1976												
OCT	7.5	17.0	0.05	31	422	67	68	34	29	0.10	3.47	0.099
NOV	7.5	14.5	0.10	28	412	66	66	33	28	0.10	3.93	0.112
DEC	7.5	12.0	0.15	28	430	67	69	34	30	0.10	5.56	0.159
JAN	7.5	10.0	0.20	23	465	69	74	37	37	0.13	6.46	0.185
FEB	7.5	12.0	0.15	18	448	68	72	36	42	0.15	5.37	0.153
MAR	7.5	14.5	0.10	17	416	67	67	33	41	0.14	3.91	0.112
APR	7.5	17.0	0.05	19	447	68	72	36	41	0.14	3.53	0.101
MAY	7.5	19.5	0.04	15	595	74	95	48	111	0.39	3.06	0.087
JUN	7.5	22.5	0.03	17	719	79	115	57	147	0.51	3.45	0.099
JUL	7.5	25.0	0.02	16	695	78	111	56	140	0.49	3.50	0.100
AUG	7.5	22.5	0.03	14	653	76	104	52	129	0.45	3.11	0.089
SEP	7.5	19.5	0.04	12	751	80	120	60	155	0.54	2.81	0.080

Table C5–2. Continued

Water Year	pH (units)	Temp. (C)	NH_3–N (mg/l)	Turbidity (NTU)	EC (mS/cm)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Ca^{2+} Hardness (mg/l)	Cl^- (mg/l)	Br^- (mg/l)	TOC (mg/l)	UVA (1/cm)
1977												
OCT	7.5	17.0	0.05	19	1,141	96	182	91	233	0.82	4.03	0.115
NOV	7.5	14.5	0.10	19	1,235	99	198	99	254	0.89	4.96	0.142
DEC	7.5	12.0	0.15	25	1,295	102	207	104	250	0.87	7.54	0.216
JAN	7.5	10.0	0.20	13	865	85	138	69	170	0.59	5.60	0.160
FEB	7.5	12.0	0.15	15	891	86	143	71	170	0.60	5.55	0.159
MAR	7.5	14.5	0.10	12	1,234	99	198	99	277	0.97	3.80	0.108
APR	7.5	17.0	0.05	17	1,617	115	259	129	350	1.22	7.58	0.217
MAY	7.5	19.5	0.04	13	1,109	94	177	89	257	0.90	3.34	0.095
JUN	7.5	22.5	0.03	22	1,531	111	245	122	296	1.04	6.48	0.185
JUL	7.5	25.0	0.02	16	1,528	111	244	122	302	1.06	6.08	0.174
AUG	7.5	22.5	0.03	11	1,599	114	256	128	368	1.29	4.83	0.138
SEP	7.5	19.5	0.04	11	1,811	122	290	145	444	1.55	4.21	0.120
1978												
OCT	7.5	17.0	0.05	34	2,916	167	467	233	653	2.29	9.16	0.262
NOV	7.5	14.5	0.10	15	1,737	119	278	139	422	1.48	3.94	0.113
DEC	7.5	12.0	0.15	10	790	82	126	63	135	0.47	5.34	0.153
JAN	7.5	10.0	0.20	25	649	76	104	52	86	0.30	5.99	0.171
FEB	7.5	12.0	0.15	35	506	70	81	41	53	0.18	4.81	0.137
MAR	7.5	14.5	0.10	39	509	70	81	41	38	0.13	5.09	0.145
APR	7.5	17.0	0.05	34	382	65	61	31	29	0.10	5.45	0.156
MAY	7.5	19.5	0.04	35	395	66	63	32	30	0.10	5.45	0.156
JUN	7.5	22.5	0.03	40	479	69	77	38	43	0.15	4.03	0.115
JUL	7.5	25.0	0.02	17	552	72	88	44	99	0.34	3.03	0.087
AUG	7.5	22.5	0.03	15	469	69	75	38	78	0.27	2.95	0.084
SEP	7.5	19.5	0.04	23	400	66	64	32	36	0.13	3.11	0.089
1979												
OCT	7.5	17.0	0.05	34	574	73	92	46	54	0.19	4.33	0.124
NOV	7.5	14.5	0.10	33	517	71	83	41	44	0.15	3.61	0.103
DEC	7.5	12.0	0.15	27	554	72	89	44	60	0.21	5.08	0.145
JAN	7.5	10.0	0.20	45	748	80	120	60	59	0.21	5.81	0.166
FEB	7.5	12.0	0.15	42	646	76	103	52	49	0.17	5.18	0.148
MAR	7.5	14.5	0.10	41	536	71	86	43	40	0.14	4.65	0.133
APR	7.5	17.0	0.05	32	453	68	72	36	33	0.12	3.19	0.091
MAY	7.5	19.5	0.04	26	366	65	59	29	27	0.09	3.04	0.087
JUN	7.5	22.5	0.03	22	504	70	81	40	72	0.25	3.25	0.093
JUL	7.5	25.0	0.02	14	415	67	66	33	67	0.24	2.89	0.083
AUG	7.5	22.5	0.03	13	588	74	94	47	116	0.41	2.91	0.083
SEP	7.5	19.5	0.04	16	598	74	96	48	107	0.38	2.93	0.084
1980												
OCT	7.5	17.0	0.05	22	531	71	85	42	67	0.23	3.12	0.089
NOV	7.5	14.5	0.10	25	453	68	72	36	38	0.13	3.37	0.096
DEC	7.5	12.0	0.15	26	481	69	77	38	40	0.14	4.63	0.132
JAN	7.5	10.0	0.20	38	531	71	85	42	40	0.14	5.74	0.164
FEB	7.5	12.0	0.15	35	404	66	65	32	30	0.11	5.57	0.159
MAR	7.5	14.5	0.10	33	348	64	56	28	26	0.09	5.71	0.163
APR	7.5	17.0	0.05	39	502	70	80	40	38	0.13	4.81	0.137
MAY	7.5	19.5	0.04	40	516	71	83	41	39	0.14	4.88	0.139
JUN	7.5	22.5	0.03	42	452	68	72	36	34	0.12	3.93	0.112
JUL	7.5	25.0	0.02	28	373	65	60	30	28	0.10	3.42	0.098
AUG	7.5	22.5	0.03	16	515	71	82	41	86	0.30	3.10	0.089
SEP	7.5	19.5	0.04	27	447	68	71	36	43	0.15	3.42	0.098
1981												
OCT	7.5	17.0	0.05	31	553	72	88	44	56	0.20	4.40	0.126
NOV	7.5	14.5	0.10	28	596	74	95	48	68	0.24	4.95	0.141
DEC	7.5	12.0	0.15	26	457	68	73	37	38	0.13	4.85	0.139
JAN	7.5	10.0	0.20	24	478	69	76	38	36	0.13	5.63	0.161
FEB	7.5	12.0	0.15	26	392	66	63	31	29	0.10	3.92	0.112
MAR	7.5	14.5	0.10	36	494	70	79	40	36	0.13	3.81	0.109
APR	7.5	17.0	0.05	21	363	65	58	29	26	0.09	2.63	0.075
MAY	7.5	19.5	0.04	28	449	68	72	36	39	0.14	3.12	0.089
JUN	7.5	22.5	0.03	25	596	74	95	48	96	0.34	3.62	0.104
JUL	7.5	25.0	0.02	16	455	68	73	36	78	0.27	3.19	0.091
AUG	7.5	22.5	0.03	13	653	76	104	52	135	0.47	3.05	0.087
SEP	7.5	19.5	0.04	15	716	79	115	57	142	0.50	3.12	0.089

Table C5–2. Continued

Water Year	pH (units)	Temp. (C)	NH_3–N (mg/l)	Turbidity (NTU)	EC (mS/cm)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Ca^{2+} Hardness (mg/l)	Cl^- (mg/l)	Br^- (mg/l)	TOC (mg/l)	UVA (1/cm)
1982												
OCT	7.5	17.0	0.05	17	765	81	122	61	136	0.48	2.99	0.085
NOV	7.5	14.5	0.10	27	391	66	63	31	29	0.10	3.06	0.087
DEC	7.5	12.0	0.15	34	473	69	76	38	40	0.14	4.92	0.141
JAN	7.5	10.0	0.20	42	621	75	99	50	50	0.18	6.11	0.175
FEB	7.5	12.0	0.15	36	383	65	61	31	30	0.10	4.41	0.126
MAR	7.5	14.5	0.10	39	395	66	63	32	30	0.10	4.60	0.131
APR	7.5	17.0	0.05	34	365	65	58	29	27	0.10	5.63	0.161
MAY	7.5	19.5	0.04	35	396	66	63	32	30	0.10	5.42	0.155
JUN	7.5	22.5	0.03	42	574	73	92	46	43	0.15	4.70	0.134
JUL	7.5	25.0	0.02	44	569	73	91	46	43	0.15	4.47	0.128
AUG	7.5	22.5	0.03	28	360	64	58	29	25	0.09	3.38	0.096
SEP	7.5	19.5	0.04	44	521	71	83	42	38	0.13	4.04	0.116
1983												
OCT	7.5	17.0	0.05	41	539	72	86	43	40	0.14	4.62	0.132
NOV	7.5	14.5	0.10	43	495	70	79	40	37	0.13	4.37	0.125
DEC	7.5	12.0	0.15	36	438	68	70	35	33	0.11	5.61	0.160
JAN	7.5	10.0	0.20	35	412	66	66	33	31	0.11	5.75	0.164
FEB	7.5	12.0	0.15	31	324	63	52	26	24	0.09	6.06	0.173
MAR	7.5	14.5	0.10	30	291	62	47	23	22	0.08	6.27	0.179
APR	7.5	17.0	0.05	31	300	62	48	24	22	0.08	6.14	0.175
MAY	7.5	19.5	0.04	31	317	63	51	25	24	0.08	5.99	0.171
JUN	7.5	22.5	0.03	33	344	64	55	28	26	0.09	5.78	0.165
JUL	7.5	25.0	0.02	35	389	66	62	31	29	0.10	5.47	0.156
AUG	7.5	22.5	0.03	40	454	68	73	36	33	0.12	4.55	0.130
SEP	7.5	19.5	0.04	39	484	69	77	39	36	0.13	4.98	0.142
1984												
OCT	7.5	17.0	0.05	37	455	68	73	36	34	0.12	5.17	0.148
NOV	7.5	14.5	0.10	39	494	70	79	40	37	0.13	5.17	0.148
DEC	7.5	12.0	0.15	35	398	66	64	32	30	0.10	5.67	0.162
JAN	7.5	10.0	0.20	33	345	64	55	28	26	0.09	5.74	0.164
FEB	7.5	12.0	0.15	39	481	69	77	38	36	0.13	4.88	0.139
MAR	7.5	14.5	0.10	42	459	68	73	37	34	0.12	4.13	0.118
APR	7.5	17.0	0.05	30	404	66	65	32	28	0.10	3.53	0.101
MAY	7.5	19.5	0.04	31	400	66	64	32	29	0.10	3.39	0.097
JUN	7.5	22.5	0.03	24	367	65	59	29	34	0.12	3.32	0.095
JUL	7.5	25.0	0.02	18	253	60	40	20	19	0.07	3.01	0.086
AUG	7.5	22.5	0.03	18	311	62	50	25	28	0.10	3.07	0.088
SEP	7.5	19.5	0.04	31	425	67	68	34	30	0.11	3.44	0.098
1985												
OCT	7.5	17.0	0.05	36	500	70	80	40	37	0.13	3.73	0.107
NOV	7.5	14.5	0.10	25	365	65	58	29	24	0.09	3.27	0.093
DEC	7.5	12.0	0.15	31	424	67	68	34	30	0.10	4.80	0.137
JAN	7.5	10.0	0.20	35	486	69	78	39	35	0.12	4.94	0.141
FEB	7.5	12.0	0.15	25	391	66	63	31	27	0.09	4.17	0.119
MAR	7.5	14.5	0.10	20	372	65	60	30	27	0.10	2.96	0.085
APR	7.5	17.0	0.05	21	471	69	75	38	51	0.18	2.97	0.085
MAY	7.5	19.5	0.04	22	439	68	70	35	48	0.17	3.26	0.093
JUN	7.5	22.5	0.03	19	481	69	77	38	72	0.25	3.46	0.099
JUL	7.5	25.0	0.02	19	479	69	77	38	74	0.26	3.33	0.095
AUG	7.5	22.5	0.03	17	798	82	128	64	166	0.58	3.35	0.096
SEP	7.5	19.5	0.04	16	927	87	148	74	201	0.70	3.19	0.091
1986												
OCT	7.5	17.0	0.05	18	1,065	93	170	85	226	0.79	3.65	0.104
NOV	7.5	14.5	0.10	18	673	77	108	54	112	0.39	3.12	0.089
DEC	7.5	12.0	0.15	17	453	68	73	36	47	0.16	4.90	0.140
JAN	7.5	10.0	0.20	18	419	67	67	34	35	0.12	5.77	0.165
FEB	7.5	12.0	0.15	41	571	73	91	46	43	0.15	5.52	0.158
MAR	7.5	14.5	0.10	33	357	64	57	29	27	0.09	5.80	0.166
APR	7.5	17.0	0.05	35	385	65	62	31	29	0.10	5.43	0.155
MAY	7.5	19.5	0.04	41	495	70	79	40	37	0.13	4.52	0.129
JUN	7.5	22.5	0.03	44	482	69	77	39	39	0.14	4.15	0.119
JUL	7.5	25.0	0.02	22	359	64	57	29	36	0.13	3.19	0.091
AUG	7.5	22.5	0.03	20	466	69	75	37	65	0.23	3.20	0.091
SEP	7.5	19.5	0.04	23	375	65	60	30	32	0.11	3.14	0.090

Table C5–2. Continued

Water Year	pH (units)	Temp. (C)	NH_3–N (mg/l)	Turbidity (NTU)	EC (mS/cm)	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Ca^{2+} Hardness (mg/l)	Cl^- (mg/l)	Br^- (mg/l)	TOC (mg/l)	UVA (1/cm)
1987												
OCT	7.5	17.0	0.05	27	443	68	71	35	35	0.12	4.12	0.118
NOV	7.5	14.5	0.10	24	507	70	81	41	50	0.18	4.82	0.138
DEC	7.5	12.0	0.15	28	495	70	79	40	45	0.16	5.19	0.148
JAN	7.5	10.0	0.20	23	453	68	72	36	37	0.13	4.92	0.141
FEB	7.5	12.0	0.15	21	445	68	71	36	32	0.11	5.12	0.146
MAR	7.5	14.5	0.10	34	478	69	76	38	35	0.12	3.99	0.114
APR	7.5	17.0	0.05	24	552	72	88	44	69	0.24	3.05	0.087
MAY	7.5	19.5	0.04	25	640	76	102	51	100	0.35	3.23	0.092
JUN	7.5	22.5	0.03	24	765	81	122	61	145	0.51	3.50	0.100
JUL	7.5	25.0	0.02	15	625	75	100	50	127	0.44	3.05	0.087
AUG	7.5	22.5	0.03	14	781	81	125	63	170	0.60	3.02	0.086
SEP	7.5	19.5	0.04	14	1,147	96	184	92	271	0.95	3.01	0.086
1988												
OCT	7.5	17.0	0.05	17	1,283	101	205	103	289	1.01	3.92	0.112
NOV	7.5	14.5	0.10	19	1,126	95	180	90	236	0.83	3.46	0.099
DEC	7.5	12.0	0.15	14	493	70	79	39	66	0.23	4.43	0.127
JAN	7.5	10.0	0.20	16	390	66	62	31	36	0.13	5.07	0.145
FEB	7.5	12.0	0.15	12	849	84	136	68	180	0.63	3.98	0.114
MAR	7.5	14.5	0.10	18	861	84	138	69	170	0.60	3.27	0.093
APR	7.5	17.0	0.05	18	405	66	65	32	41	0.14	3.20	0.092
MAY	7.5	19.5	0.04	19	586	73	94	47	93	0.32	3.12	0.089
JUN	7.5	22.5	0.03	20	799	82	128	64	160	0.56	3.41	0.098
JUL	7.5	25.0	0.02	15	661	76	106	53	139	0.49	3.17	0.091
AUG	7.5	22.5	0.03	15	896	86	143	72	201	0.70	3.17	0.091
SEP	7.5	19.5	0.04	14	1,132	95	181	91	264	0.92	3.12	0.089
1989												
OCT	7.5	17.0	0.05	16	1,359	104	217	109	312	1.09	4.41	0.126
NOV	7.5	14.5	0.10	16	811	82	130	65	154	0.54	3.29	0.094
DEC	7.5	12.0	0.15	15	587	73	94	47	90	0.31	4.71	0.135
JAN	7.5	10.0	0.20	12	713	79	114	57	137	0.48	4.91	0.140
FEB	7.5	12.0	0.15	13	608	74	97	49	102	0.36	4.48	0.128
MAR	7.5	14.5	0.10	23	276	61	44	22	20	0.07	2.76	0.079
APR	7.5	17.0	0.05	17	319	63	51	25	24	0.09	2.93	0.084
MAY	7.5	19.5	0.04	21	428	67	68	34	46	0.16	3.30	0.094
JUN	7.5	22.5	0.03	21	472	69	75	38	63	0.22	3.57	0.102
JUL	7.5	25.0	0.02	14	355	64	57	28	51	0.18	3.11	0.089
AUG	7.5	22.5	0.03	12	439	68	70	35	75	0.26	3.01	0.086
SEP	7.5	19.5	0.04	13	430	67	69	34	62	0.22	2.41	0.069
1990												
OCT	7.5	17.0	0.05	13	536	71	86	43	87	0.30	3.03	0.086
NOV	7.5	14.5	0.10	13	572	73	92	46	96	0.34	3.34	0.095
DEC	7.5	12.0	0.15	13	660	76	106	53	117	0.41	5.90	0.169
JAN	7.5	10.0	0.20	13	401	66	64	32	48	0.17	4.81	0.137
FEB	7.5	12.0	0.15	13	382	65	61	31	44	0.15	4.01	0.115
MAR	7.5	14.5	0.10	13	635	75	102	51	114	0.40	2.89	0.083
APR	7.5	17.0	0.05	13	496	70	79	40	76	0.27	3.73	0.107
MAY	7.5	19.5	0.04	26	596	74	95	48	71	0.25	3.16	0.090
JUN	7.5	22.5	0.03	24	610	74	98	49	101	0.36	3.91	0.112
JUL	7.5	25.0	0.02	15	596	74	95	48	114	0.40	3.45	0.098
AUG	7.5	22.5	0.03	14	639	76	102	51	126	0.44	3.40	0.097
SEP	7.5	19.5	0.04	13	1,035	91	166	83	235	0.82	3.34	0.095
1991												
OCT	7.5	17.0	0.05	21	1,393	106	223	111	297	1.04	5.01	0.143
NOV	7.5	14.5	0.10	21	1,214	99	194	97	236	0.83	5.99	0.171
DEC	7.5	12.0	0.15	15	772	81	123	62	136	0.48	5.80	0.166
JAN	7.5	10.0	0.20	14	988	90	158	79	192	0.67	7.54	0.215
FEB	7.5	12.0	0.15	14	658	76	105	53	102	0.36	5.86	0.167
MAR	7.5	14.5	0.10	18	315	63	50	25	22	0.08	2.84	0.081
APR	7.5	17.0	0.05	13	831	83	133	66	167	0.59	2.76	0.079
MAY	7.5	19.5	0.04	27	1,084	93	173	87	217	0.76	3.77	0.108
JUN	7.5	22.5	0.03	25	1,029	91	165	82	215	0.75	4.27	0.122
JUL	7.5	25.0	0.02	20	983	89	157	79	206	0.72	4.31	0.123
AUG	7.5	22.5	0.03	14	1,157	96	185	93	269	0.94	3.89	0.111
SEP	7.5	19.5	0.04	13	1,100	94	176	88	255	0.89	3.55	0.102

Table C5–3. Estimated No–Project Export Water Quality and THM Concentrations and Changes Resulting from Operations of DW Alternatives for 1968–1991

Water Year	No–Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1968																
OCT	21	0.07	3.1	36	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	0	0.00	(0.3)	(3)
NOV	32	0.11	3.2	33	0	0.00	(0.0)	(0)	0	0.00	(0.0)	(0)	0	0.00	(0.1)	(0)
DEC	45	0.16	3.6	32	0	0.00	(0.0)	(0)	0	0.00	(0.0)	(0)	0	0.00	(0.1)	(0)
JAN	20	0.07	3.8	27	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.1)	(1)
FEB	20	0.07	3.6	31	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.1)	(1)
MAR	17	0.06	2.7	27	(1)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.1)	(1)
APR	42	0.15	3.4	40	(4)	(0.01)	(0.1)	(1)	(3)	(0.01)	(0.0)	(1)	(3)	(0.01)	(0.1)	(1)
MAY	54	0.19	3.5	50	(12)	(0.04)	(0.2)	(4)	(9)	(0.03)	(0.1)	(2)	(9)	(0.03)	(0.2)	(4)
JUN	48	0.17	3.0	48	2	0.01	0.0	1	2	0.01	0.0	1	1	0.01	0.0	0
JUL	28	0.10	2.7	47	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	(0.0)	(1)
AUG	65	0.23	3.0	48	(14)	(0.05)	0.0	(1)	(18)	(0.06)	(0.0)	(2)	(27)	(0.09)	(0.1)	(4)
SEP	120	0.42	3.0	46	2	0.01	0.0	0	2	0.01	0.0	0	(17)	(0.06)	0.0	0
1969																
OCT	101	0.35	3.4	44	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)
NOV	89	0.31	2.9	33	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	(0.0)	(0)
DEC	28	0.10	4.6	38	1	0.00	(0.8)	(6)	1	0.00	(0.8)	(6)	3	0.01	(1.1)	(8)
JAN	29	0.10	5.2	37	(0)	(0.00)	(0.1)	(0)	(0)	(0.00)	(0.1)	(0)	(1)	(0.00)	(0.2)	(1)
FEB	29	0.10	5.4	46	0	0.00	0.0	0	0	0.00	0.0	0	(0)	(0.00)	(0.0)	(0)
MAR	26	0.09	3.8	37	0	0.00	0.1	1	(0)	(0.00)	0.1	1	(0)	(0.00)	(0.0)	(0)
APR	28	0.10	3.9	46	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(0)
MAY	28	0.10	5.5	77	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	0.0	0
JUN	29	0.10	4.8	78	(1)	(0.00)	(0.2)	(3)	(1)	(0.00)	(0.2)	(3)	(2)	(0.01)	(0.3)	(6)
JUL	41	0.14	3.8	69	(13)	(0.05)	(0.0)	(3)	(13)	(0.05)	(0.0)	(3)	(15)	(0.05)	(0.2)	(6)
AUG	66	0.23	3.3	55	2	0.01	0.0	1	2	0.01	0.0	1	(18)	(0.06)	0.1	(1)
SEP	21	0.07	2.9	38	2	0.01	(0.5)	(6)	2	0.01	(0.5)	(6)	6	0.02	(0.7)	(8)
1970																
OCT	28	0.10	3.9	45	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.2)	(3)
NOV	27	0.09	3.6	36	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
DEC	23	0.08	4.0	34	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
JAN	30	0.10	5.4	39	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.1)	(1)
FEB	25	0.09	4.1	34	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.1)	(0)
MAR	19	0.07	2.9	29	(0)	(0.00)	0.1	1	(0)	(0.00)	0.1	1	(1)	(0.00)	(0.2)	(2)
APR	38	0.13	3.9	46	(1)	(0.00)	(0.0)	(0)	(3)	(0.01)	(0.1)	(2)	(3)	(0.01)	(0.2)	(3)
MAY	48	0.17	3.9	55	0	0.00	0.0	0	(6)	(0.02)	(0.1)	(2)	(5)	(0.02)	(0.2)	(4)
JUN	39	0.14	3.2	50	1	0.00	0.0	1	1	0.00	0.0	1	1	0.00	0.0	0
JUL	20	0.07	2.8	47	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)
AUG	60	0.21	3.2	53	(26)	(0.09)	(0.1)	(4)	(20)	(0.07)	0.0	(2)	(30)	(0.11)	(0.2)	(6)
SEP	127	0.45	3.1	49	3	0.01	(0.0)	0	3	0.01	0.0	0	3	0.01	(0.0)	0

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Table C5–3. Continued

Water Year	No-Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1971																
OCT	106	0.37	3.4	44	0	0.00	(0.0)	(0)	0	0.00	(0.0)	(0)	0	0.00	(0.0)	(0)
NOV	24	0.08	3.0	31	1	0.00	(0.5)	(4)	1	0.00	(0.5)	(4)	3	0.01	(0.7)	(7)
DEC	27	0.09	4.9	41	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.1)	(1)	(2)	(0.01)	(0.3)	(3)
JAN	20	0.07	3.8	27	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.1)	(1)
FEB	22	0.08	3.8	32	(4)	(0.01)	(0.6)	(5)	(4)	(0.01)	(0.5)	(4)	(4)	(0.01)	(0.6)	(5)
MAR	17	0.06	2.8	28	(2)	(0.01)	(0.3)	(3)	(2)	(0.01)	(0.2)	(3)	(2)	(0.01)	(0.3)	(3)
APR	30	0.11	3.4	40	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(1)
MAY	24	0.08	3.2	42	(1)	(0.00)	(0.2)	(2)	(1)	(0.00)	(0.2)	(2)	(2)	(0.01)	(0.4)	(5)
JUN	18	0.06	3.0	46	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	0.0	0
JUL	18	0.06	2.9	49	0	0.00	(0.0)	(1)	0	0.00	(0.0)	(1)	0	0.00	(0.0)	(1)
AUG	59	0.20	3.3	54	(28)	(0.10)	(0.4)	(9)	(27)	(0.10)	(0.3)	(8)	(30)	(0.10)	(0.4)	(9)
SEP	55	0.19	2.9	40	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	(9)	(0.03)	(0.1)	(1)
1972																
OCT	37	0.13	3.4	40	13	0.04	(0.4)	(4)	13	0.04	(0.4)	(4)	12	0.04	(0.4)	(4)
NOV	49	0.17	3.6	38	6	0.02	(0.1)	(0)	6	0.02	(0.1)	(0)	6	0.02	(0.1)	(1)
DEC	24	0.09	4.1	34	0	0.00	(0.4)	(3)	1	0.00	(0.4)	(3)	4	0.01	(0.8)	(6)
JAN	27	0.10	4.3	31	1	0.00	(0.1)	(1)	0	0.00	(0.1)	(0)	2	0.01	(0.1)	(1)
FEB	21	0.07	4.0	33	(0)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.4)	(3)	(2)	(0.01)	(0.5)	(4)
MAR	19	0.07	3.3	33	(0)	(0.00)	0.0	0	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.2)	(2)
APR	44	0.15	4.5	54	(5)	(0.02)	(0.3)	(5)	(4)	(0.01)	(0.3)	(4)	(4)	(0.01)	(0.4)	(5)
MAY	52	0.18	3.6	50	(4)	(0.01)	(0.0)	(0)	(3)	(0.01)	(0.0)	(0)	(2)	(0.01)	(0.1)	(1)
JUN	47	0.16	3.3	53	1	0.00	(0.1)	(1)	1	0.00	(0.1)	(1)	0	0.00	(0.4)	(7)
JUL	29	0.10	2.9	50	1	0.00	(0.0)	(1)	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(1)
AUG	33	0.12	2.9	45	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	2	0.01	(0.0)	(0)
SEP	125	0.44	3.1	49	(47)	(0.16)	0.1	(2)	(45)	(0.16)	0.1	(2)	(64)	(0.22)	(0.0)	(5)
1973																
OCT	88	0.31	2.8	36	0	0.00	(0.0)	0	0	0.00	(0.0)	0	(6)	(0.02)	0.0	0
NOV	24	0.08	3.1	32	0	0.00	(0.5)	(4)	0	0.00	(0.5)	(4)	2	0.01	(0.7)	(6)
DEC	23	0.08	4.4	37	(1)	(0.00)	(0.1)	(1)	(0)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.4)	(3)
JAN	28	0.10	5.6	40	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.2)	(1)
FEB	23	0.08	4.3	36	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
MAR	26	0.09	3.9	39	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.1)	(1)
APR	31	0.11	3.5	41	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(0)
MAY	29	0.10	3.5	47	(1)	(0.00)	(0.2)	(3)	(1)	(0.00)	(0.2)	(3)	(2)	(0.01)	(0.4)	(5)
JUN	26	0.09	3.2	49	(1)	(0.00)	(0.1)	(1)	(6)	(0.02)	(0.2)	(4)	(6)	(0.02)	(0.3)	(6)
JUL	18	0.06	2.8	47	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	0.0	0
AUG	69	0.24	3.2	54	(27)	(0.10)	(0.1)	(4)	2	0.01	0.0	1	(24)	(0.08)	(0.1)	(4)
SEP	119	0.42	3.0	47	2	0.01	(0.0)	0	2	0.01	0.0	0	2	0.01	(0.0)	0

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Table C5–3. Continued

Water Year	No-Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1974																
OCT	81	0.29	2.5	32	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	(0.0)	(0)
NOV	18	0.06	3.0	30	(2)	(0.01)	(0.5)	(5)	(2)	(0.01)	(0.5)	(5)	(3)	(0.01)	(0.7)	(7)
DEC	24	0.08	4.5	37	(0)	(0.00)	(0.1)	(0)	(0)	(0.00)	(0.1)	(0)	(1)	(0.00)	(0.3)	(2)
JAN	25	0.09	4.8	35	(1)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.1)	(2)
FEB	20	0.07	3.6	31	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
MAR	18	0.06	3.1	31	(0)	(0.00)	0.1	1	(0)	(0.00)	0.1	1	(0)	(0.00)	(0.0)	(0)
APR	26	0.09	3.5	40	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(0)
MAY	26	0.09	3.5	47	0	0.00	0.0	0	0	0.00	0.0	0	(0)	(0.00)	(0.0)	(0)
JUN	22	0.08	3.2	50	0	0.00	0.0	0	(4)	(0.01)	(0.1)	(2)	(4)	(0.01)	(0.2)	(5)
JUL	28	0.10	3.1	53	(9)	(0.03)	(0.1)	(3)	(4)	(0.01)	0.1	0	(8)	(0.03)	(0.2)	(4)
AUG	59	0.21	3.3	54	(2)	(0.01)	0.0	0	2	0.01	0.0	0	(2)	(0.01)	0.1	1
SEP	25	0.09	2.8	37	12	0.04	(0.4)	(4)	12	0.04	(0.4)	(4)	12	0.04	(0.4)	(4)
1975																
OCT	21	0.07	3.2	37	2	0.01	(0.2)	(2)	2	0.01	(0.2)	(2)	5	0.02	(0.6)	(6)
NOV	30	0.11	3.5	36	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	2	0.01	(0.1)	(1)
DEC	30	0.11	4.2	36	0	0.00	(0.1)	(1)	0	0.00	(0.1)	(1)	0	0.00	(0.1)	(1)
JAN	45	0.16	4.7	34	0	0.00	(0.1)	(0)	0	0.00	(0.1)	(0)	0	0.00	(0.1)	(1)
FEB	26	0.09	4.5	38	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
MAR	20	0.07	3.5	35	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.2)	(2)
APR	28	0.10	3.5	41	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	(0.0)	(0)
MAY	25	0.09	3.5	47	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
JUN	19	0.06	3.1	47	0	0.00	0.0	0	(0)	(0.00)	(0.1)	(1)	(0)	(0.00)	(0.1)	(1)
JUL	26	0.09	3.0	51	(3)	(0.01)	(0.1)	(2)	(2)	(0.01)	(0.0)	(1)	(3)	(0.01)	(0.1)	(3)
AUG	63	0.22	3.4	55	(19)	(0.07)	(0.1)	(4)	(12)	(0.04)	0.0	(1)	(28)	(0.10)	(0.3)	(7)
SEP	43	0.15	2.9	40	5	0.02	(0.1)	(2)	5	0.02	(0.1)	(2)	6	0.02	(0.1)	(2)
1976																
OCT	20	0.07	2.7	32	2	0.01	(0.4)	(4)	2	0.01	(0.4)	(4)	6	0.02	(0.6)	(7)
NOV	24	0.08	3.5	35	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	2	0.01	(0.2)	(2)
DEC	50	0.18	5.6	49	(7)	(0.03)	(0.7)	(7)	(5)	(0.02)	(0.5)	(5)	(4)	(0.02)	(0.5)	(5)
JAN	69	0.24	6.8	52	(25)	(0.09)	(1.8)	(15)	(25)	(0.09)	(1.8)	(15)	(25)	(0.09)	(1.9)	(16)
FEB	29	0.10	4.8	41	(0)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.2)	(1)	(5)	(0.02)	(0.9)	(8)
MAR	35	0.12	4.1	42	0	0.00	0.1	1	0	0.00	0.1	1	(5)	(0.02)	(0.5)	(5)
APR	63	0.22	4.0	51	0	0.00	0.1	1	0	0.00	0.1	1	(2)	(0.01)	(0.2)	(3)
MAY	68	0.24	3.5	51	2	0.01	0.1	3	2	0.01	0.1	2	2	0.01	0.0	0
JUN	54	0.19	3.1	51	2	0.01	0.1	2	2	0.01	0.1	2	2	0.01	0.0	1
JUL	59	0.21	3.0	54	4	0.01	0.1	3	4	0.01	0.1	3	4	0.01	0.1	2
AUG	175	0.61	3.7	73	7	0.02	0.1	3	7	0.02	0.1	3	7	0.02	0.1	2
SEP	255	0.89	3.3	60	5	0.02	0.1	2	5	0.02	0.1	2	5	0.02	0.1	1

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Table C5–3. Continued

Water Year	No–Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1977																
OCT	271	0.95	3.9	63	2	0.01	0.1	1	2	0.01	0.1	1	2	0.01	0.0	1
NOV	172	0.60	4.3	54	1	0.00	0.1	1	1	0.00	0.1	1	1	0.00	0.0	0
DEC	72	0.25	4.9	44	(0)	(0.00)	(0.0)	(0)	0	0.00	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
JAN	144	0.51	6.1	51	1	0.00	0.2	2	1	0.00	0.2	2	1	0.00	0.0	0
FEB	68	0.24	4.6	42	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
MAR	77	0.27	3.6	40	1	0.00	0.4	4	1	0.00	0.4	4	0	0.00	0.1	1
APR	81	0.28	5.2	67	2	0.01	0.4	6	2	0.01	0.4	6	2	0.01	0.2	3
MAY	126	0.44	3.8	60	3	0.01	0.4	7	3	0.01	0.4	7	3	0.01	0.3	5
JUN	142	0.50	5.0	97	3	0.01	0.7	15	3	0.01	0.7	15	4	0.01	0.6	11
JUL	179	0.63	4.5	99	21	0.07	0.5	15	21	0.07	0.5	15	21	0.07	0.5	13
AUG	248	0.87	5.6	124	16	0.06	0.7	19	16	0.06	0.7	19	17	0.06	0.7	17
SEP	285	1.00	3.7	69	7	0.02	0.2	4	7	0.02	0.2	4	7	0.02	0.2	4
1978																
OCT	300	1.05	4.9	84	4	0.01	0.1	3	4	0.01	0.1	3	4	0.01	0.1	2
NOV	314	1.10	3.9	57	(0)	(0.00)	0.3	4	(0)	(0.00)	0.3	4	0	0.00	0.2	2
DEC	104	0.37	4.4	42	1	0.00	0.1	1	1	0.00	0.1	1	0	0.00	0.0	(0)
JAN	57	0.20	5.7	43	(9)	(0.03)	(0.9)	(7)	(9)	(0.03)	(0.9)	(7)	(13)	(0.05)	(1.3)	(10)
FEB	37	0.13	4.2	36	(1)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.0)	(0)	(2)	(0.01)	(0.2)	(2)
MAR	27	0.10	3.5	35	(0)	(0.00)	0.1	0	(0)	(0.00)	0.1	0	(1)	(0.00)	(0.1)	(1)
APR	27	0.10	3.4	40	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(1)
MAY	30	0.11	3.5	47	0	0.00	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(0)
JUN	40	0.14	3.5	56	(1)	(0.00)	0.1	1	(11)	(0.04)	0.5	7	(13)	(0.05)	0.2	2
JUL	49	0.17	3.6	64	(19)	(0.07)	1.0	17	1	0.00	0.1	2	(12)	(0.04)	0.5	10
AUG	84	0.29	3.5	59	2	0.01	0.0	1	3	0.01	0.1	1	2	0.01	0.0	1
SEP	85	0.30	2.9	43	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	0.0	0
1979																
OCT	42	0.15	3.6	42	11	0.04	(0.5)	(5)	11	0.04	(0.5)	(5)	10	0.04	(0.5)	(6)
NOV	51	0.18	3.0	32	9	0.03	(0.0)	0	9	0.03	(0.0)	0	9	0.03	(0.1)	(0)
DEC	109	0.38	5.3	50	(47)	(0.16)	(1.2)	(14)	(47)	(0.16)	(1.1)	(13)	(46)	(0.16)	(1.3)	(14)
JAN	34	0.12	5.0	36	(5)	(0.02)	(0.8)	(5)	(5)	(0.02)	(0.8)	(5)	(6)	(0.02)	(1.2)	(8)
FEB	31	0.11	4.5	38	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.2)	(2)
MAR	22	0.08	3.0	31	(0)	(0.00)	0.1	1	(0)	(0.00)	0.1	1	(0)	(0.00)	(0.0)	(0)
APR	33	0.11	3.5	41	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
MAY	32	0.11	3.5	48	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(0)
JUN	26	0.09	3.2	49	(1)	(0.00)	(0.0)	(0)	(6)	(0.02)	(0.1)	(1)	(6)	(0.02)	(0.1)	(2)
JUL	41	0.14	2.9	51	(11)	(0.04)	0.0	(1)	(2)	(0.01)	0.1	1	(10)	(0.04)	(0.0)	(1)
AUG	97	0.34	3.4	59	(8)	(0.03)	0.1	1	3	0.01	0.0	2	(5)	(0.02)	0.1	2
SEP	165	0.58	3.2	52	3	0.01	0.0	1	3	0.01	0.0	1	3	0.01	0.0	1

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Table C5–3. Continued

Water Year	No–Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1980																
OCT	166	0.58	3.0	44	(0)	(0.00)	0.0	0	0	0.00	0.0	0	0	0.00	0.0	0
NOV	47	0.17	3.2	33	11	0.04	(0.4)	(4)	11	0.04	(0.4)	(4)	10	0.04	(0.5)	(4)
DEC	29	0.10	4.1	34	2	0.01	(0.3)	(2)	2	0.01	(0.3)	(2)	5	0.02	(0.8)	(5)
JAN	35	0.12	5.5	40	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
FEB	29	0.10	5.3	45	0	0.00	0.0	0	0	0.00	0.0	0	(0)	(0.00)	(0.0)	(0)
MAR	28	0.10	5.5	56	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
APR	33	0.11	3.7	43	0	0.00	0.0	1	(1)	(0.00)	(0.0)	(1)	(1)	(0.00)	(0.1)	(2)
MAY	35	0.12	3.9	53	(2)	(0.01)	(0.3)	(4)	(3)	(0.01)	(0.3)	(5)	(5)	(0.02)	(0.5)	(7)
JUN	44	0.16	3.7	60	(2)	(0.01)	(0.1)	(1)	(4)	(0.02)	(0.0)	(1)	(12)	(0.04)	(0.4)	(8)
JUL	48	0.17	3.7	67	(9)	(0.03)	(0.0)	(2)	1	0.01	0.1	1	1	0.00	0.0	0
AUG	79	0.28	3.6	60	3	0.01	0.0	1	3	0.01	0.0	1	3	0.01	0.0	1
SEP	71	0.25	3.1	45	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	0.0	0
1981																
OCT	41	0.14	3.8	45	11	0.04	(0.5)	(5)	11	0.04	(0.5)	(5)	10	0.04	(0.5)	(5)
NOV	59	0.21	4.3	45	6	0.02	(0.1)	(0)	6	0.02	(0.1)	(0)	7	0.02	(0.1)	(1)
DEC	49	0.17	4.5	39	8	0.03	(0.3)	(2)	8	0.03	(0.3)	(2)	9	0.03	(0.4)	(3)
JAN	28	0.10	4.9	35	0	0.00	(0.0)	(0)	0	0.00	(0.0)	(0)	(2)	(0.01)	(0.6)	(4)
FEB	23	0.08	3.6	30	(0)	(0.00)	0.0	0	0	0.00	(0.1)	(1)	(1)	(0.00)	(0.2)	(1)
MAR	20	0.07	3.1	31	(0)	(0.00)	0.0	0	(1)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.2)	(2)
APR	37	0.13	3.2	39	(1)	(0.00)	0.1	0	(1)	(0.00)	0.1	0	(2)	(0.01)	(0.0)	(1)
MAY	56	0.20	3.6	52	(9)	(0.03)	0.1	(0)	(8)	(0.03)	0.0	(0)	(8)	(0.03)	(0.1)	(2)
JUN	60	0.21	3.3	54	1	0.01	(0.1)	(3)	1	0.01	(0.1)	(3)	1	0.00	(0.2)	(3)
JUL	35	0.12	2.9	50	1	0.00	0.0	0	1	0.00	0.0	0	2	0.01	(0.0)	(1)
AUG	78	0.27	3.1	53	(14)	(0.05)	0.2	2	(20)	(0.07)	0.2	2	(31)	(0.11)	0.1	(0)
SEP	160	0.56	3.3	53	4	0.01	0.0	0	4	0.01	0.0	0	(23)	(0.08)	0.2	2
1982																
OCT	131	0.46	2.8	38	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	(0.0)	(0)
NOV	17	0.06	2.7	28	(2)	(0.01)	(0.5)	(5)	(2)	(0.01)	(0.5)	(5)	(3)	(0.01)	(0.7)	(7)
DEC	22	0.08	4.1	34	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.1)	(1)	(2)	(0.01)	(0.3)	(2)
JAN	33	0.12	5.8	42	(1)	(0.00)	(0.2)	(2)	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.2)	(2)
FEB	25	0.09	4.3	36	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
MAR	29	0.10	4.8	49	(0)	(0.00)	0.1	1	(0)	(0.00)	0.1	1	(0)	(0.00)	(0.0)	(0)
APR	27	0.09	5.7	68	0	0.00	0.0	1	0	0.00	0.0	1	0	0.00	0.0	0
MAY	29	0.10	5.5	76	0	0.00	0.0	1	0	0.00	0.0	1	0	0.00	0.0	0
JUN	25	0.09	3.7	57	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	0.0	0
JUL	35	0.12	3.4	60	(9)	(0.03)	(0.2)	(4)	(9)	(0.03)	(0.2)	(5)	(9)	(0.03)	(0.3)	(7)
AUG	56	0.20	3.1	51	(8)	(0.03)	0.0	(1)	(8)	(0.03)	0.0	(1)	(22)	(0.08)	(0.2)	(5)
SEP	24	0.08	3.1	40	(2)	(0.01)	(0.5)	(6)	(2)	(0.01)	(0.5)	(6)	(1)	(0.00)	(0.6)	(8)

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Table C5–3. Continued

Water Year	No–Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1983																
OCT	30	0.10	4.6	55	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)
NOV	28	0.10	4.1	41	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(0)
DEC	31	0.11	5.7	48	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	0
JAN	30	0.10	5.8	41	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
FEB	23	0.08	6.2	51	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
MAR	21	0.07	6.4	64	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
APR	24	0.08	5.9	71	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
MAY	25	0.09	5.8	81	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	0.0	0
JUN	24	0.09	5.9	95	0	0.00	0.0	0	0	0.00	0.0	0	0	0.00	0.0	0
JUL	29	0.10	5.3	95	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	0
AUG	31	0.11	3.5	55	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(1)
SEP	29	0.10	4.3	58	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)
1984																
OCT	30	0.10	5.3	64	(0)	(0.00)	(0.0)	0	(0)	(0.00)	(0.0)	0	(0)	(0.00)	(0.0)	(0)
NOV	28	0.10	4.8	48	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.0)	(0)
DEC	30	0.10	5.7	48	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
JAN	27	0.09	5.6	40	0	0.00	0.1	1	0	0.00	0.1	1	0	0.00	0.0	0
FEB	27	0.09	4.6	39	(0)	(0.00)	0.0	0	(0)	(0.00)	0.0	0	(0)	(0.00)	(0.1)	(1)
MAR	24	0.09	3.6	36	(0)	(0.00)	0.1	1	(0)	(0.00)	0.1	1	(0)	(0.00)	(0.0)	(0)
APR	33	0.12	3.9	46	(0)	(0.00)	0.0	0	(1)	(0.00)	0.0	0	(1)	(0.00)	(0.0)	(1)
MAY	38	0.13	3.9	53	0	0.00	0.0	1	(3)	(0.01)	0.0	0	(2)	(0.01)	(0.0)	(1)
JUN	33	0.12	3.3	52	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	0.0	0
JUL	21	0.07	2.9	49	(1)	(0.00)	0.0	1	(1)	(0.00)	0.1	1	(0)	(0.00)	0.0	0
AUG	62	0.22	3.4	57	(23)	(0.08)	0.3	2	(19)	(0.07)	0.3	3	(29)	(0.10)	0.4	4
SEP	64	0.22	2.9	42	1	0.00	(0.0)	0	1	0.00	(0.0)	0	1	0.00	(0.0)	0
1985																
OCT	33	0.11	2.9	34	10	0.04	(0.4)	(4)	10	0.04	(0.4)	(4)	10	0.03	(0.4)	(4)
NOV	21	0.07	3.2	32	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.1)	(1)	(3)	(0.01)	(0.5)	(5)
DEC	25	0.09	4.4	37	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.0)	(0)	(0)	(0.00)	(0.1)	(1)
JAN	47	0.16	4.5	33	(0)	(0.00)	(0.0)	(0)	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.2)	(1)
FEB	25	0.09	4.0	34	(0)	(0.00)	(0.0)	0	(3)	(0.01)	(0.7)	(5)	(5)	(0.02)	(0.9)	(7)
MAR	24	0.08	2.9	30	0	0.00	0.1	1	(0)	(0.00)	0.1	1	(4)	(0.01)	(0.3)	(3)
APR	56	0.19	3.7	46	(9)	(0.03)	(0.1)	(3)	(1)	(0.00)	0.0	0	(1)	(0.00)	(0.1)	(1)
MAY	38	0.13	3.6	49	(2)	(0.01)	(0.1)	(1)	0	0.00	0.1	1	0	0.00	0.0	0
JUN	54	0.19	3.5	57	2	0.01	0.0	1	2	0.01	0.1	1	2	0.01	0.0	1
JUL	35	0.12	3.0	52	1	0.00	(0.0)	0	1	0.00	0.0	1	2	0.01	(0.0)	0
AUG	50	0.17	3.1	49	(5)	(0.02)	(0.0)	(1)	1	0.01	0.0	1	2	0.01	0.0	1
SEP	136	0.48	3.3	53	(30)	(0.11)	0.1	(2)	3	0.01	0.0	1	3	0.01	0.0	0

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C-061862

Table C5–3. Continued

Water Year	No–Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1986																
OCT	122	0.43	3.4	46	0	0.00	(0.0)	(1)	0	0.00	0.0	0	1	0.00	0.0	0
NOV	110	0.39	3.2	37	0	0.00	0.0	0	0	0.00	0.1	1	0	0.00	0.0	1
DEC	59	0.21	4.8	42	2	0.01	(0.1)	(1)	2	0.01	(0.1)	(1)	2	0.01	(0.2)	(2)
JAN	31	0.11	5.5	39	3	0.01	(0.7)	(5)	3	0.01	(0.7)	(5)	3	0.01	(0.8)	(6)
FEB	28	0.10	5.2	44	(0)	(0.00)	0.0	0	0	0.00	0.0	0	(0)	(0.00)	(0.0)	(0)
MAR	27	0.09	5.8	59	0	0.00	0.1	2	0	0.00	0.1	2	0	0.00	0.0	0
APR	29	0.10	5.2	62	0	0.00	0.0	1	0	0.00	0.0	1	(0)	(0.00)	0.0	0
MAY	36	0.13	4.1	56	(0)	(0.00)	0.0	0	(7)	(0.02)	0.4	6	(7)	(0.02)	0.1	1
JUN	43	0.15	3.7	59	1	0.00	(0.0)	(0)	1	0.00	(0.0)	(0)	(13)	(0.05)	0.3	3
JUL	34	0.12	3.2	56	(9)	(0.03)	0.2	1	1	0.00	(0.2)	(3)	1	0.00	(0.2)	(4)
AUG	69	0.24	3.5	58	2	0.01	0.0	1	2	0.01	0.1	1	2	0.01	0.0	1
SEP	116	0.41	3.1	47	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	0.0	0
1987																
OCT	105	0.37	4.2	57	1	0.00	(0.0)	0	1	0.00	0.0	0	1	0.00	(0.0)	(0)
NOV	98	0.34	4.6	52	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	(0.0)	(1)
DEC	117	0.41	5.5	52	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	(0.0)	(1)
JAN	87	0.30	4.7	36	0	0.00	0.1	1	1	0.00	0.1	1	0	0.00	(0.0)	(0)
FEB	32	0.11	4.6	38	0	0.00	0.1	1	0	0.00	0.1	1	(0)	(0.00)	0.0	0
MAR	19	0.07	3.2	32	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.2)	(2)
APR	42	0.15	3.3	40	(7)	(0.02)	0.4	4	(5)	(0.02)	0.4	5	(4)	(0.02)	0.3	4
MAY	53	0.18	3.4	47	(0)	(0.00)	0.2	3	(3)	(0.01)	0.4	5	(2)	(0.01)	0.4	6
JUN	57	0.20	3.3	53	2	0.01	0.1	1	2	0.01	0.1	1	2	0.01	0.1	1
JUL	35	0.12	2.8	49	1	0.00	0.0	0	1	0.00	0.0	1	2	0.01	(0.0)	0
AUG	60	0.21	3.0	48	2	0.01	0.0	2	2	0.01	0.0	2	2	0.01	0.0	2
SEP	153	0.54	3.2	52	3	0.01	0.0	1	3	0.01	0.1	1	4	0.01	0.1	1
1988																
OCT	171	0.60	3.8	55	1	0.00	0.0	1	1	0.00	0.0	1	1	0.00	0.0	0
NOV	155	0.54	3.3	40	0	0.00	0.1	1	0	0.00	0.1	2	0	0.00	0.1	1
DEC	67	0.23	4.2	38	1	0.00	0.0	0	1	0.00	0.0	0	1	0.00	(0.0)	(0)
JAN	27	0.09	5.0	35	(3)	(0.01)	(0.9)	(6)	(3)	(0.01)	(0.9)	(6)	(4)	(0.01)	(1.3)	(9)
FEB	28	0.10	4.1	35	0	0.00	0.0	0	(9)	(0.03)	(0.2)	(3)	(10)	(0.03)	(0.6)	(5)
MAR	51	0.18	3.5	37	(0)	(0.00)	0.2	2	(0)	(0.00)	0.2	2	(16)	(0.06)	(0.0)	(1)
APR	72	0.25	4.1	52	(14)	(0.05)	0.1	(1)	(0)	(0.00)	0.1	2	(0)	(0.00)	(0.0)	(0)
MAY	72	0.25	3.6	52	(9)	(0.03)	0.1	2	2	0.01	0.1	3	2	0.01	0.1	1
JUN	56	0.20	3.2	53	1	0.00	0.0	0	2	0.01	0.1	1	1	0.01	0.0	0
JUL	62	0.22	3.1	57	(19)	(0.07)	0.3	4	3	0.01	(0.0)	(0)	5	0.02	(0.3)	(6)
AUG	156	0.54	3.6	68	6	0.02	0.0	2	6	0.02	0.1	3	6	0.02	0.1	2
SEP	255	0.89	3.8	70	6	0.02	0.0	1	7	0.02	0.1	2	7	0.02	0.1	1

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Table C5–3. Continued

Water Year	No–Project Alternative				Alternative 1 Changes				Alternative 2 Changes				Alternative 3 Changes			
	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)	Cl^- (mg/l)	Br^- (mg/l)	DOC (mg/l)	THM (µg/l)
1989																
OCT	276	0.97	4.8	81	3	0.01	0.0	1	3	0.01	0.1	1	3	0.01	0.0	1
NOV	210	0.74	3.4	44	0	0.00	0.1	1	0	0.00	0.1	2	0	0.00	0.1	1
DEC	130	0.46	4.8	47	1	0.00	0.0	0	1	0.00	0.1	1	1	0.00	(0.0)	(0)
JAN	98	0.34	5.1	40	0	0.00	0.0	0	0	0.00	0.1	1	0	0.00	(0.0)	(0)
FEB	60	0.21	4.5	40	0	0.00	0.1	1	0	0.00	0.1	1	(0)	(0.00)	0.0	0
MAR	16	0.06	2.6	27	(2)	(0.01)	(0.4)	(4)	(2)	(0.01)	(0.4)	(4)	(2)	(0.01)	(0.5)	(5)
APR	30	0.11	3.4	39	(0)	(0.00)	0.0	0	0	0.00	0.0	0	(0)	(0.00)	(0.0)	(0)
MAY	39	0.14	3.6	50	(6)	(0.02)	(0.1)	(3)	(4)	(0.01)	(0.0)	(2)	(4)	(0.01)	(0.1)	(2)
JUN	59	0.21	3.5	58	2	0.01	0.0	0	2	0.01	0.0	0	2	0.01	0.0	0
JUL	35	0.12	3.0	51	2	0.01	0.0	1	2	0.01	0.0	1	2	0.01	0.0	1
AUG	45	0.16	3.0	47	1	0.01	(0.0)	(0)	1	0.01	(0.0)	(0)	2	0.01	(0.0)	(0)
SEP	145	0.51	2.5	41	(67)	(0.24)	0.3	(1)	(72)	(0.25)	0.4	0	(63)	(0.22)	0.6	4
1990																
OCT	182	0.64	3.6	52	0	0.00	(0.0)	(0)	0	0.00	(0.0)	(0)	1	0.00	(0.0)	(1)
NOV	195	0.68	4.2	53	(0)	(0.00)	0.1	1	(0)	(0.00)	0.1	1	0	0.00	(0.0)	(0)
DEC	96	0.33	6.4	61	0	0.00	(0.1)	(1)	0	0.00	(0.1)	(1)	0	0.00	(0.1)	(2)
JAN	47	0.17	4.8	35	4	0.01	(0.3)	(2)	4	0.02	(0.3)	(2)	4	0.01	(0.4)	(3)
FEB	35	0.12	4.5	38	1	0.00	(0.0)	0	(1)	(0.00)	(0.1)	(1)	(1)	(0.00)	(0.2)	(2)
MAR	58	0.20	3.2	35	0	0.00	0.2	2	0	0.00	0.2	2	0	0.00	(0.0)	(0)
APR	49	0.17	4.8	59	(3)	(0.01)	0.1	1	0	0.00	0.1	2	0	0.00	(0.0)	(0)
MAY	86	0.30	3.5	52	(1)	(0.00)	0.3	4	1	0.00	0.1	3	1	0.00	0.1	1
JUN	55	0.19	3.4	55	2	0.01	0.1	2	2	0.01	0.1	2	2	0.01	0.1	2
JUL	67	0.23	3.2	59	5	0.02	(0.0)	0	5	0.02	(0.0)	0	5	0.02	(0.0)	0
AUG	153	0.54	3.7	70	7	0.02	0.1	2	7	0.02	0.1	2	7	0.02	0.1	2
SEP	248	0.87	3.9	70	6	0.02	0.1	2	6	0.02	0.1	2	6	0.02	0.1	2
1991																
OCT	277	0.97	4.8	81	3	0.01	0.1	1	3	0.01	0.1	1	3	0.01	0.1	1
NOV	258	0.90	5.9	83	2	0.01	0.1	3	2	0.01	0.1	3	2	0.01	0.1	1
DEC	199	0.70	6.0	64	1	0.01	0.1	1	1	0.01	0.1	1	1	0.00	(0.0)	(0)
JAN	159	0.56	6.9	59	0	0.00	0.1	1	1	0.00	0.1	1	0	0.00	(0.1)	(0)
FEB	73	0.25	4.8	43	1	0.00	0.1	1	1	0.00	0.1	1	(0)	(0.00)	0.0	0
MAR	18	0.06	2.7	28	1	0.00	0.1	1	1	0.00	0.1	1	0	0.00	0.0	0
APR	43	0.15	3.4	41	1	0.00	0.3	4	1	0.00	0.3	4	1	0.00	0.2	2
MAY	97	0.34	3.8	57	3	0.01	0.3	6	3	0.01	0.3	6	2	0.01	0.3	5
JUN	61	0.22	3.3	54	2	0.01	0.1	3	2	0.01	0.1	3	2	0.01	0.1	3
JUL	109	0.38	3.5	70	10	0.03	0.2	6	10	0.03	0.2	6	10	0.03	0.2	5
AUG	184	0.64	3.8	75	8	0.03	0.2	5	8	0.03	0.2	5	8	0.03	0.2	4
SEP	247	0.87	3.6	66	6	0.02	0.1	2	6	0.02	0.1	2	6	0.02	0.1	2

Note: Negative values shown in parentheses.

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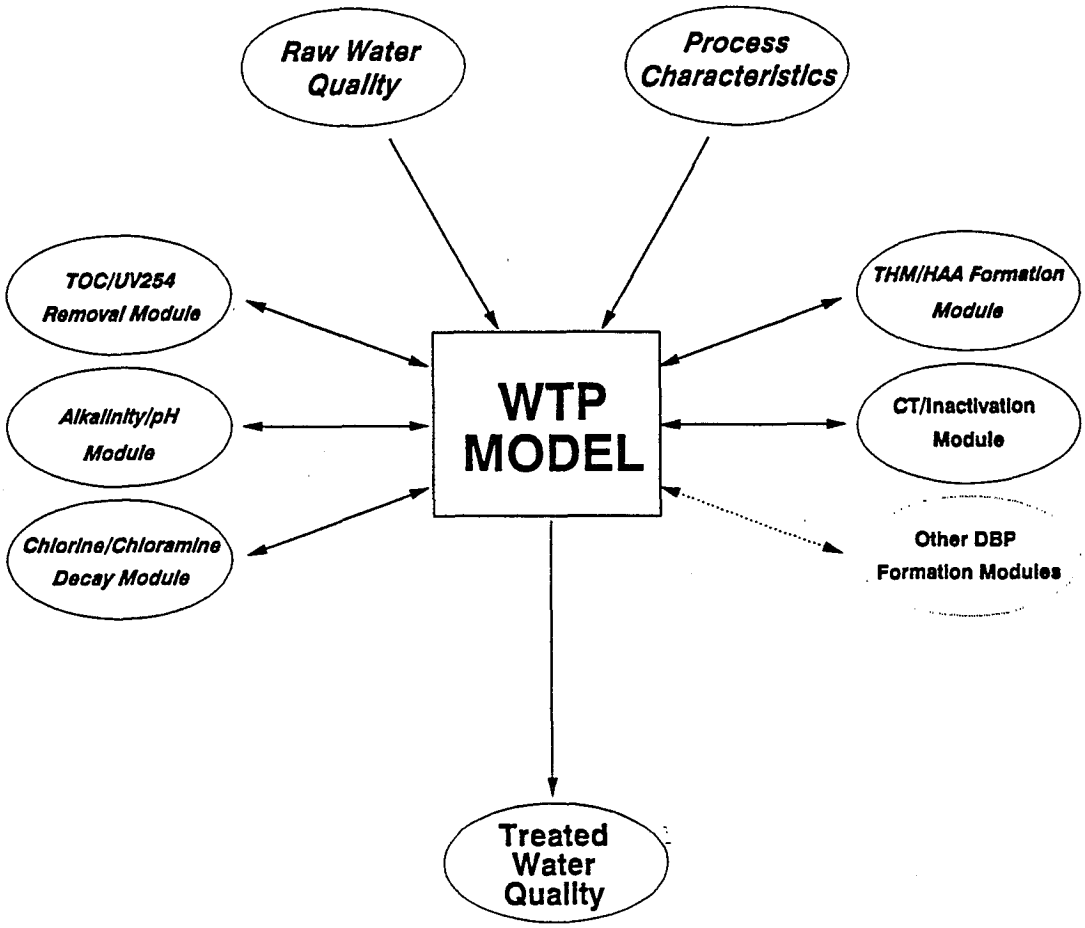

Source: Malcolm Pirnie 1992.

Figure C5-1.
Water Treatment Plant Model Components

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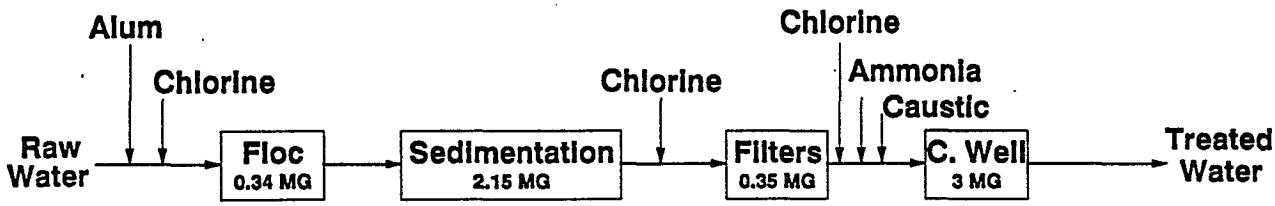
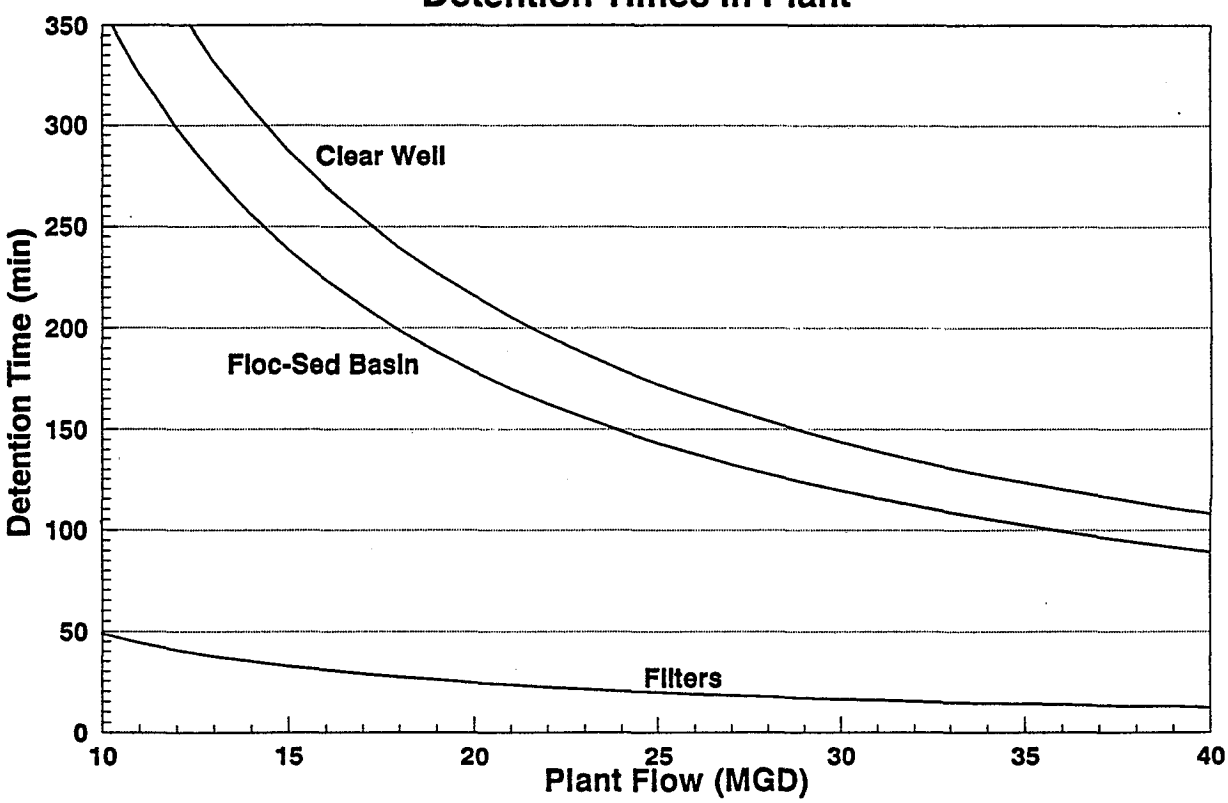
Process Flow Considerations for Modeling



Chemical Dosages (mg/L)

	Alum	Chlorine			Ammonia	Caustic
		Pre-Sed	Pre-Filt	Post-Filt.		
Minimum	25	2.0	1.0	0.3	0.34	5.0
Average	36	2.75	1.2	0.5	0.50	8.5
Maximum	52	3.5	1.5	1.0	1.0	15

Detention Times in Plant



Source: Malcolm Pirnie 1992.

Figure C5-2.
Penitencia Water Treatment Plant Process Parameters

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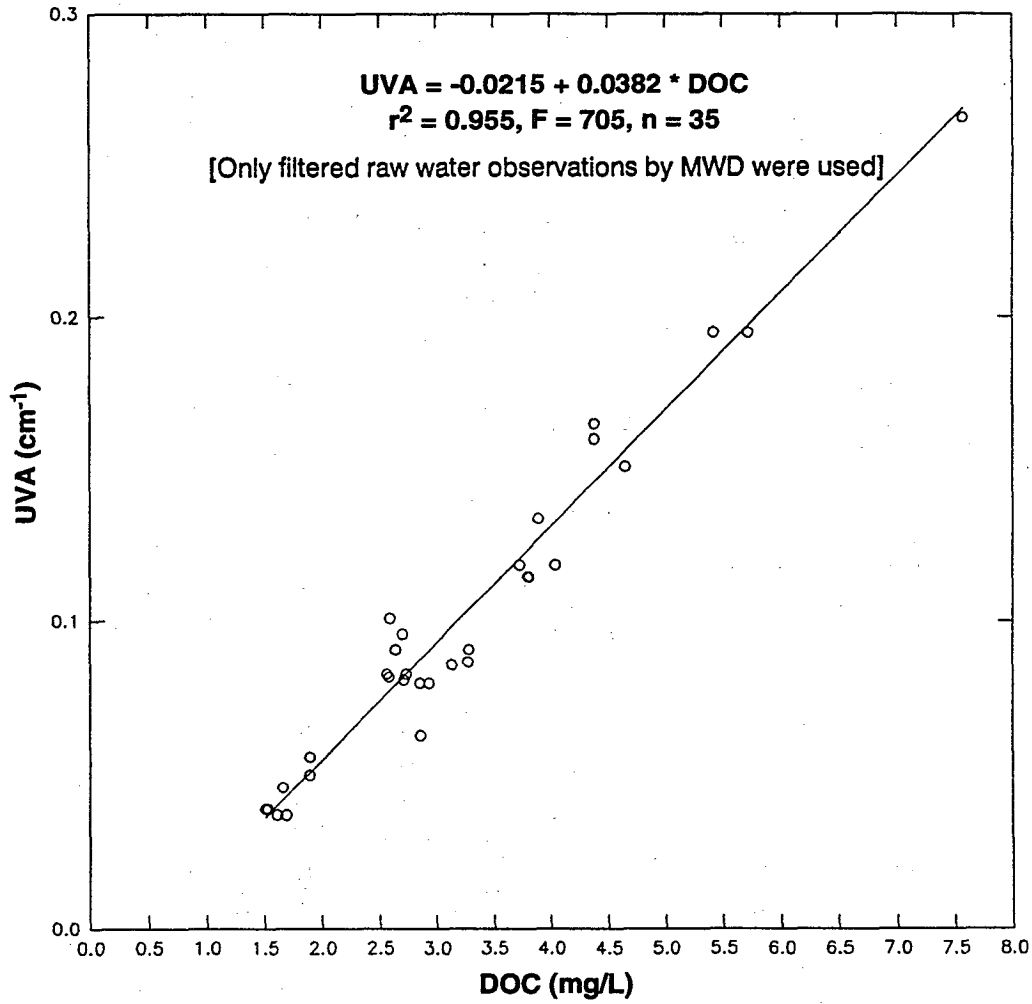

Source: Malcolm Pirnie 1992.

Figure C5-3.
Correlation between UVA and DOC in Metropolitan Water District Samples

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Prepared by: Jones & Stokes Associates

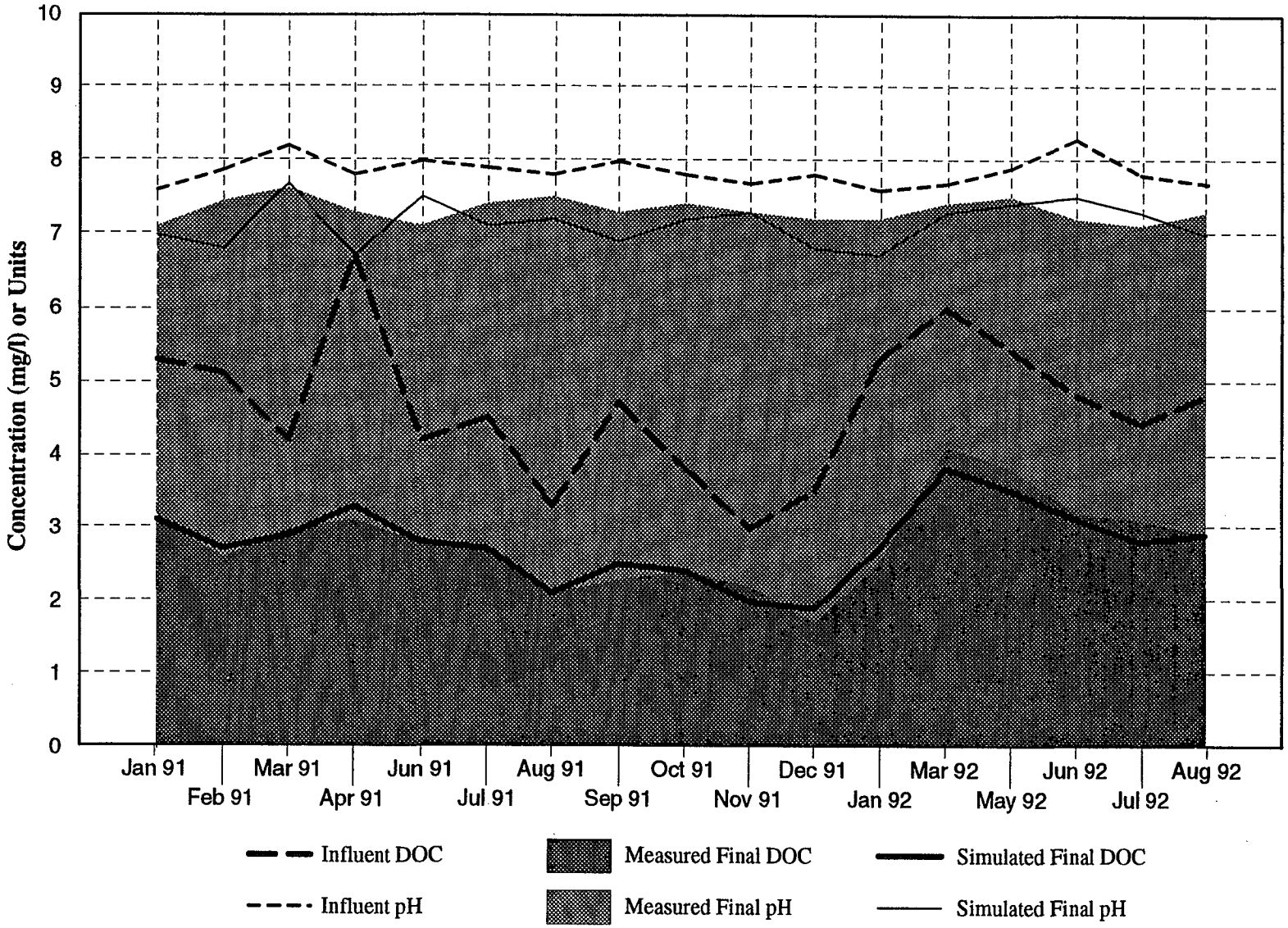

Figure C5-4.
Comparison of Simulated and Measured DOC and pH at the Penitencia Water Treatment Plant

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PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

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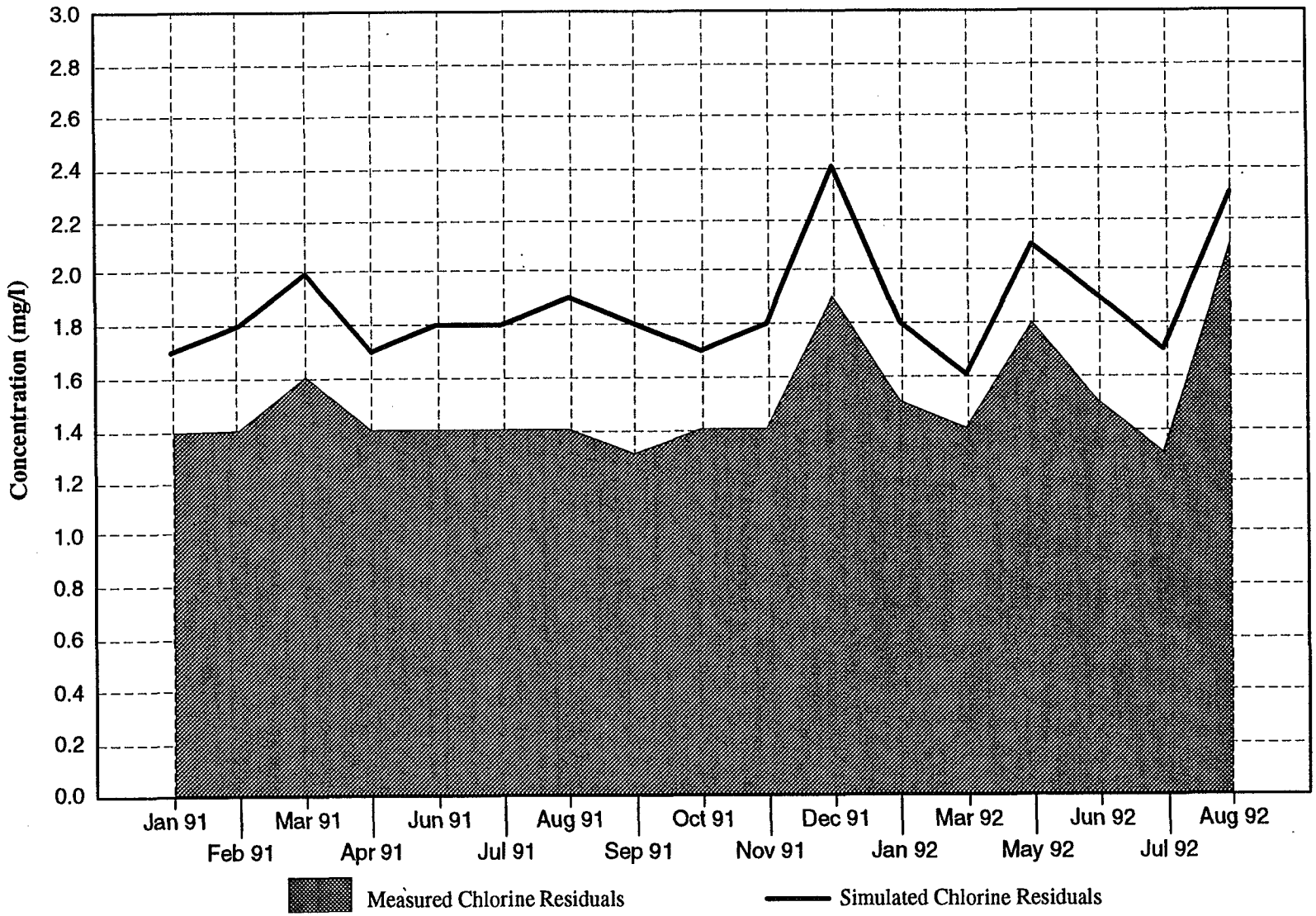

Figure C5-5.
Comparison of Simulated and Measured Chlorine Residuals at the Penitencia Water Treatment Plant

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Prepared by: Jones & Stokes Associates

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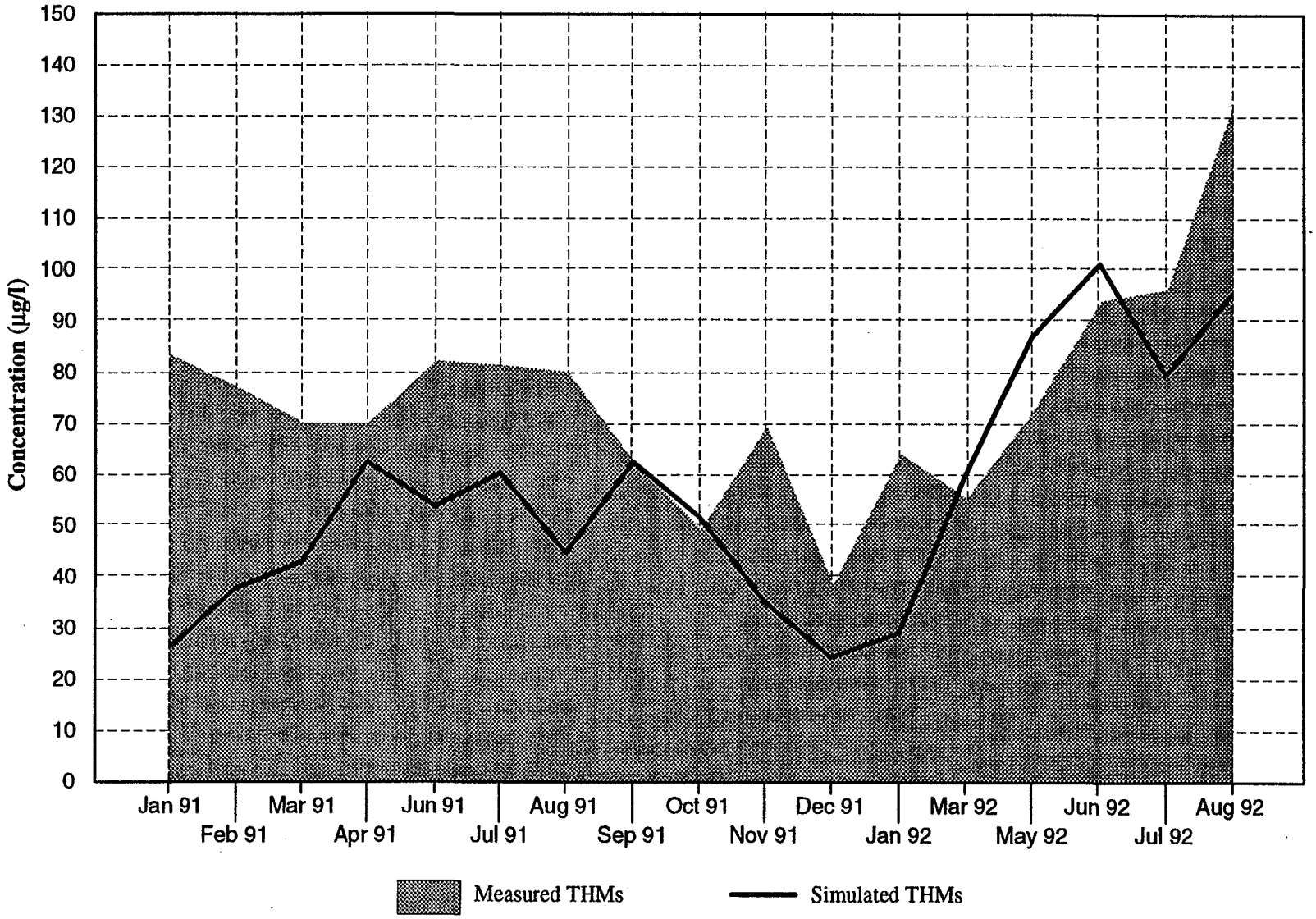

Figure C5-6.
Comparison of Simulated and Measured Total THMs at the Penitencia Water Treatment Plant

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

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C-061869

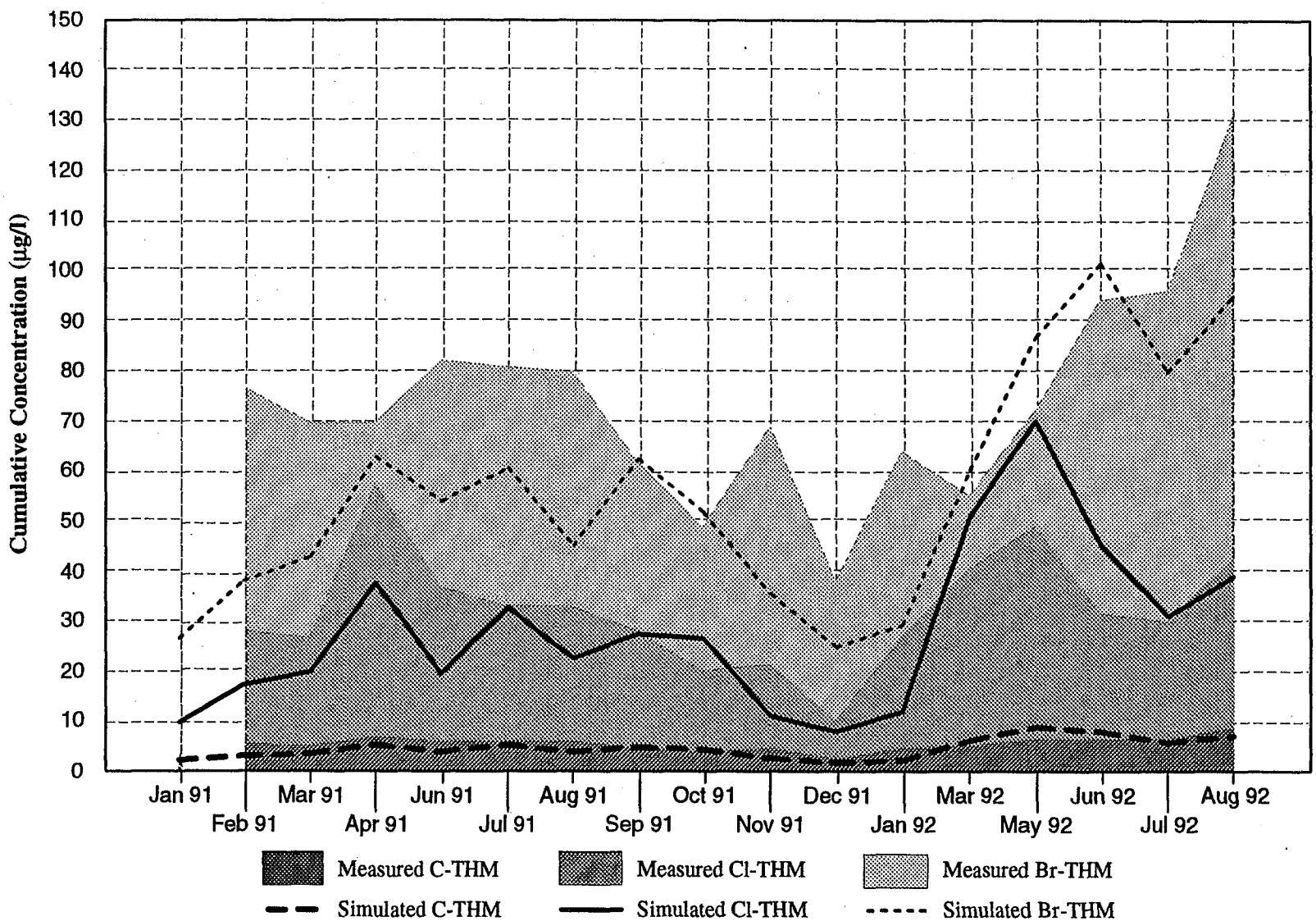

Figure C5-7.
Comparison of Simulated and Measured THM Species at the Penitencia Water Treatment Plant

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

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C-061870

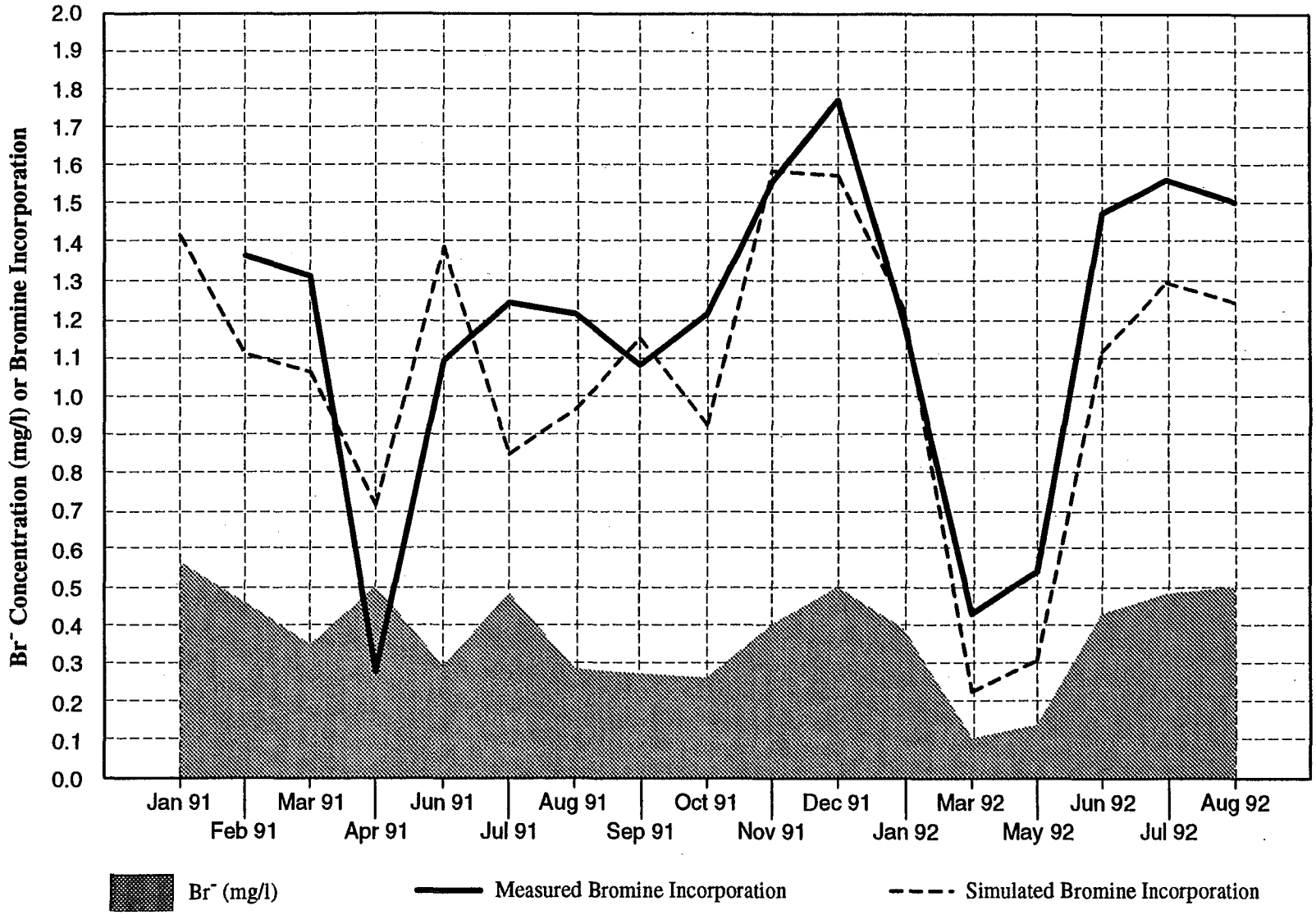

Figure C5-8.
Comparison of Simulated and Measured Bromine Incorporation at the Penitencia Water Treatment Plant

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

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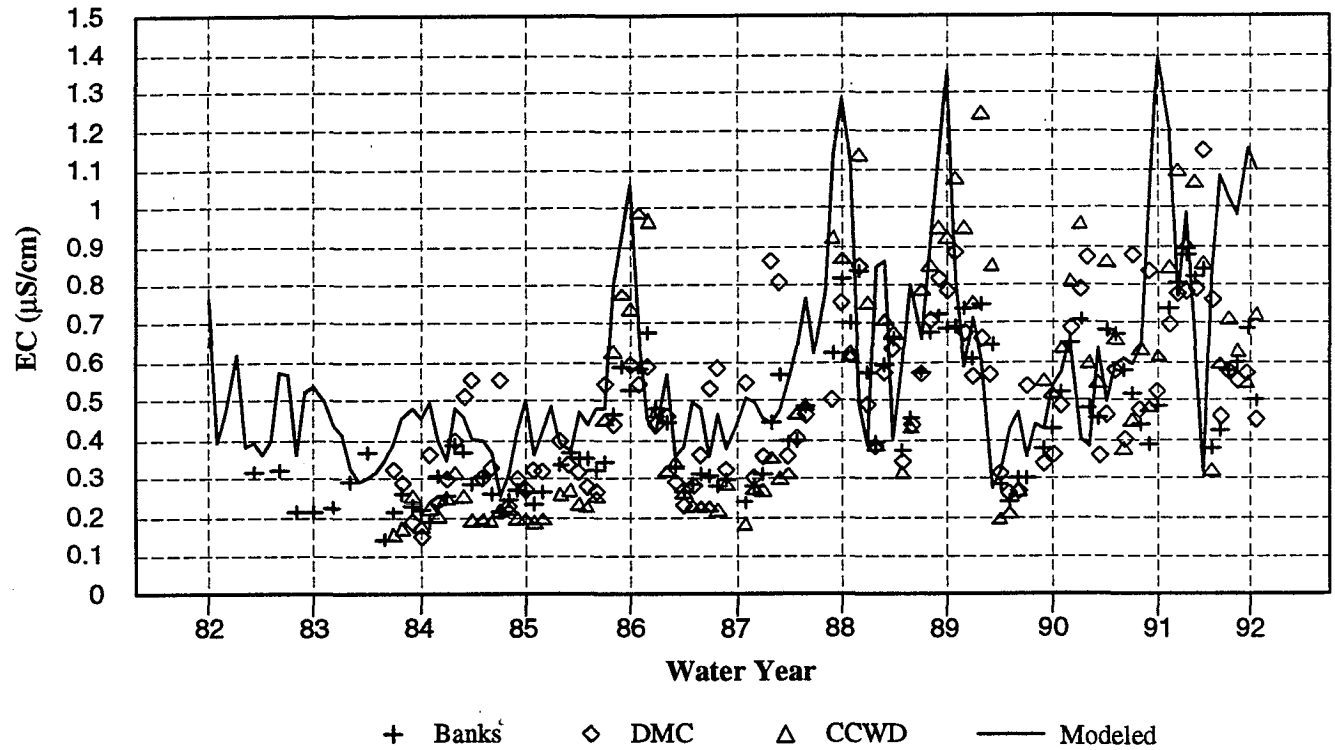
C-061871



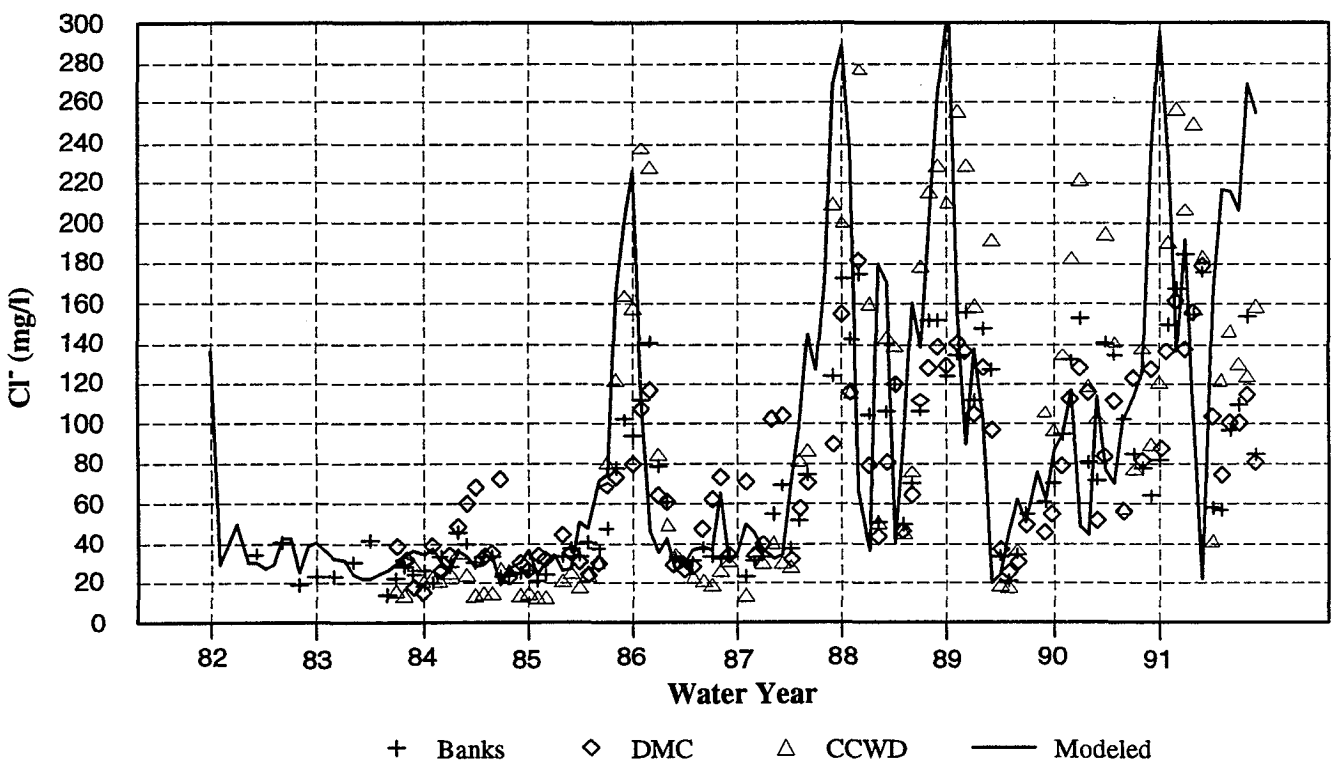
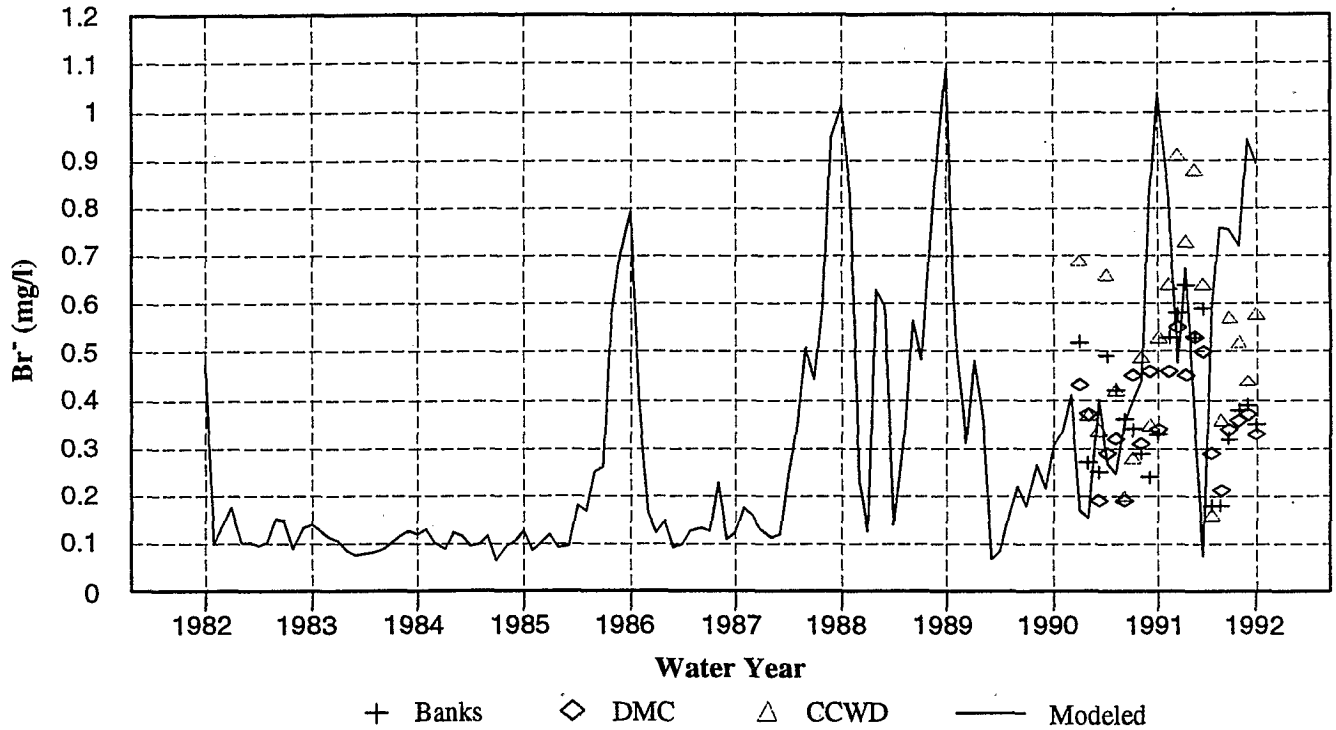


Figure C5-9.
DeltaDWQ - Estimated Delta Export EC and Chloride for 1982-1991 with Historical Inflows and Exports Compared with MWQI Grab Samples

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates



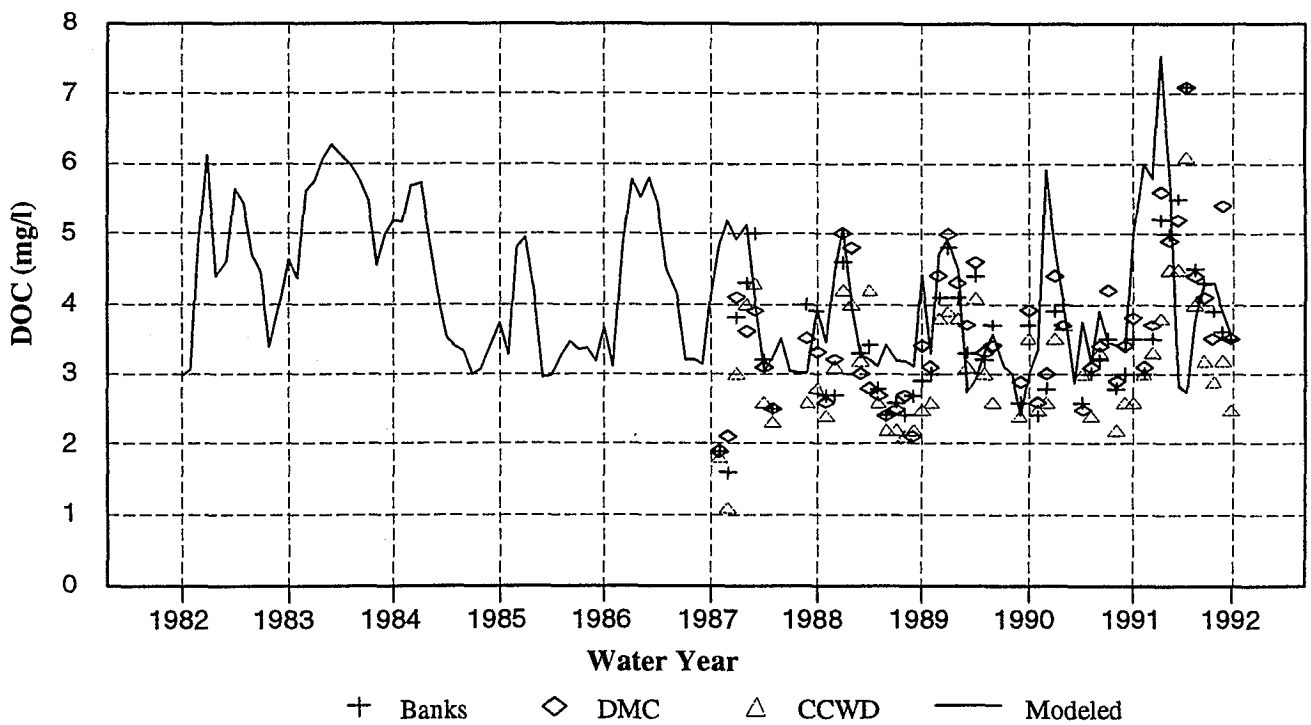


Figure C5-10.
DeltaDWQ - Estimated Delta Export Bromide and DOC for 1982-1991 with Historical Inflows and Exports Compared with MWQI Grab Samples

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

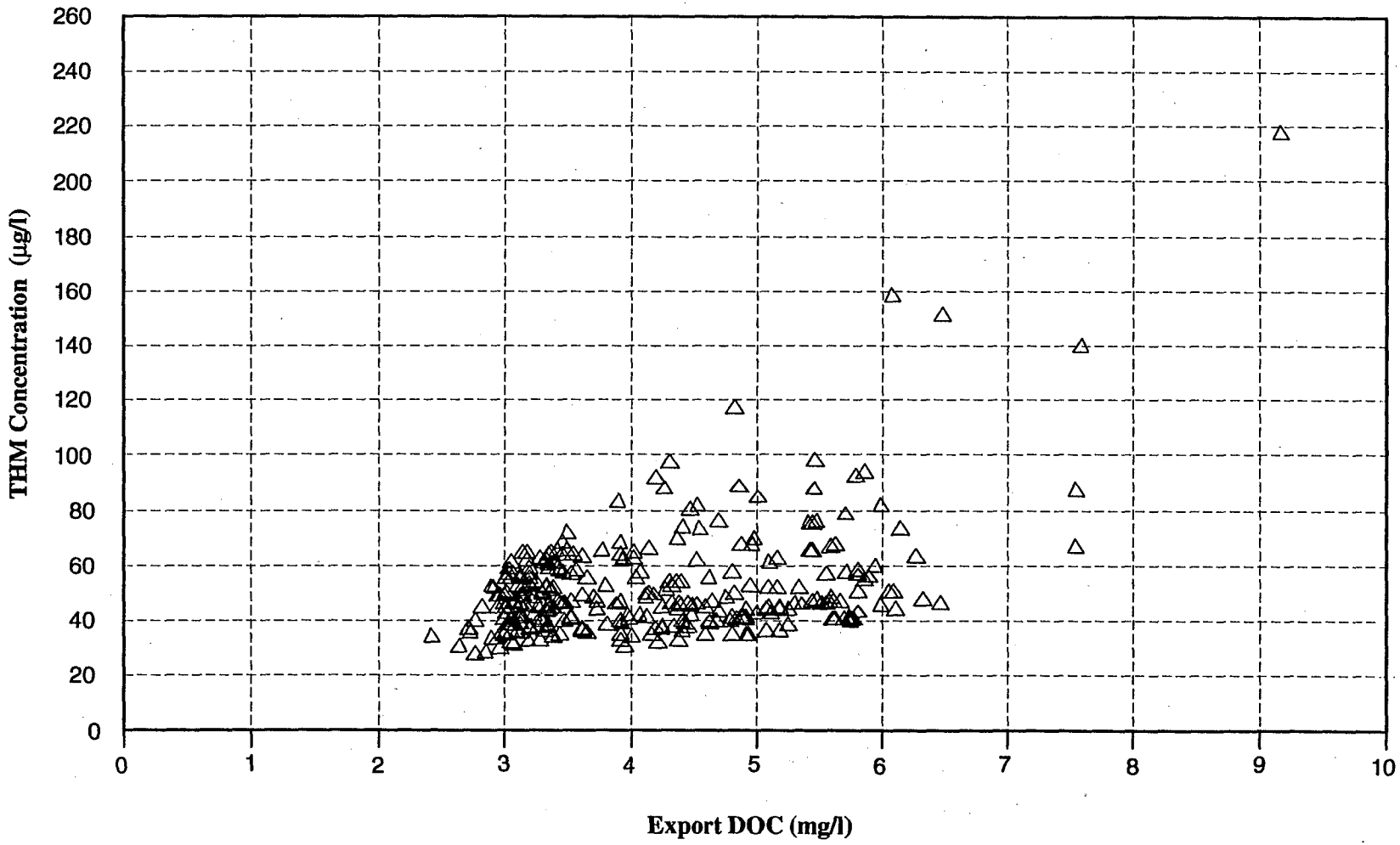


Figure C5-11.
Simulated Total THM as a Function of Estimated Historical Export DOC Concentrations for 1967-1991

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

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C-061874

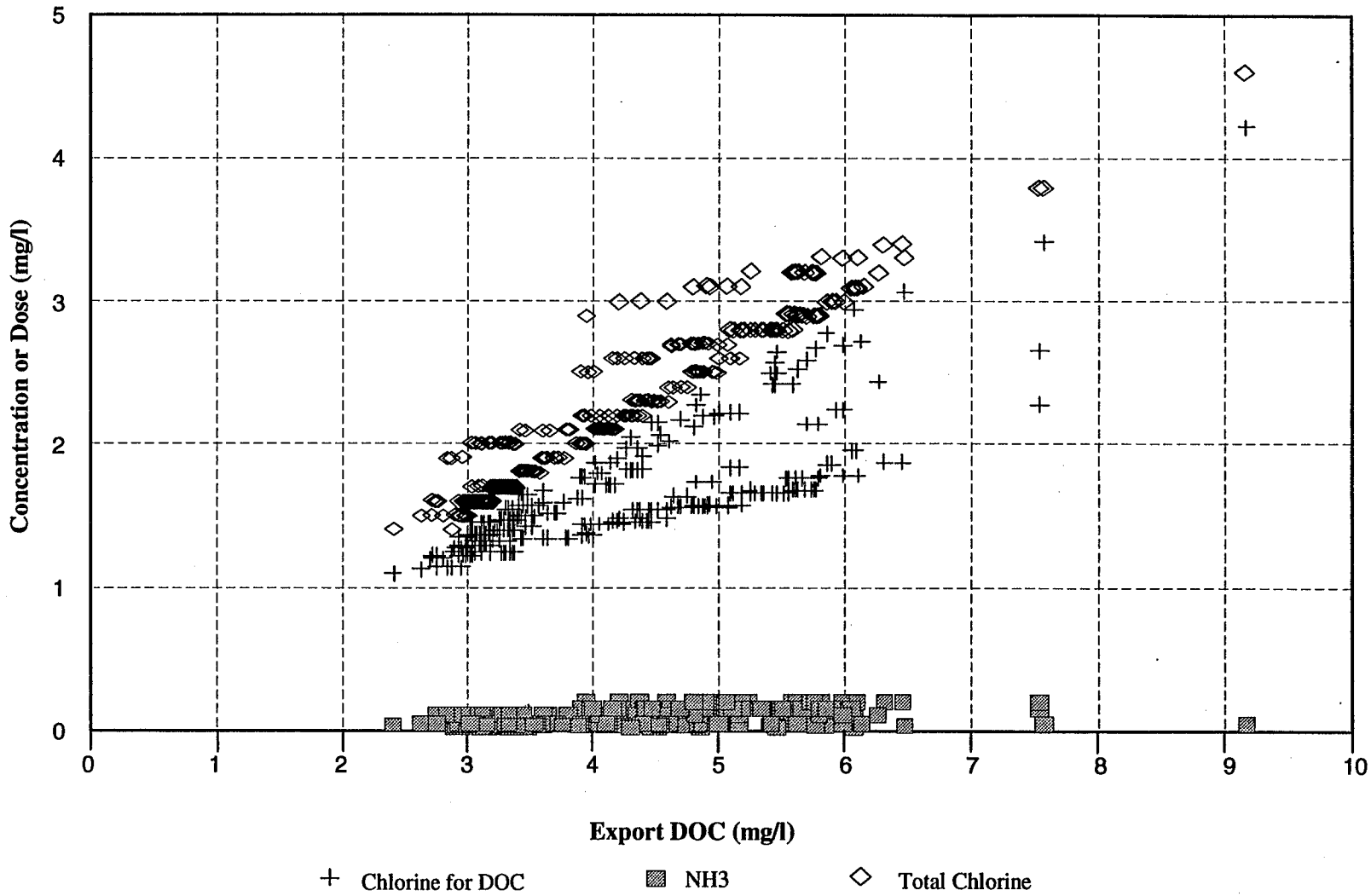

Figure C5-12.
Simulated Chlorination Dose as a Function of Estimated Historical Export DOC and Ammonia Concentrations for 1967-1991

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

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C-061875

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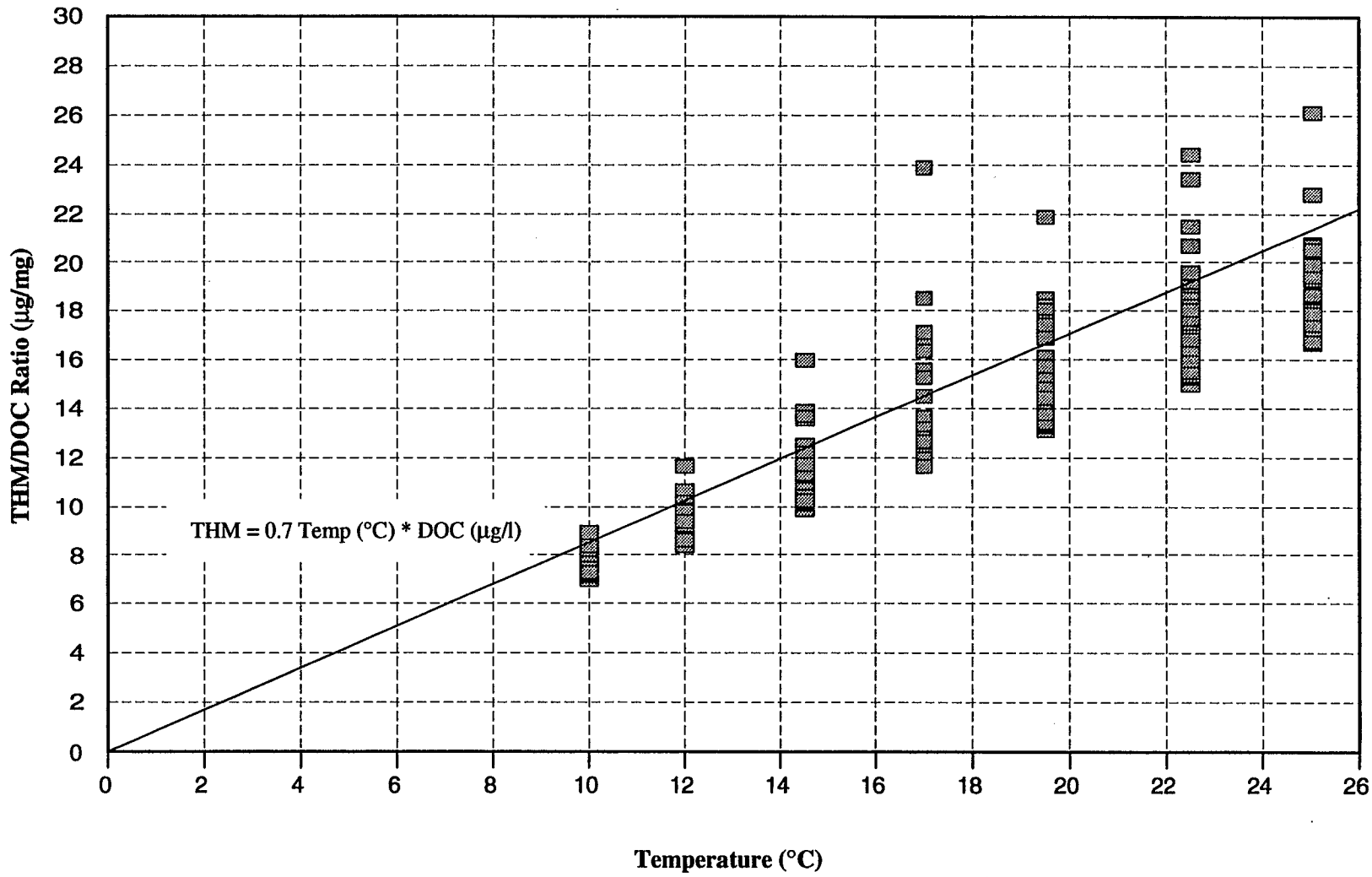

Figure C5-13.
Simulated Ratios of THM to DOC as a Function of Temperature for Estimated Historical Export Water Quality for 1967-1991

DELTA WETLANDS
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Prepared by: Jones & Stokes Associates

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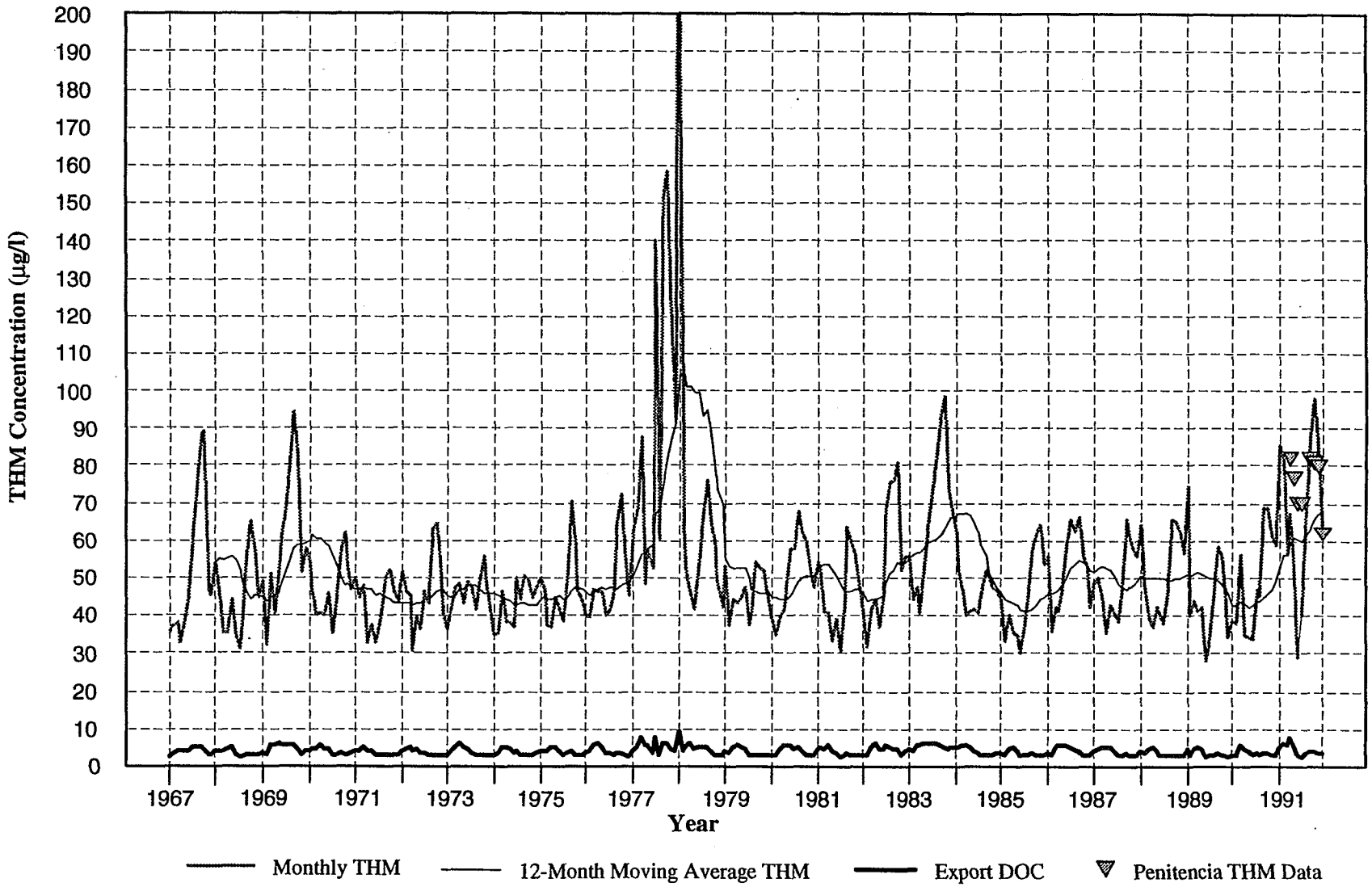

Figure C5-14.
Simulated THM Concentrations for Estimated Historical Export Water Quality

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates

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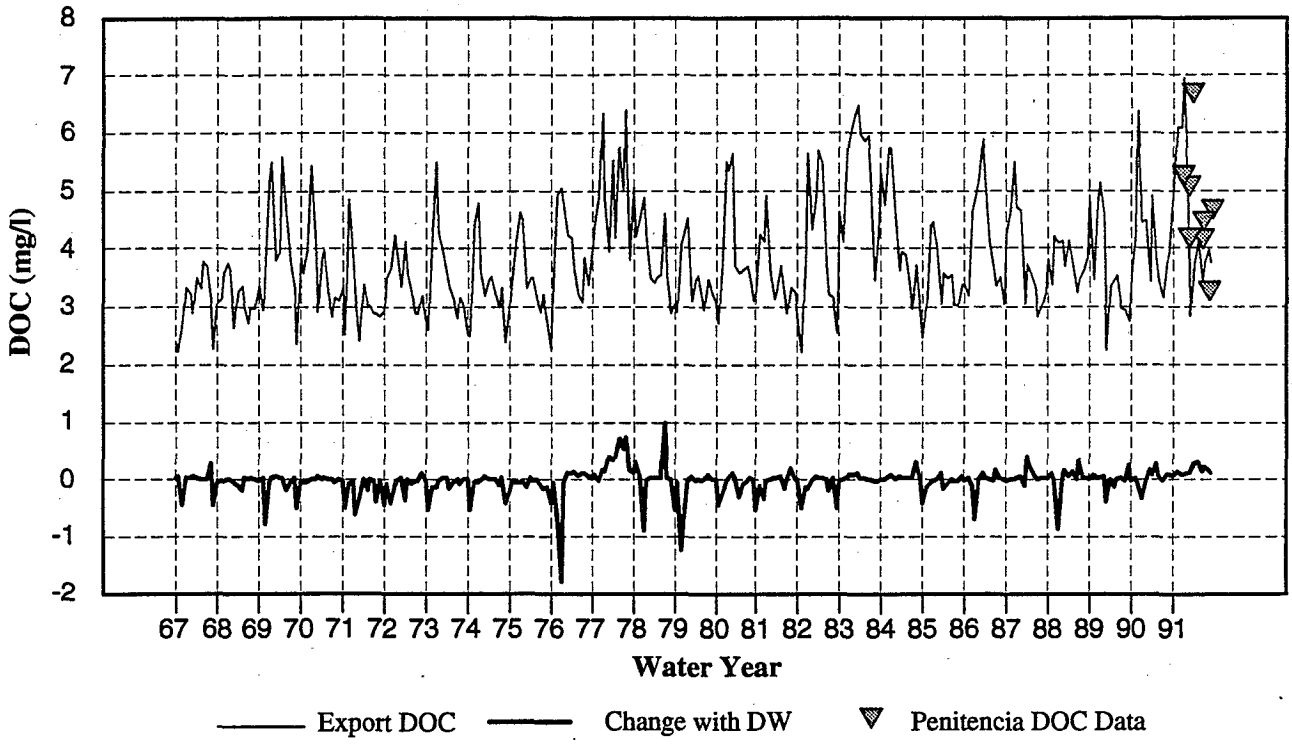
C—061877



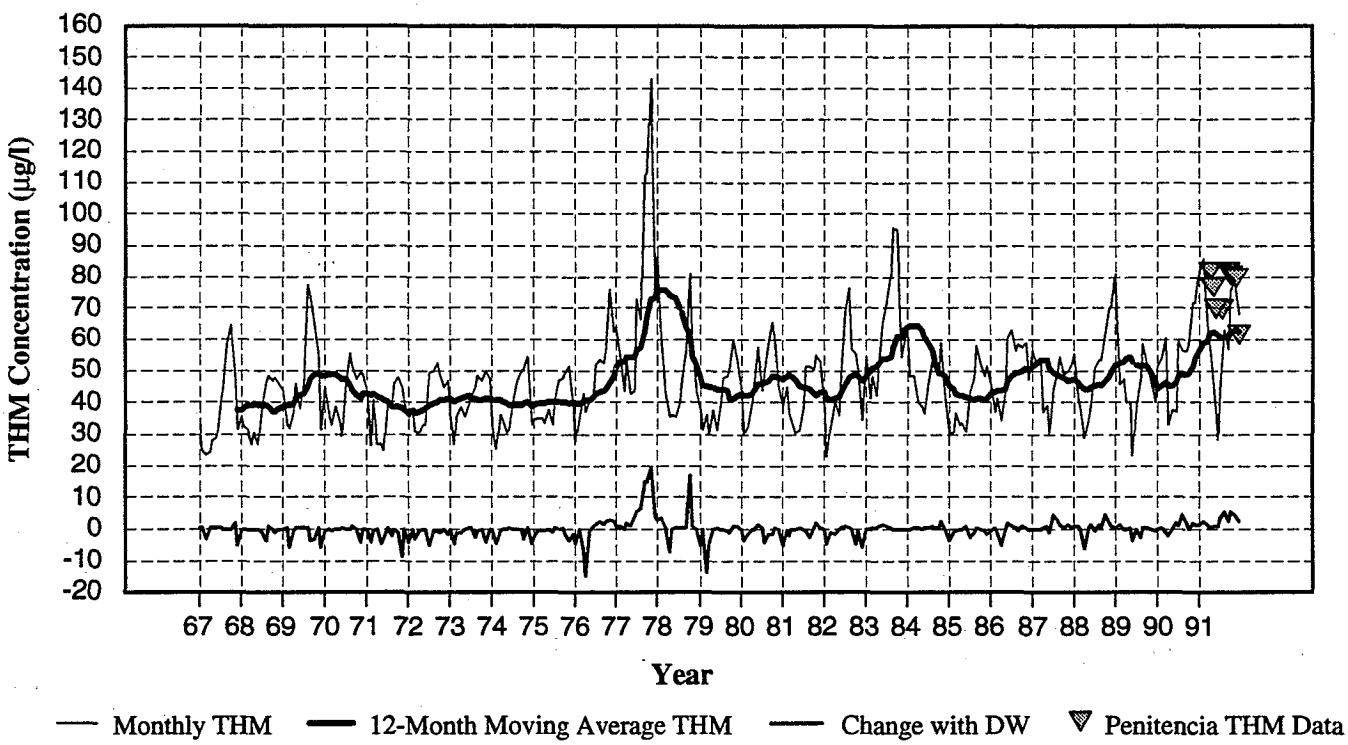
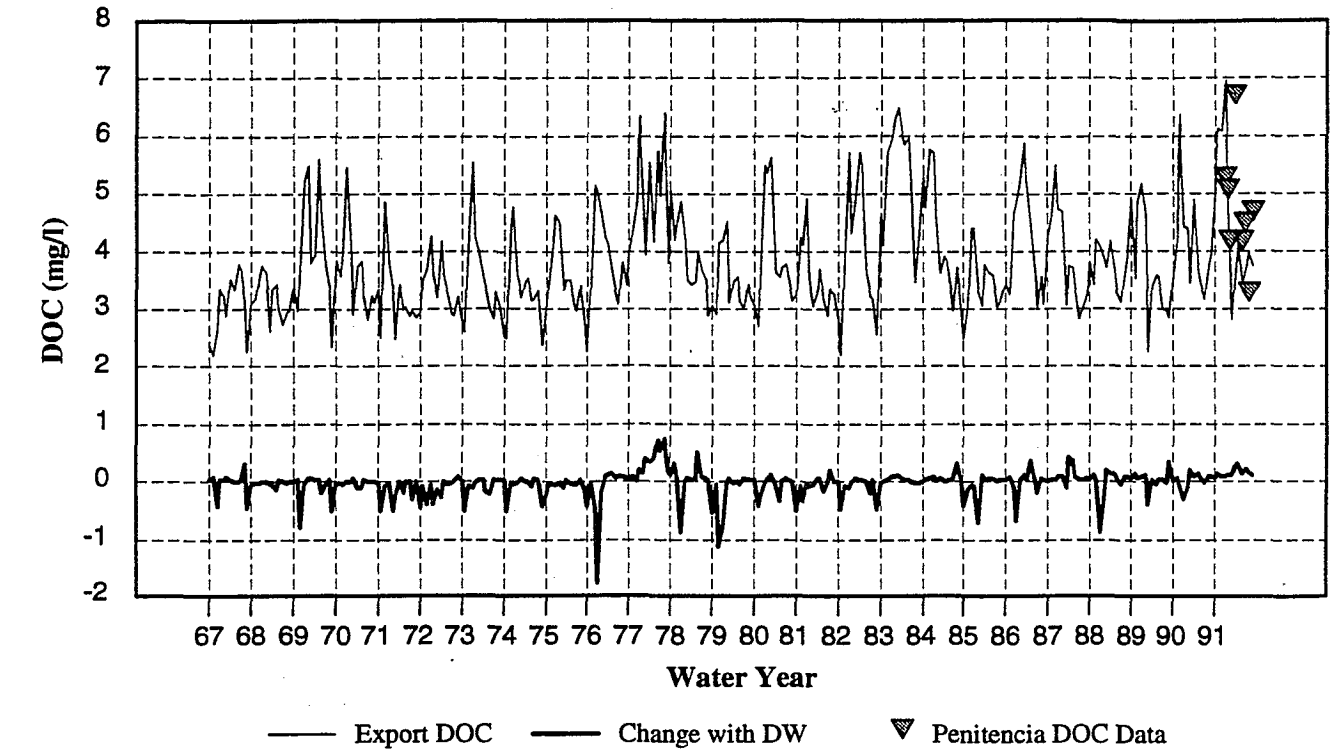


Figure C5-15.
Simulated Inflow DOC and Final THM Concentration for Delta Exports for Alternative 1 Compared with the No-Project Alternative

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates



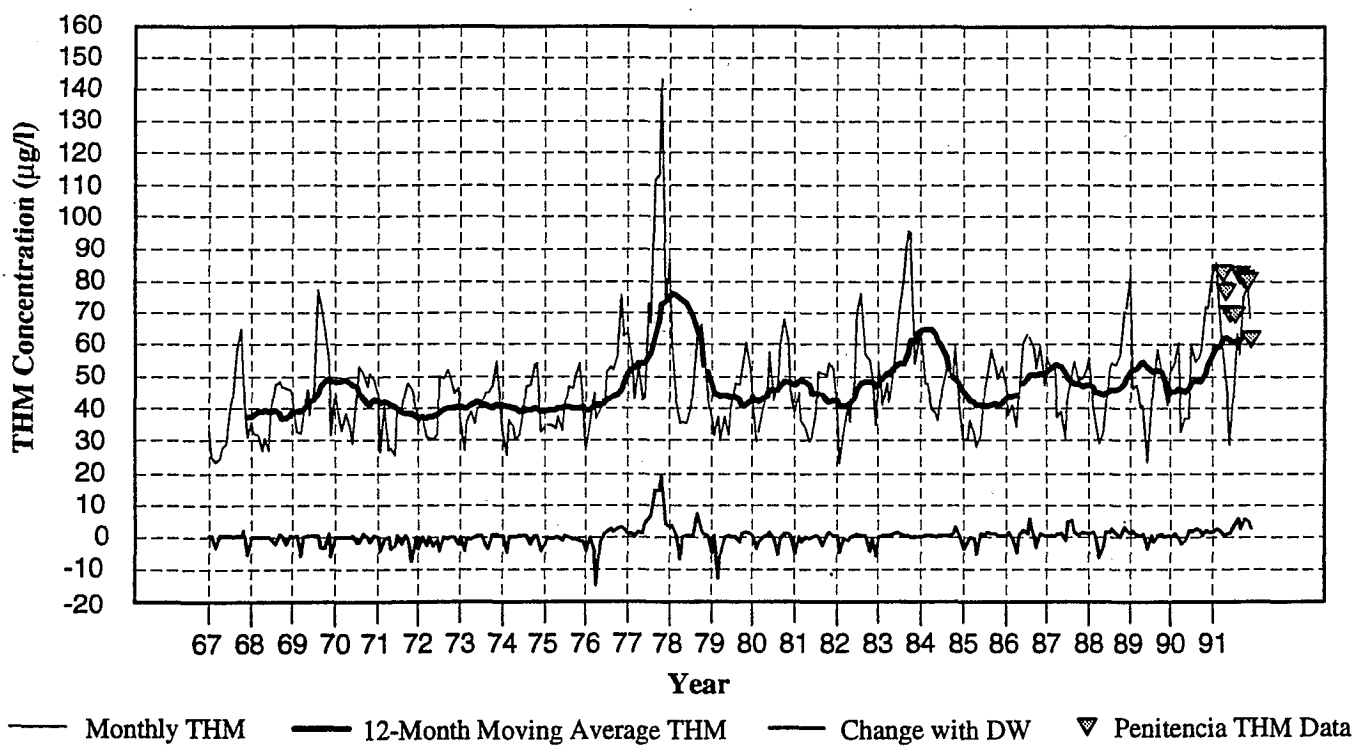
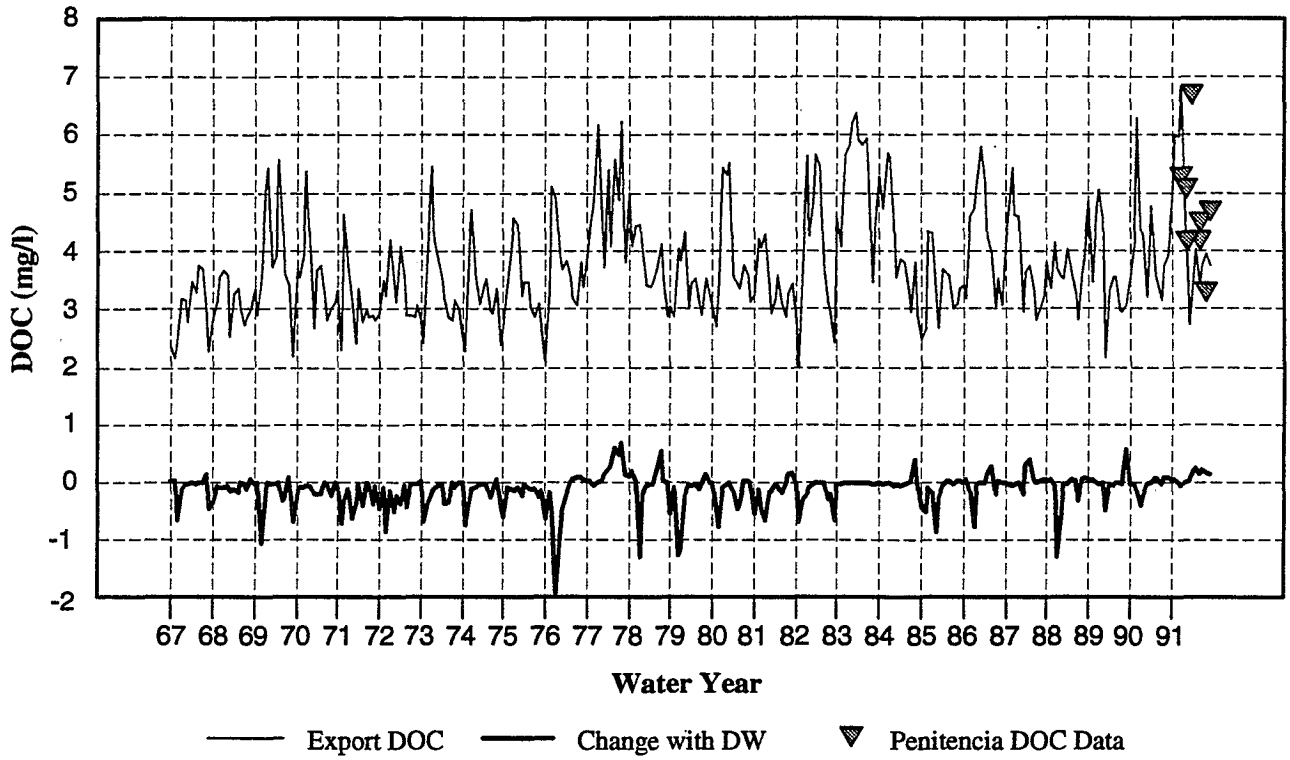


Figure C5-16.
Simulated Inflow DOC and Final THM Concentration for Delta Exports for Alternative 2 Compared with the No-Project Alternative

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates



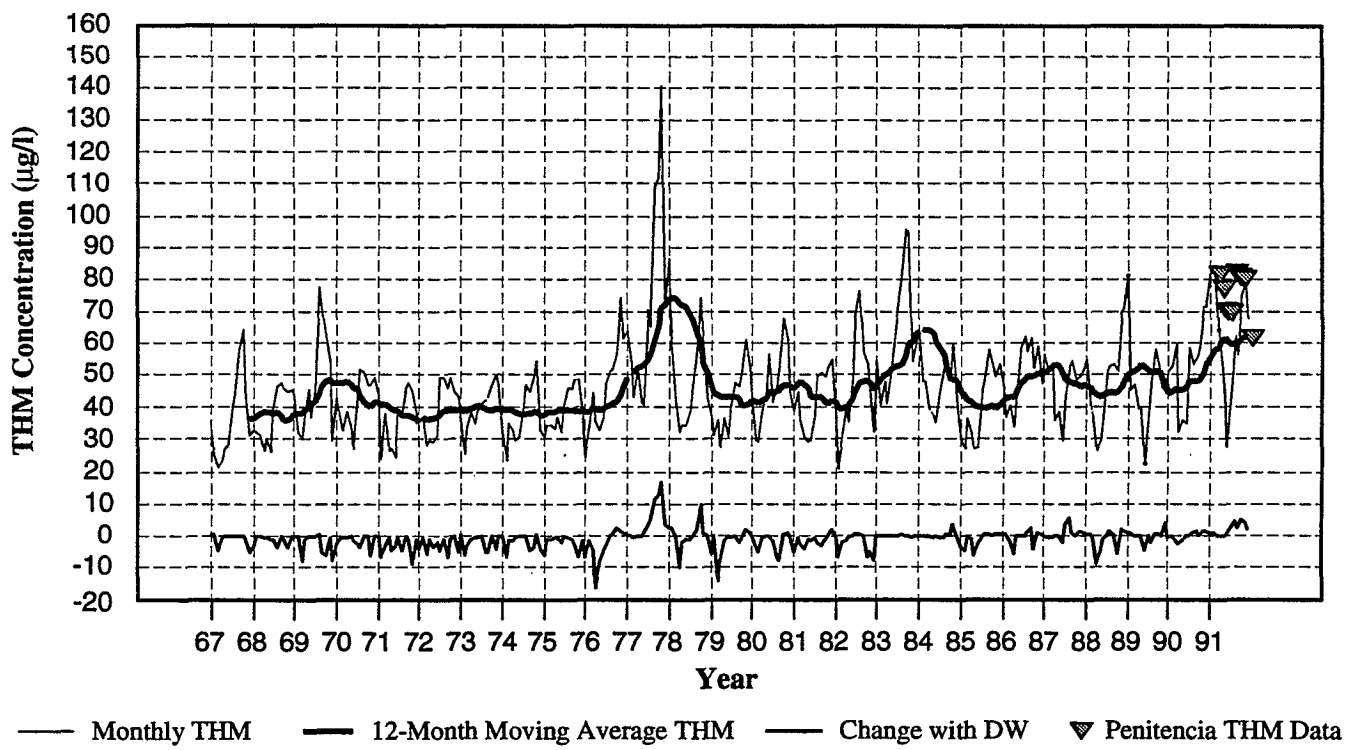


Figure C5-17.
Simulated Inflow DOC and Final THM Concentration for Delta Exports for Alternative 3 Compared with the No-Project Alternative

DELTA WETLANDS
PROJECT EIR/EIS
Prepared by: Jones & Stokes Associates