FILE:JUNE88.DOC
DRAFT VERSION: May 12, 1988 1:18 PM
FONT: HELVETICA 10
WORD PROCESSOR PROGRAM: MICROSOFT WORD 4.0
AUTHORS: MARVIN JUNG (Entire report except for Total Trihalomethane Formation Potential section)
B.J. ARCHER (Total THM Formation Potential)

INTERNAL DRAFT FOR REVIEW ONLY

MWQI Copy

Photocopy and RETURN

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
Central District

INTERAGENCY DELTA HEALTH ASPECTS
MONITORING PROGRAM

PROJECT REPORT

OBSERVATIONS AND RELATIONSHIPS OF

DELTA WATER QUALITY -- 1983 TO 1987

A PRELIMINARY ANALYSIS

June 1988

NOTE TO REVIEWERS:

At the request of the DWR editor, this is an unformatted document. Please excuse improperly blocked and uncentered paragraphs as these and other formalities will be taken care of in the final version.

Figures and Tables appear at the end of the text in this draft but will be inserted on pages where referenced in the final copy. Many of the figures are taken from other sources such as the DWR Delta Atlas, DWR testimony, and other reports. We have not yet renumbered these in the draft but have noted in the text which figure will be used. Some of the figures and tables will also be redone and reduced in size in the final report. Suggestions and comments on the selection and presentation of figures and tables are welcome.

FILE:JUNE88.DOC
DRAFT VERSION: May 12, 1988 1:18 PM
FONT: HELVETICA 10
WORD PROCESSOR PROGRAM: MICROSOFT WORD 4.0
AUTHORS: MARVIN JUNG (Entire report except for Total Trihalomethane Formation Potential section)
B.J. ARCHER (Total THM Formation Potential)

INTERNAL DRAFT FOR REVIEW ONLY

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
Central District

INTERAGENCY DELTA HEALTH ASPECTS
MONITORING PROGRAM

PROJECT REPORT

OBSERVATIONS AND RELATIONSHIPS OF DELTA WATER QUALITY -- 1983 TO 1987

A PRELIMINARY ANALYSIS

June 1988

NOTE TO REVIEWERS:

At the request of the DWR editor, this is an unformatted document. Please excuse improperly blocked and uncentered paragraphs as these and other formalities will be taken care of in the final version.

Figures and Tables appear at the end of the text in this draft but will be inserted on pages where referenced in the final copy. Many of the figures are taken from other sources such as the DWR Delta Atlas, DWR testimony, and other reports. We have not yet renumbered these in the draft but have noted in the text which figure will be used. Some of the figures and tables will also be redone and reduced in size in the final report. Suggestions and comments on the selection and presentation of figures and tables are welcome.

This report was prepared by

MARVIN JUNG & ASSOCIATES, INC.
2020 29th Street, Suite 205
Sacramento, California 95817
(916) 456-1740

As part of contract B-56213 for the
Department of Water Resources

and by

B. J. Archer, P. E.

with information provided by the
Department of Water Resources

FOREWORD

Sound water resource management requires a sound data collection effort to understand the factors that could impact water quality. With this goal in mind, the Department of Water Resources in cooperation with other water agencies initiated the Interagency Delta Health Aspects Monitoring Program in 1983. This program was developed in response to a scientific panel that had identified what types of information were needed to monitor and assess Delta water quality with respect to human health concerns.

This Project Report marks the fifth anniversary of the program. The program began as a monitoring study and has evolved into a combination of monitoring and special water quality related investigations on Delta water supplies. Through the guidance of a Technical Advisory Group, representing water agencies that are concerned about the safety of using Delta water as a primary domestic water source, study priorities are determined and carried out by the Department. In addition, the Department of Health Services serves on the advisory group providing input on human health related issues and laboratory quality assurance.

The 1988 Project Report describes the preliminary results of an ongoing comprehensive analysis of data collected from 1983 through 1987. The analysis also includes data on water quality related factors presented during the 1987 Bay-Delta Hearings. The study results indicate that Delta water supplies are generally of acceptable quality with respect to the levels of chemical contaminants and minerals that may affect human health. However, due to some proposed changes in drinking water quality standards and proposed construction projects, more intensive monitoring is needed.

The program will continue to provide this much needed information. The program's activities are invaluable to the Department's mission of water resource planning and protection for California.

James U. McDaniel
Chief, Central District

CONTENTS

Figures and Tables (Temporary List)
by order of appearance and report sections

NOTE: These tables and figures are in draft form; not all may be in the final report as some can be combined or eliminated. Readers suggestions are welcomed.

Section: Floods

Section: Water Exportation and Diversions

Section: Flows and Patterns

Section: Total Trihalomethane Formation Potential

Section: Characteristics of Water Sources

State of California
GEORGE DEUKMEJIAN, GOVERNOR
The Resources Agency
GORDON K. VAN VLECK, Secretary for Resources

Department of Water Resources
DAVID N. KENNEDY, Director

(list of deputy directors, assistant, and chief counsel)

(Assuming DWR reorganization not in effect yet)

DIVISION OF PLANNING

Arthur C. Gooch ....Chief

CENTRAL DISTRICT

James U. McDaniel ....District Chief
Harold Higgins ....Chief, Planning & Technical Services Branch

This report was prepared under the supervision of:

Richard Woodard ....Chief, Water Quality & Reuse Section

By:

Marvin Jung, Water Quality Consultant
MARVIN JUNG & ASSOCIATES, INC.
Sacramento, California

and

B. J. Archer, P. E.

With the assistance of:

Barbara Heinsch ....Student Assistant

Report editing provided by:

Vera L. Padjen ....Research Writer

ACKNOWLEDGMENTS

The Department of Water Resources is the lead agency conducting the Interagency Delta Health Aspects Monitoring Program. Current program funding and technical assistance are actively provided by the Department of Health Services, the State Water Contractors, the Metropolitan Water District of Southern California, the East Bay Municipal Utility District, the Santa Clara Valley Water District, the Alameda County Water District, and the Alameda County Flood Control & Water Conservation District, Zone 7.

The following is a list of representatives from these agencies that have contributed their time and knowledge to the study.

(Will list only most currently active participants of TAG??)

Department of Water Resources

Richard Woodard....Chief, Water Quality & Reuse Section
Central District
William B. Mitchell....Chief, Water Quality Section
Division of Operations & Maintenance

Department of Health Services--Sanitation & Radiation Laboratory

Michael G. Volz, Ph.D.....Quality Assurance Officer
David P. Spath, Ph.D......???

East Bay Municipal Water District

Keith Carns........Manager, Water Quality & Distribution Planning

State Water Contractors

John Coburn..........Staff Engineer

The Metropolitan Water District of Southern California

Michael J. McGuire, Ph.D.....Director, Water Quality

Santa Clara Valley Water District

Isabel S. Gloege..............Chief, Water Quality Section
William Molnar.................??

Alameda County Water District

Michael Lanier............Supervisor, Water Quality

Alameda Co. Water District Zone 7

Andrew Florendo ....??

DWR Program Staff

Project Management ....Richard Woodard

Field Supervisor....................Michael Sutliff

Field Crew Chief....................Michael Atherstone

Field Operations ....Walt Lambert

Field Logistics Coordination..................William McCune

Data Management Assistance..........Lori Weisser

Data System Operations.............Bruce Agee

Technical Assistance................Barbara Heinsch

Consultants

Water Quality & Toxicity....................Marvin Jung and Associates, Inc.

Water Quality Treatment.....................B. J. Archer, P. E.

Original written and graphic materials from Department of Water Resources files, publications, and Bay-Delta Hearing testimony were used with the agency's permission to develop some portions of this report. In some cases, the borrowed text and graphics are unchanged from the original source. The sources and authors are acknowledged in the Reference section by topic.

SUMMARY

Freshwaters of the Sacramento-San Joaquin Delta are the primary source of water for over 16 million Californians. Reductions in the quality of water could result in human health problems and/or increased treatment costs. Water quality monitoring is an important mission of the Department's total effort in managing this valuable resource.

A number of complex interactions impact the quantity and quality of Delta water supplies. Among these factors are Sacramento and San Joaquin river flows, tidal action, water exports, local consumptive uses, upstream diversions, levee failures, waste discharges, urban runoff,and irrigation return flows.

In 1983, the Department of Water Resources began to routinely monitor Delta water supplies for the purpose of protecting human health concerns. This study was named the Interagency Delta Health Aspects Monitoring Program. It is cooperatively supported and guided by water districts and agencies that are concerned about the safety of using Delta water as a main domestic source. This June marks the fifth anniversary of the program.

As much as five year's of monthly water quality observations have been collected at some Delta stations. The data set represents water quality under a variety of hydrologic conditions and events. Observations in water years 1983, 1984, and 1986 were during classified "wet" years. Those taken in 1985 and 1987 represented "dry" conditions. Water quality as affected by major events such as the massive storms during late February-mid March 1986, which led to flooding of some Delta islands, were monitored.

This Project Report presents an assessment of the impacts of water quality related factors on Delta water supplies from 1983-87. Delta water quality with respect to total trihalomethane formation potential, pesticide contaminants, and ionic composition are discussed. Data from other Department reports and testimony presented during the State Water Resources Control Board Delta Hearings in 1987 provided the opportunity to review compiled information that previously were not readily available. Much of this information has been concisely presented in the discussion of water quality related factors.

Observations of total trihalomethane formation potential, pesticide contaminants, and sodium to chloride ion ratios were examined for data collected from 1983-87. Pronounced effects could be seen at some stations from changing environmental conditions and water management activities including project operations and agriculture in the Delta.

In general, Delta water quality is at an acceptable level for use as a drinking water supply. The few pesticide contaminants that have been found in Delta water samples have been at concentrations marginally above laboratory detection and within safe limits. Selenium in Central Valley agricultural drainage discharged into the San Joaquin River are diluted to levels below detection (less than 1 ug/l) downstream of Vernalis to sufficiently meet the EPA maximum limit of 10 ug/l for drinking water.

Total trihalomethane formation potential (TTHMFP) concentrations in Delta waters appear to be affected by a combination of factors: (1) the presence of bromides, (2) primary productivity in the channels, (3) agricultural drainage discharges, and (4) Delta flows in the channels. In general, TTHMFP has been higher downstream of the Sacramento River at Greenes Landing.

Bromide, a common ion in seawater, can significantly raise the TTHMFP concentration because of its high atomic weight. Brominated THMs were commonly found at stations where water quality were most affected by seawater intrusion or a local bromide source. These stations included

Sacramento River at Mallard Island, Rock Slough at Old River, Clifton Court intake, Delta Mendota Canal intake, and the San Joaquin River near Vernalis. The high amounts of brominated THMs at the Vernalis station is probably from Central Valley irrigation return flows as shown by TTHMFP data collected on the San Luis Drain. However, the origin of the irrigation water is Delta water exported by the State and Federal Water Projects which also contain bromides. There may also be an in-valley bromide source.

Algae and phytoplankton concentrations in the Delta, as measured by chlorophyl a and pheophytin, correlated with TTHMFP trends at some stations. There appeared to be a good correlation between TTHMFP increases when chlorophyl levels increased above 20 ug/l. Spring and fall bloom conditions apparently may seasonally contribute to the availability of THM precursor material in the Delta.

Increases in TTHMFP were seen on the Sacramento River after rice field drainages were discharged into the river. The increased level of THM precursor material in farm drainage could be seen in the river. Samples taken from Delta island drainages have high TTHMFP concentrations. Delta agricultural drainages are currently being investigated by the Department in another study.

Water at the Banks Pumping Plant headworks and Clifton Court Forebay intake responded to water year conditions with respect to THM speciation. Higher percentages (70+) of chloroform by weight correlated with wet years and lower percentages with dry years. These observations are attributed to the amount of seawater ions (bromides) that are transported to the pumps or repelled by Delta outflow.

While there is no definitive correlation to predict the THM concentrations in treated water from TTHMFP measurements in raw water supplies, there are concerns for the technological ability to reduce THMs. EPA is in the process of reviewing the 100 ug/l maximum THM standard for drinking water. Proposed standards are much lower than the current level. The impact of a lower standard would require significant retrofitting of water treatment facilities and expenditures. Reduced TTHMFP levels in raw water supplies would reduce treatment needs. One task of the Delta Health Aspects Monitoring Program is to examine how the total THM formation potential could be best managed in the Delta by understanding their sources.

In studying the effects of bay water intrusion and freshwater flow on Delta export water quality, the comparison of specific molar ion ratios appears to be a useful tool in addition to electrical conductivity, salinity, and ion concentration measurements in identifying the sources and mixing of water types.

The mean sodium to chloride molar ion ratios showed that much of the water in the State and Federal Water Projects and surrounding stations (Rock Slough at Old River) are more chemically similar to Sacramento River at Mallard Island water than at Greenes Landing. The ratios also traced the return of Project waters to the Delta from the San Joaquin River.

As more chemical analyses are performed and examined in Delta agricultural drainage, chemical characterization of specific irrigation return waters might also be traced and their effects on Delta water quality better understood.

The drinking water quality of the Delta water supplies could change in the near future as a result of new construction and water project operations. Some of these proposals which are under study include the Bedford Island Project where 19,440 acres of Delta islands are flooded to store 382,520 acre-feet of water and later pumped out for use. Other plans under consideration include relocating the Clifton Court Intake gates and changes to the State's Delta Water Quality Standards and EPA Drinking Water Standards for trihalomethanes (THMs).

The proposed construction projects and regulatory changes point to the importance of continued monitoring and for additional studies to understand their potential effects on water quality.

The recommendations made as a result of the data analysis included additional monitoring to comprehensively address the many specific points under investigation under the program and initiation of some special studies in response to the proposed construction projects.

Subsequent program reports will continue to provide an interpretation of the results from the monitoring and special investigations.

Chapter 1. INTRODUCTION

Freshwaters of the Sacramento-San Joaquin Delta are the primary source of water for over 16 million Californians. Due to significant climatic differences throughout the State and the distribution of the populace, water resources must be managed, shared, and protected. The reduced quality of water may result in human health problems and/or increased treatment costs.

In 1983, the Department of Water Resources began to routinely monitor Delta water supplies for the purpose of protecting human health concerns. This study was named the Interagency Delta Health Aspects Monitoring Program. It is cooperatively supported and guided by water districts and agencies that are concerned about the safety of using Delta water as a main domestic source. This June marks the fifth anniversary of the program.

The program has evolved in the recent years from a routine monitoring program to one coupled with several special investigations on potential water quality problems.

The previous seven progress reports and two project reports presented information on the results and interpretation of the data collected in the program. The program continues to evolve as necessary to meet the goal of improving our understanding of factors affecting Delta water supplies so that future water management plans will protect water quality.

Beginning with this Project Report and following with subsequent project reports, the results of the ongoing examination of factors relevant to Delta and export water quality will be presented. Project reports will be produced annually instead of every 18 months. Progress reports will be available every October, January, and April. These changes are necessary to improve the responsiveness of the monitoring program to its goals.

Several projects and plans that might significantly affect the quality and quantity of Delta water supplies in the near future have been proposed. Some of these proposals include the Bedford Island Project where 19,440 acres of Delta islands are flooded to store 382,520 acre-feet of water and later pumped out for use. Other plans under consideration include relocating the Clifton Court Intake gates and changes to the State's Delta Water Quality Standards and EPA Drinking Water Standards for trihalomethanes (THMs). Further discussion of these and other proposals are presented in this report and in the appendices. In all cases, much more data collection is necessary to evaluate their potential impacts. Under the guidance of the Program's Technical Advisory Group, priorities are established, program changes made, or special studies initiated.

Chapter 2. FINDINGS

1. The level of THM bromide in the San Joaquin River is, by far, the highest of all the fresh water tributaries to the Delta.

2. Some of the peak TTHMFP values coincide and apparently are a consequence of the first significant rainfall which carries decaying organic matter into the river and tributary streams.

3. THM bromide levels increased at the Rock Slough and the Clifton Court stations on Old River from the middle of 1985 through the end of the year because of a prolonged period of low and reverse Delta outflow. In February of 1986 heavy precipitation resulted in very high Delta outflows which moved the saline water out of the Delta and THM bromide levels returned to normal.

4. Factors other then the major river inflows that adversely effect Delta water quality are agricultural drainage from Delta Islands, phytoplankton blooms in the southern and central Delta and reverse net outflows that allow sea water intrusion to occur.

5. TTHMFP levels at stations in the southern Delta increase in relation to chlorophyll levels above about 20ug/L.

6. It appears that during the normal type water year, the major source of THM precursors and bromides at the export stations is from the San Joaquin River which averaged 172 ug/L TTHMFP higher than the Sacramento River.

7. In studying the effects of bay water intrusion and freshwater flow on Delta export water quality, the comparison of specific molar ion ratios appears to be a useful tool in addition to electrical conductivity, salinity, and ion concentration measurements in identifying the sources and mixing of water types.

8. The mean sodium to chloride molar ion ratios showed that much of the water in the State and Federal Water Projects and surrounding stations (Rock Slough at Old River) are more chemically similar to Sacramento River at Mallard Island water than at Greenes Landing. The ratios also traced the return of Project waters to the Delta from the San Joaquin River.

9. As more chemical analyses are performed and examined in Delta agricultural drainage, chemical characterization of specific irrigation return waters might also be traced and their effects on Delta water quality better understood.

Chapter 3. RECOMMENDATIONS

The following are a list of recommendations for consideration by the Program's Technical Advisory Group based on the initial analysis of five years of data. A brief description of the need to support each recommendation is provided.

* Repeat tidal effects study on Old and Middle Rivers

The limited study on water quality along Old and Middle Rivers conducted in fall 1986 suggested that under certain conditions, water near Union and Victoria Islands might result in pronounced increases in conductivity and salts in export water. Agricultural drainage is a suspected source as there are many drainages emptying into the channels. Should the Clifton Court Intake be moved water quality may become poorer. Further investigation on water quality in this area is needed.

* Dye dispersion studies

Mixing of water from different sources are poorly understood and dye dispersion studies would improve the interpretation of water quality data within the Delta. Dye studies could address questions on the dilution and mixing of agricultural drainages, San Joaquin River water, and other water quality issues.

* Increase frequency of sampling

Increasing monitoring to semi-monthly collections would significantly improve the understanding of Delta water quality factors.

* Focus on smaller geographical area for special studies.

Additional stations need to be monitored to examine the linkage between water quality at different stations. The stations are too distant apart and untested rough assumptions must be made in developing an understanding of the relationships.

Information on Clifton Court Forebay is poor as there are no stations within the Forebay to determine if the Forebay is a source of THM precursors or if there are significant changes due to biological productivity in the Forebay that could affect TTHMFP.

* Expand monitoring work to some D-1485 stations

Preliminary analysis suggests a correlation of TTHMFP with biological productivity as measured by chlorophyl a and pheophytin concentrations taken by the DWR D-1485 study. Water samples taken by the D-1485 study should also include TTHMFP analyses and samples taken by the Delta health Aspects Monitoring Program should include the biological pigment analyses.

* Need for baseline monitoring and monitoring of changes from proposed construction projects potentially affecting water quality.

Numerous proposed projects and changes to water quality standards could effect the future use of Delta water supplies. These include the Bedford Island Project, relocation of the Clifton Court Intake, weirs for the South Delta Water Agency, revised SWRCB Delta standards, and new EPA THM standards.

* Need to monitor impact on water quality from competing beneficial uses.

Experiments to increase phytoplankton productivity for fisheries by altering flows could impact water quality at some stations.
* Further investigation of filtered versus unfiltered samples for TTHMFP should be performed during phytoplankton blooms.

* A study to assess the effects of phytonplankton blooms on THM precursor levels should be implemented. The study should include coordinated collection of TTHMFP and chlorophyll data.

* The explanation for some of the high TTHMFP values in the Sacramento River during certain months of the year is unknown and needs further study.

* Investigate sources of THM precursors and bromides upstream of the Delta on the Sacramento and San Joaquin rivers. Collection of samples at various locations along the river above and below agricultural drains would better define the sources.

* Perform laboratory studies to determine TTHMFP response to increased levels of bromide. Spiked river water samples of varying bromide levels could indicate how much bromide combines in the reaction and if bromides have the effect of utilizing precursors more effectively.

Chapter 4. DELTA WATER QUALITY

Through the Interagency Delta Health Aspects Monitoring Program, data is collected each month to evaluate the quality of Delta water supplies for human consumption. Nearly five years of data have been recorded at several Delta locations under different water year conditions and events. A comprehensive examination of factors that could affect water quality is underway and will continue concurrently with the monitoring study. Due to the 1987 State Water Resources Control Board Bay-Delta Hearings, the opportunity to examine historical data previously not compiled or readily available was provided in the hearing testimonies and submittals. This opportunity to supplement data from the hearings with those from the Interagency Monitoring Program substantially broadens and improves the ability to understand how and why Delta water quality is variable.

The results of an initial analysis of the data are described in this report. Subsequent annual project reports will report on the continued analysis and interpretation of data. Progress reports will continue to update the public on the quarterly activities and results of field and laboratory measurements.

The primary objectives of the analysis are to:

1. Summarize trends, relationships, and ranges of values in observations taken under the Delta Health Aspects Monitoring Program from 1983 through 1987.

2. Address specific questions about sources and contribution of THM precursors affecting Delta water quality.

3. Determine if special studies or monitoring program changes are needed.

Some specific points under examination include:

1. The relationship of Delta outflow on water quality observed at each station.

2. Identifying major events that could have affected water quality observations.

3. The contribution of THM precursors from Suisun Bay to the Delta.

4. Estimations on theoretical mixing of water types in the Delta.

5. The relationship of primary productivity events on THM formation potential.

6. Characterization of prominent seasonal and monthly patterns of Delta water quality.

7. Relationship of air temperature and consumptive channel use of water by Delta farmers.

8. Baseline water quality conditions in the Clifton Court area.

9. Water quality changes attributable to biological productivity and mixing within Clifton Court Forebay or State Water Project operations.

The effort included a review of the following databases:

1. Delta Health Aspects Monitoring Program 1983-87

- Basic water quality measurements
- Mineral quality analyses
- THM formation potential and THM speciation
- Pesticide analyses
- Special tidal effects study

2. DWR Delta Agricultural Drainage Investigation

3. DWR D-1485 Monitoring Study

   - Basic water quality measurements
   - Chlorophyl a and pheophytin

4. National Weather Service data

   - Stockton and Sacramento air temperatures
   - Precipitation data

5. DWR Dayflow Delta hydrology computer model calculations and measurements of daily flow

6. Miscellaneous supplementary data

   - DWR Northern District Sacramento River TTHMFP study
   - DWR 1954-56 Delta agricultural drainage report
   - DWR testimony submitted for SWRCB Delta hearings
   - DWR State Water Project Operations & Maintenance records on Clifton Ct. Intake and Banks Pumping Plant daily pumped volumes.

Topics Covered

Three key topics are discussed in this report. The first topic is an overview of the major factors in the Bay-Delta environment that effect Delta water quality. Both natural and human factors can have significant effects on the quantities and qualities of Delta water supplies at any time. The typical variable events such as irrigation and increased drainage disposal, pesticide use, tidal variations, floods, and water project operations are briefly discussed.

The second key topic examines some of the observations and relationships of Delta water quality seen in 1983 through 1987. Information are presented on total trihalomethane formation potential (TTHMFP), trihalomethane (THM) precursors and speciation, major ion ratios, and their relationship to Delta outflow estimates.

The last key topic describes proposed projects and plans that might become additional factors affecting export water quality and quantities in the near future. These proposals include the Bedford Island Project, a new Clifton Court Intake location, channel weirs, revised Delta water quality standards and policies, and experiments on altering flow and diversion operations to protect and enhance other beneficial uses such as fisheries.

Methodology

To determine the significance of any relationship between Delta channel flows and observed water quality, data from the DWR DAYFLOW (also referred to as DAYFLO) hydrology model were examined along with the mean daily flow reported for the day when water quality samples were taken by the Interagency Monitoring Program.

DAYFLOW is a computer program developed in 1978 as an accounting tool for determining historical Delat boundary hydrology. The program provides the best estimate of historical mean daily flows and its accuracy is affected by the model's computational scheme and accuracy and limitations of both monitored and estimated stream inflows, Delta precipitation, Delta exports, and Delta gross channel depletions. Further details about the model and calculations of flow are presented in Appendix A.

Both daily and monthly average DAYFLOW data reflected and represented the hydrologic conditions in the Delta when plotted and compared. However, when mean daily flow data for the monitoring program sampling dates were plotted points, the results did not resemble the hydrologic conditions seen in the DAYFLOW daily and monthly average plots.

Five day average flows were then computed for each sampling date and the results compared favorably in reflecting the hydrologic patterns observed in the DAYFLOW graphs. For each sampling date, the daily flow of that day plus that of the previous 4 days were summed and averaged. The assumption is that the water quality of a given day result from flow conditions stabilized over a 5 day period. Appropriate DAYFLOW values were compared for each monitoring station.

Statistical calculations were made for each station to determine range and variability of data to determine best characterization of each station. Historical events were traced to chronologically document possible events that may have had significant effects on water quality. Conditions under different water years compared.

This report discussses the Delta outflow relationship with TTHMFP, THM species, and molar sodium to chloride (Na:Cl) ion ratios from July 1983 through September 1986 for stations located at:

Sacramento River at Greenes Landing
San Joaquin River near Vernalis
Sacramento River at Mallard Island
Rock Slough at Old River
Clifton Court Intake
Harvey O. Banks Pumping Plant Headworks

DAYFLOW data past September 1986 were not available for use in this analysis as there is a lag in reporting and tabulating the data. An analysis of water quality relationships and factors at other monitoring stations and other topics will be reported in subsequent progress and project reports of the Delta Health Aspects Monitoring Program.

A. Major Factors Effecting Bay-Delta Water Quality

The Sacramento-San Joaquin Delta is geographically defined in California Water Code Section 12220 (Atlas Figure 4). About 60 islands and tracts lie in parts of six counties--Sacramento, San Joaquin, Yolo, Solano, Alameda, and Contra Costa. The Delta extends over 738,000 acres of which about 550,000 acres of prime agricultural land. Industrial areas exist on the fringes of the Delta and towns and other urban developments occupy parts of 12 islands or tracts.

Most of the islands lie below the surrounding water level to as much as 20 to 25 feet below the mean tide level (Atlas Figure 21). The low-lying lands are protected from high tides and floodflows by a levee system. Over 700 miles of waterways meander through the maze of Delta islands.

Some interesting facts about the Delta are presented in Table ???? (Atlas Table 5).

Tides

Water quality at many locations within San Francisco Bay and the western Delta are significantly affected by ocean tides. Seawater intrusion creates water supply problems in several ways. Seawater can cause scaling and corrosion problems in pipes and tanks, damage to crops, and with respect to human health concerns, water sources may contain higher levels of sodium and have the increased probability of forming brominated trihalomethanes during treatment. In general, the high solubility of salts in seawater results in expensive treatment methods to control their presence.

San Francisco Bay tides are categorized as "mixed" tides because of the variation in tidal heights between each of the the two high and two low tides (DWR-39). The tidal day is about 24 hours and 50 minutes long. Spring tides occur near the times of full and new moons and the spring-tidal range is larger than the mean tidal range (the difference between the mean high and mean low tides) or the mean daily range. Neap tides occur during the first and third quarters and the tidal range is least. Because tides are so closely related to the earth's positioning with the sun and moon, there is substantial variation in the tides at the same place during the month.

Accompanying the periodic rise and fall are strong tidal currents. However, tidal currents are affected by many nonperiodic processes in the coastal ocean. In large estuaries such as San Francisco Bay, riverflow modifies tidal currents, altering their timing, so that current prediction is more difficult than predictions of tidal height (DWR-37 and/or DWR-40). Both tides and tidal currents are affected by winds and storms.

The basis for some of the standards set for regulating Delta inflows to the Bay as set in State Water Resources Control Baord Decision 1485 are to repel seawater intrusion. Delta waters exported by the State and Federal Water Projects are vulnerable to serious seawater contamination without measures for regulating upstream diversion releases and levee protection against floods. Operations at the Clifton Court Intake are synchronized to take water during incoming tides to take advantage of the tremendous pumping force of the tides in pushing fresh water into the lower Delta. However, pumping is near continuous at the Federal Water Project Intake resulting in slightly more saline water on the average in the Delta Mendota Canal.

Agriculture

Because agriculture is the primary use of land in the Delta (average annual gross value $375 million), farming practices are significant factors affecting the quantities and quality of water in the channels. About half of land is used to grow corn, grain, and hay (DWR-308, DWR-312, and/or DWR-311). To protect crop production in the Delta Lowlands, special fall irrigation after harvest and winter pond leaching are conducted to manage soil salinities that are harmful to corn grain yields (DWR 324). Delta irrigation management is related to salinity, crop tolerance to salinity, and the need for leaching to maintain soil salinity within the tolerance of the crop being grown. Irrigation facilities in the Delta are innumerable (DWR-49).

The Delta uplands are composed of mineral soils and are surface irrigated (generally furrow-type but includes strip-check and sprinkler). Salinity control in the root zone is accomplished by winter rainfall plus the application of irrigation water in excess of crop water demand to leach most of the accumulating salts downward and below the reach of roots. If a shallow water table is present, salt control by leaching becomes much more difficult and drains may need to be constructed to collect and transport the drainage for disposal.

The Delta lowlands cover about 469,000 acres and are mostly composed of organic soils and sub-irrigated. In this method temporary ditches (30 feet apart, 6 inches wide, and 12-18 inches deep) are used to distribute water through the fields. Raising the water level in the ditches by means of control structures causes horizontal movement of water through the soil. Shallow water tables are present (within three to five feet) and it is regulated as to depth below the soil surface by open drains and large drainage pumps (DWR 322 and DWR 321).

Typically, salts from applied irrigation water during sub-irrigation and from the shallow water table accumulate more near the soil surface where roots are more prevalent and active. Sub-irrigation replenishes the soil water used by crops or evaporated from the soil surface and may remove some accumulating salts by means of the drainage system. The shallow water table prevents significant downward leaching during and following a sub-irrigation.

While these farming practices are important means of protecting crop yields, on the other hand, Delta water quality in the channels receive saline drainage. Concentration of salts in the channels may become elevated under low river flow conditions when dilution and dispersion are reduced. Agricultural drainages also appear to be rich in trihalomethane precursor materials as seen by total THM formation potential measurements. The increase in salinity of the channels during the summer causes some farm operators to cease irrigation during that period because of the negative impacts of applying highly-saline water to crops.

In general, there are two peak periods when drainage volume are the highest during the water year. Drainage volume is at a low in October and rises rapidly to the first maximum in December and January as a result of the winter pond leaching. A second low occurs in February after leaching has been completed. Drainage increases thereafter as lands are irrigated to moisten the soils for seed germination in the spring. The final maximum drainage period occurs during the hot summer period as irrigation (applied water) demands are high to meet crop demands.

The current drainage volumes can only be estimated. An early DWR study on drainage in the Delta Lowlands estimated about 30,000 acre-feet in October, 1955 and a maximum of about 96,000 acre-feet in January, 1955 (DWR Report 4, Table 10).

One or the other!

In 1987, an estimated 260 pumping stations were identified in the Delta (DWR-64). The DWR 1955 study was based on data from about 206 pump stations involving about 300 pumps. Efforts to obtain more recent data to quantify drainages have been pursued by the Department but unsuccessful due to lack of permission to collect data from most of the pump station owners. However, based on comparisons of the number of pump stations and other information found in the 1955 study, drainage quantities are probably more since corn production is now about three times higher than in 1955. In 1955, asparagus was the major crop grown and it is much more salt tolerant than corn. Asparagus production is now one-third of the 1955 crop acreage. A comparison of crop acreages over time in the Delta are shown in Table ??? (DWR-312).

Data on water quality characteristics of Delta farmland drainage is also severely limited. Total dissolved solids data from the 1955 study are shown in Table ??? (DWR report 4--Table 16).

It is doubtful if significant changes to the current Delta irrigation practices would be made without a significant loss in corn grain production. A four year study on the corn yield with different irrigation management practices on subirrigated Delta organic soils and a model called DELCORN concluded that the leaching practices are necessary. However, alternatives such as growing a more salt tolerant crop, alternative sources of water, or leaving the field to fallow were not considered. The model also indicated that pond leaching is required less frequently and is more effective in restoring relative corn grain yield than the practice of fall subirrigation after harvest.

Some of the reported problems attributed to land derived salts include raising salinities of water in Cache Slough at the City of Vallejo intake to significantly higher levels than in the Sacramento River. Similarly, water taken by the Contra Costa Canal at pumping plant #1 are more saline than water in Old River at Rock Slough.

Pesticide Use

Pesticide use is also a major water quality concern. Synthetic organic chemicals are used on crops, irrigation ditches, levees, and Delta channels to control insects, weeds, and aquatic vegetation.

Pesticide use is expected to continue as a necessary practice for protecting and enhancing crop production. The use of weedicides to control aquatic plant growth in ditches, drains, and channels will also continue for flow and navigational reasons. Strong legislative actions have resulted in many regulatory and enforcement actions in the development, sale, use, and disposal of toxic chemicals. In California, the State Water Resources Control Board have regulated the release of rice field drainage containing the herbicides Ordram, Bolero, and Basagran, into the Sacramento River. Chlorinated pesticides such as DDT and toxaphene have also been eliminated from use. In 1986, voters passed Proposition 65, an intiative that has resulted in a development of confusing regulations on toxic chemicals manufactured, sold, used, and found in California. Some major supermarket chains are advertising the sale of produce free of pesticide residues to capitalize on the increased public concerns for toxic chemicals in food. As a result, the potential threat of pesticides on water quality are optimistically on the decrease.

Hydrologic Conditions

The principal rivers of the Delta are the Sacramento and San Joaquin and their tributaries. These include the American, Calaveras, Cosumnes, Feather, Merced, Mokelumne, Stanislaus, and Tuolomne rivers. They drain almost all of the Central Valley and provide about 47 percent of the total runoff of the state.

To provide protection of the beneficial uses of water in the Delta, the State Water Resources Control Board developed and implemented under its full authority a single comprehensive set of water quality standards (Decision 1485, see Appendix B). The Board's water quality control plan (Delta Plan) sets terms and conditions in the water right permits issued to the Department of Water Resources and U. S. Bureau of Reclamation in the operation of the State and Federal Water Projects, respectively. The Plan covers salinity control, fish and wildlife protection, and coordination of terms and conditions in the respective SWP and CVP permits.

Beneficial uses in the Delta and Suisun Marsh have been historically classified under three broad categories: (1) agriculture, (2) fish and wildlife, and (3) municipal and industrial. Water quality standards were established to protect each use.

The underlying principle of these standards is that water quality in the Delta should be at least as good as those levels which would have been available had the CVP and SWP not been built, as limited by the constiutional mandate of reasonable use. The standards, shown in Appendix B, include adjustments in the levels of protection to reflect changes in hydrologic conditions experienced under different water year types. Classification of water year type are also shown in Appendix B.

California experienced record breaking precipitation in most river basins during the 1982-1983 water year (October 1982 through September 1983). Unimpaired runoff in the Central Valley was 36 million acre-feet above normal. The water year was classified "wet", as determined by the Four Basin Index contained in Decision 1485. Delta outflows were massive, approaching 400,000 cubic feet per second in March and remaining above 20,000 cubic feet per second through the calendar year. These extraordinarily high flows created a natural hydraulic barrier against salinity intrusion and the Delta remained essentially a freshwater environment. Electrical conductivity (E.C.) at Chipps Island exceeded 200 microsiemens per centimeter (91 mg/L chloride) only once, during a short period in August. The hydrograph of these flows is shown in Figure ?? (DWR D-1485 annual report 1985--Figure 3 "Monthly Average Flows"). Contributing flows by the San Joaquin River, also at record levels, are shown.

During 1983, the Department of Water Resources operated the State Water Project in full compliance with Decision 1485 Delta standards. Sufficient water was available to satisfy delivery requirements, and all Delta export water quality objectives were met. The unusually high Delta outflows resulted in excellent water quality throughout 1983 at all major locations at which standards apply.

The 1983-84 water year began with heavy precipitation in November and December, and threatened to be a repeat of the previous record year. As SWP operation centers were adjusting for a heavy runoff, the weather pattern changed and the above-normal first quarter was followed by well below normal precipitation for the remaining three quarters. The State Water Resources Control Board still classified 1984 as a wet year, because total Central Valley runoff exceeded 34 million acre-feet. Below normal runoff in April through July, however, resulted in the year being further designated as one of subnormal snowmelt, allowing lower Delta outflow standards to be in effect during that period.

The Delta Outflow Index is a calculated value that is taken as a relative measure of the net westerly flow of freshwater at Chipps Island near Pittsburg. In 1984, outflow averaged above 30,000 cfs through the end of March, easily meeting Decision 1485 standards. Delta outflows remained below 14,000 cfs from May through October. Delta salinity standards required by Decision 1485 became controlling in June,requiring outflow to be maintained at a level substantially exceeding the minimum outflow requirements for a subnormal snowmelt year. The Delta Outflow Index averaged about 10,600 cfs in May, just under 8,000 cfs in June, and about 9,800 cfs in July. Sacramento River flow standards at Rio Vista were met by wide margins in 1984. The May through July Delta export limits of Decision 1485 were also met, although by small margins in June and July.

With the single exception of the standard at Jersey Point, all Decision 1485 Delta salinity standards were easily met in 1984. For a short period in late July, the mean electrical conductivity standard of 0.45 millimhos per centimeter was approached at the Jersey Point station, but the standard was not exceeded. This salinity distribution had remained relatively stable since the low spring outflows.

Water year 1984-85 was characterized by fluctuations in precipitation amounts, beginning with above normal precipitation over much of the State. November precipitation set records, with some stations reporting over 500 percent of average. This pattern changed abruptly, however, with record lows in January. Many stations had less than 10 percent of January averages, and several had no precipitation during the month. February precipitation was just slightly over half of normal statewide. March provided near normal rainfall overall, but was light in the northern and southern ends of the State. April precipitation was scanty again and failed to improve the water supply situation. Although the wet beginning somewhat compensated for the later dry weather, runoff in northern California was still below normal. San Francisco Bay streams had less than half their water year averages, and Central Valley streams had half to three-quarters of their average flows. Reservoir storage was variable, but generally less than the year before. The State Water Resources Control Board classified 1985 as a "dry" year for the Delta.

Early in 1985, the Delta Outflow Index averaged slightly over 12,000 cfs, then declined gradually through spring and summer. The average monthly index measured 8,800 cfs in March, 6,900 cfs in April, and then was increased to 7,200 cfs in May to help reduce salinity at Emmaton. The index continued to decline through summer, reaching a low of just under 1,900 cfs in August. Delta outflows generally increased during the fall, and the index reached 8,400 cfs in December. Delta outflow remained above the minimum required by Decision 1485. Sacramento River flow at Rio Vista also remained above the minimum required by Decision 1485. Decision 1485 export limitations were met in 1985, although by slim margins in May and June. The maximum permissible SWP export for June was increased from 3,000 cfs to 3,300 cfs to compensate the project for participating in the interagency controlled flow study earlier in the spring. With the exception of the standard at Emmaton, all Decision 1485 Delta salinity standards were met in 1985. For a short period in mid-May, the 14-day mean electrical conductivity standard of 0.45 millimhos per centimeter was exceeded at the Emmaton station. From May 11 through 14, the 14-day mean was 0.46 millimhos per centimeter.

Water year 1985-86 was a wet year but rainfall was erratic. Fall 1985 was dry but higher rainfall followed in January 1986. A series of massive storms in mid-February produced record-breaking runoff and much flooding. A significant portion of an average year's water supply fell during a 10-day period in February.

Despite the heavy February rainfall, the April 1 snowpack in the northern Sierra was less than normal. Spring runoff volumes in the Sacramento River basin were about 80 percent of normal. In the San Joaquin River basin, snowpack was above average and runoff was about 140 percent of normal.

By year's end, reservoir storage and streamflow in the State were at or slightlyabove average. The SWRCB Four Basin Index final classification for 1986 was "wet". The april-July unimpaired snowmelt runoff was 5.8 MAF, which designated 1986 as a subnormal snowmelt year.

The 1986 Delta Outflow Index was erratic as the weather. During January the Index averaged about 10,000 cfs. In early February, it had increased to about 30,000 cfs with the late January rainfall. The Index rose with the heavy rainfall in late February and early March. The Index averaged over 250,000 cfs peaking up to 500,000 cfs on some days. The Index then declined gradually during spring and by June was about 9,000 cfs. During the summer it averaged about 6,000 cfs. In fall and early winter 1986, the Index fluctuated at a higher level with seasonal rainfall but generally remained below 12,000 cfs. Delta outflow and Sacramento River flow at Rio Vista both remained above the minimums required by Decision 1485.

All Delta salinity standards in Decision 1485 and the North Delta Water Agency contract were met during the year. Balanced water conditions were in effect in the Delta from June 21 to August 6. These are periods mutually declared by DWR and the USBR when upstream reservoir storage withdrawals plus other inflow are about equal to the water supply needed to meet Sacramento Valley uses, Delta water quality objectives, and exports.

The State Water Project was operated within the export limits imposed by Decision 1485. Mean monthly SWP diversions were about 2,950 cfs during May and June and 3,850 cfs during July.

Floods

Flood protection from high tides and riverflow are provided by an extensive network of levees. However, due to the age and materials used to construct the levees, many islands are susceptible to flooding. The rich organic peat soils used as levee material are of low density and highly compressible. They are structurally weak because they are susceptible to oxidation, wind erosion, and fire, which have resulted in the continuous subsidence of levees and the island surfaces. As subsidence continues, water pressure on the levees and seepage through or under them rises, increasing their instability.

On the channel side of the levees, wind-generated waves, boat wakes, and high water flow erode away the slopes. Levee protection is a major concern as the collapse of some islands can cause uncontrolled seawater intrusion further into the interior Delta if repairs are not made (Atlas Figure 29).

Over a dozen islands have been flooded during the last eight years with some islands flooded more than once (Atlas Figure 23).

The Delta's levees are classified as project or nonproject levees. The former meet federal standards for flood protection and are maintained by local districts under the supervision of the Department of Water Resources. Project levees are constructed of more stable material such as mineral soils. Only about 35 percent of the Delta levees are project levees.

The remaining majority of levees are nonproject levees that generally meet less stringent standards for flood protection. Many have inadequate freeboard and levee section, subsiding peat foundations, marginal stability, seepage problems, poor maintenance, and other deficiencies. In 1980, the Department inspected the nonproject levees at 52 tracts and islands. Based on Army Corps of Engineers standards fror project levees, 20 tracts and islands were rated as fair, 28 poor, and 4 as very poor.

Water Exportation and Diversions

Water supplies are transferred through the Delta for export to several public agencies which have long-term contracts with the federal Central Valley Project (CVP) and the State Water Project (SWP). These agencies include Bay Area water agencies as well as those in the central and southern part of the state. In addition, diversion occurs above the SWP and CVP by other water districts (Atlas Figure 16). These supplies meet all or part of the water needs of more than 16 million of the state's 24 million residents and more than 4 million of the 10 million acres of productive irrigated farmlands.

Pumping rates can have effects on water quality. For example, as the Contra Costa Canal pumping plant #1 pumping rate increases, the salinity of water taken is lowered to nearly that of Old River near Rock Slough. This improvement occurs because local degraded water in Rock Slough resulting from agricultural drainage is diluted with better quality water from Old River.

The two largest exporters of Delta water are the State and Federal Water Projects. To protect water rights and water quality in the Delta, the State Water Resources Control Board instructed the Department of Water Resources and U. S. Bureau of Reclamation in developing a coordinated plan in the operations of releasing and exporting water through the Delta from their respective facilities. This plan was executed on November 24, 1986 and is named the Coordinated Operations

Agreement (COA). The COA allocates the responsibility of the tow project's share of flows necessary for maintaining Delta water quality between the CVP and the SWP.

Under D-1485, chloride standards has been set for many Delta stations for the protection of municipal and industrial water uses (Appendix B). With respect to the CVP and SWP exports, Delta outflow must be maintained to meet these standards and meet the export obligations. Consequently, there are export-outflow relationships to meet water quality standards (chlorides) at specific Delta locations designated in D-1485.

How other water quality characteristics such as total trihalomethane formation potential and sodium concentrations are affected by Delta outflow and exports will be addressed in the Delta Health Aspects Monitoring Program.

Flows and Patterns

Flow patterns are complex and attempts to monitor and model them have been the subject of numerous studies by DWR and others for nearly 30 years (DWR-43). The DAYFLOW model hydrologic scheme is shown in Figure (DWR-46). Water quality data from the Interagency Delta Health Aspects Monitoring Program were compared against the 5 day average flow values for the appropriate sampling dates. The DAYFLOW parameters used for the IDHAMP stations are listed below:

Station	DAYFLOW Parameter
Sacramento River at Greenes Landing	QSAC
San Joaquin River near Vernalis	QSJR
Rock Slough at Old River	QSAC, QTOT, QOUT, QEXP, QEAST, QSJR
Clifton Court Intake	QDPP, QTPP, QSJR, QOUT, QEAST
Delta-Mendota Canal Intake	QEAST, QSJR, QTPP
Sacramento River at Mallard Island	QOUT, QEAST, QSAC

The DAYFLOW computational scheme and parameters are described in Appendix A.

Another tool used by DWR, the SWRCB, USBR, and Contra Costa Water District, is the Fischer Delta Model. This model simulates hydrodynamics (water movement) and corresponding salinity conditions in the Delta channels and Suisun Bay for time periods of up to a year or more. The model results are based on data from a network (grid) of stations with 114 junctions representing inflows, channel depletions, irrigation returns, exports, and the tidal boundary (Figure ???; DWR 78).

The Fischer model is limited to water quality with respect to salinity and rough estimates of irrigation return flow quality and quantity. Long-term data collection on many other important water quality parameters have been limited to DWR D-1485 and the Delta Health Aspects

Monitoring Program. Efforts to better quantify and characterize irrigation return water is underway through the Department's Delta Agricultural Drainage Investigation.

The Fischer Delta Model has been used to simulate the direction of channel flows under different scenarios and assumptions. Figures ??? through ?? represent some of the possible results. For example in Figure ???(DWR-51C) the results are based on CVP pumping at 4700 cfs, Contra Costa Canal at 250 cfs, the Delta cross channel open, and no pumping at the SWP. Figure ??? (DWR 51D) is based on the Delta cross channel open and CVP pumping at 4700 cfs, SWP pumping at 6000 cfs, and Contra Costa Canal at 250 cfs. The last example (Figure ???; DWR 51E) is based on the Delta cross channel open and CVP pumping at 4700 cfs, Contra Costa Canal at 250 cfs, SWP pumping at 4000 cfs, Sacramento River at 50,000 cfs, and San Joaquin River at 9000 cfs.

As exports from the Southern Delta increase from zero, there are a progression of changes in the Delta channels in and south of the San Joaquin River. When outflow is high and there are no exports, flows are positive downstream in all Delta channels. When there is low outflow and no exports, channel depletions alone are sufficient to set up reverse flows in many southwestern Delta channel reaches. The flows tend to converge on the areas of high channel depletion. At low export levels as in Figure ??(DWR 51C), the channel reaches subject to reverse flow become more continuous and flow reversals extend into upper Middle River and the main San Joaquin. As the exports increase to high levels as in Figure ??(DWR 51D), the flow reversals extend downstream to the confluence with the Sacramento River at Sherman Island. Finally, when high exports occur in the early winter, reverse flows are confined to the Old and Middle river channels leading to the pumps (Figure ???;DWR 51E).

B. Observations and Relationships 1983-87

1. Total Trihalomethane Formation Potential

This analysis was performed to graphically examine the relationships between Delta tributary stream flows, phytoplankton blooms in the Delta, brominated species of trihalomethane and total trihalomethane formation potential (TTHMFP) of Delta water.

The analysis consisted of preparing time plots of trihalomethane (THM) concentrations, molecular weight of bromide contained in the brominated species of THM, chlorophyll concentrations and flow data for selected water quality stations in the Delta. The graphs were scrutinized for any marked relationships between these parameters. A station to station comparison of THM and THM bromide concentration was also plotted for certain stations.

All flow data used in the analysis was from the Central District's computer program called DAYFLOW. This program contains flow data (stream measurements) for all Delta tributary streams and calculates the net Delta outflow on a daily basis. The program uses a daily estimate of in-channel use for Delta channels and this estimate is probably not very accurate during periods of above or below average climatological conditions. District personnel are currently working to improve this aspect of their program. Chlorophyll data was obtained from the DWR D-1485 Monitoring Study. Trihalomethane data used in the analysis was collected at monthly intervals. Occasionally, a data points are missing due to some oversight in the collection or analysis of the sample. The graphs are generally grouped by the type of data plotted. For example, THM data and THM bromide data are displayed in one group of plots because their period of record is longer then the records for flow and chlorophyll. The THM data is then plotted again on graphs along with flow and chlorophyll data for the purpose of examining the relationships between the parameters. The period of record available for flow data was July 1983 through September 1986. This is the shortest period of record plotted and limits the time period for which other parameters can be compared to flow. Chlorophyll data was available for July 1983 through December 1986 and THM data was available for July 1983 through December 1987.

Certain distinctive events occurred during the study period that could have affected changes in Delta water quality. The relationships between some events and quality changes are obvious while others are obscure.and uncertain. These events and associated comments are provided below by calendar year.

1983

This year was classified as wet and San Joaquin River flows remained above 8,000 cfs all year. Chlorophyll levels remained below 10 ug/L in the southern Delta.

1984

Initial and most intense phytoplankton bloom of the year peaked June 11th. Chlorophyll levels reached 75 ug/L. Second bloom peaked August 10th with a chlorophyll level of 36 ug/L. The third bloom peaked September 5th with a chlorophyll level of 24 ug/L. Blooms were located between San Joaquin River and Clifton Court. Taste and odor problem and clogging of sand filters were experienced by Santa Clara Valley Water District and Contra Costa

A barrier was installed in Old River between the San Joaquin River and the Tracy Pumping Plant intake on September 8th. The Department of Fish and Game.requested installation of the barrier to restrict flow in Old River and increase flow in the San Joaquin River past Stockton. Fish and Game requests the DWR to install the barrier when low dissolved oxygen levels threaten the fishery in the Stockton Ship Channel. The flow increase, caused by the barrier disperses and moves the low dissolved oxygen water out of the channel. Fish and Game had requested that the barrier remain in place until November 30th but removal of the barrier on October 19th was required due to levee erosion. When the barrier is in place, the flow split between Old River and San Joaquin River is about 27% and 73% respectively. These values are generally reversed without the barrier. No changes in Delta water quality were observed during the time the barrier was in place.

1985

Most intense phytoplankton bloom occurred in mid-May. Chlorophyll levels were near 90 ug/L.

In an attempt to promote alga growth and thereby provide a larger food supply for Delta fishery, Fish and Game requested a curtailment in water exports. Purpose of the curtailment was to slow water movement in the Delta when phytoplankton bloom conditions were optimal. This experiment began during the third week of March and ended the second week of April. Results of the experiment were inconclusive as no significant bloom occurred during that time. Fish and Game have not requested a repeat experiment and may not desire to further pursue this scheme. Had the experiment been successful, the DWR and the water contractors could have been confronted with conflicting water use requirements. While a phytoplankton bloom producing a larger food supply is desirable for the fishery, the potential for taste and odor problems, filter clogging and increased TTHMFP could be crucial to South Bay Water Contractors.

1986

Record breaking rainfall occurred during a 10 day period in February. Generally, TTHMFP levels increased in January due to some early rains and the increase continued into February during the initial runoff from very heavy precipitation. Following this initial runoff period TTHMFP levels begin to decline.
In the central Delta a phytoplankton bloom occurred in June that raised the chlorophyll level to 100 ug/L. A bloom occurred in the southern Delta that increased the chlorophyll level to 40 ug/L.

1987

At this time no data is available regarding phytoplankton blooms. The Old River barrier was installed and removed during the months of October and September.

To provide a quick guide to key flow information Figure THM-1, shows flows for the Sacramento and San Joaquin rivers, Delta Outflow Index and runoff to the Delta resulting from precipitation. Data is from DWR DAYFLOW computer program.

San Joaquin River Near Vernalis

The level of THM bromide in the San Joaquin River is, by far, the highest of all the fresh water tributaries to the Delta. Figure THM-2, shows TTHMFP and THM bromide During the study period THM bromide ranged from 12.2 to 198.2 ug/L and averaged 71.7 ug/L. TTHMFP ranged from 207 to 1,476 ug/L and averaged 496 ug/L. The river, under normal conditions, includes a high percentage of agricultural drainage which contains a significant level of bromide. High levels of bromide in drainage water from some parts of the San Joaquin Valley has been confirmed previously by analyses of San Luis Drain water. The graph, Figure THM-3, showing the TTHMFP, THM bromide and San Joaquin River flow indicates that THM bromide usually increases and decreases with TTHMFP except during periods when the San Joaquin river flow has greatly increased. Because the molecular weight of bromine is about twice the weight of chlorine, it is more likely that TTHMFP increases with an increase in bromides. During the higher river flows, which also coincide with precipitation, the TTHMFP increases but THM bromide decreases in concentration. This event occurred three times during the study period. The date of those occurrences were March 1983, January 1984 and March 1986. Presumably, surface runoff adds THM precursors but no significant amount of bromide.

Figure THM-4, shows the chlorophyll and TTHMFP values for the period of record. There is a very good direct correlation between the two parameters when the chlorophyll levels are greater then 20 ug/L

Levels of Chlorophyll greater then 20 ug/L are considered to represent a major phytoplankton bloom. Early in this program samples were collected at certain Delta stations for purposes of determining the effect of biomass and suspended materials on TTHMFP. Each station sample was split into two samples, one was filtered and the other was left unfiltered. They were then analyzed for TTHMFP at the laboratory. Results of these analyses showed no meaningful differences between the two samples. However, these samples were collected during the months of October 1981, November 1981 and January 1982, periods in which a major bloom did not exist. In view of the findings of this data analysis, further investigation of filtered vs unfiltered samples should be performed during bloom conditions.

Sacramento River at Greens Landing

The Sacramento River at Greenes Landing graph, Figure THM-5, shows the TTHMFP and THM bromide for the period of record. This graph demonstrates that Sacramento River water is low in bromide and would not be a source of the higher bromide levels found in the lower Delta. The explanation for some of the high TTHMFP values in the Sacramento River during certain months of the year is unknown and needs further study. Figure THM-6, shows TTHMFP, Sacramento River flow and chlorophyll. Some of the peak TTHMFP values are a consequence of the first significant rainfall which carries decaying organic matter into the river and tributary streams. Some peak TTHMFP values during other times of the year may be due to releases of water from rice fields above the City of Sacramento. The rice field releases are usually made during mid-August through September.

Figure THM-7, shows the TTHMFP and chlorophyll for the complete chlorophyll record. There may be a slight correlation of TTHMFP to chlorophyll, but it seems doubtful that the relationship could be defined given the other sources of THM precursors and the rate of flow at this station.

During a seven month period, November 1985 through June 1986, DWR's Northern District collected samples, on three separate occasions, from the Sacramento River for TTHMFP analyses. The samples were collected from four locations along the Sacramento River between the town of Anderson, upsteam, and Elkhorn Ferry, downstream, which is a short distance above the city of Sacramento. Figure THM-7A is a map showing the sampling locations. Samples were also collected from Sutter Bypass, Colusa Basin Drain and Feather River near Verona. TTHMFP values increase in the downstream direction between Anderson and Elkhorn Ferry. Averages of the Sacramento River data show the most upstream station was 219 ug/L TTHMFP while the Elkhorn Ferry station was 373 ug/L TTHMFP. This represents a 70 percent increase or 154 ug/L of TTHMFP between the two stations. The average TTHMFP for Sacramento River at Greenes Landing during the same months in which analyses were made for the Elkhorn Ferry station was 554 ug/L One sampling date, June 25, 1986, coincided for the Elkhorn Ferry and Greenes Landing stations. On that date TTHMFP concentrations were 233 ug/L and 1,005 ug/L respectively. Analyses from the Sutter Bypass station averaged 581 ug/L TTHMFP and the Colusa Basin Drain averaged 700 ug/L TTHMFP. Both of these systems contribute precursors to the Sacramento River. One sample was collected from the Feather River station near Verona. The

TTHMFP concentration was 195 ug/L, near the same level as the Sacramento River near Anderson.

During the period of study TTHMFP values at Greenes Landing ranged from 131 to 1,110 ug/L and averaged 324 ug/L. THM bromide ranged from 3.4 to 16.3 ug/L and averaged 7.7 ug/L.

A more detailed study of Sacramento River inflows is needed to better understand the sources of THM precursors. Also, waste effluents, both municipal and industrial, that are discharged to the river or its tributaries should be reviewed and possibly sampled for TTHMFP.

Sacramento River at Mallard Island

Sacramento River at Mallard Island is the most bayward station monitored. Monitoring at the station did not begin until May 1985 and has a shorter period of record than other stations. Since 1985 was a dry year and Delta outflows were low, water at this station contained a considerable amount of sea water (EC 10,000+ umhos). Figure THM-8,shows TTHMFP, THM bromide and Delta outflow. The high proportion of brominated species at this station, demonstrates the influence of sea water. Also, THM bromide levels increased at the Rock Slough and the Clifton Court stations on Old River during this same time period. In February of 1986 heavy precipitation resulted in very high Delta outflows which moved the saline water out of the Delta. Bromide levels declined to less than 100 ug/L during this period. The high outflows lasted until May 1986. After May the Delta outflow began to decrease and by July the net Delta outflow only averaged 4,324 cfs for the month. The THM bromide levels began to increase and peaked at over 1,000 ug/L in September. TTHMFP levels at this station increase when low Delta outflows exist that allow bay water to move to this location. As stated in the discussion of the Vernalis station, the TTHMFP increase is mostly due to the higher molecular weight of bromine. During the heavy precipitation in early 1986 the resulting high Delta Outflow pushed the sea water out of the area and the TTHMFP decreased from a high of over 1300 ug/L to about 600 ug/L. During the study period the TTHMFP ranged from 471 to 1359 ug/L and averaged 850 ug/L. THM bromide ranged from 14.9 to 1206.4 ug/L and averaged 617.7 ug/L.

Figure THM-9, shows chlorophyll plotted with TTHMFP. There was only one period when chlorophyll exceeded 20 ug/L. This occurred in June 1986 and was near the end of several months of high flow in the Sacramento and San Joaquin rivers. Since chlorophyll data was not collected on the same day as TTHMFP, the high rate of mixing and water exchange may be one reason for lack of correlation.

American, Cosumnes and Mokelumne Rivers

TTHMFP and bromide concentrations in these rivers are considerable lower then in the Sacramento and San Joaquin rivers. Figure THM-10 shows TTHMFP for the Cosumnes and Mokelumne rivers. There was one exceptionally high TTHMFP value in the Cosumnes River in December 1983. The TTHMFP concentration was 837 ug/L and was probably due to surface runoff caused by heavy precipitation that occurred at that time.

TTHMFP in the American River ranged from 154 to 387 ug/L and averaged 236 ug/L. THM bromide ranged from 1.5 to 9.9 and averaged 3.5 ug/L. Figure THM-11 shows TTHMFP for the American and Sacramento rivers. The graph provides a comparison of the two streams. As can be seen on the graph some of the TTHMFP peaks coincide. Further investigation would be required to understand why this takes place.
TTHMFP in the Cosumnes River ranged from 135 to 837 ug/L and averaged 251 ug/L. THM bromide ranged from 1.9 to 6.1 ug/L and averaged 3.8 ug/L.
TTHMFP in the Mokelumne River ranged from 115 to 425 ug/L and averaged 250 ug/L. THM bromide ranged from 1.5 to 4.5 ug/L and averaged 2.4 ug/L.

Agricultural Drainage From Delta Islands

Agricultural drainage of three Delta Islands; Empire, Grand and Tyler were monitored during the study period. Figure THM-12 shows TTHMFP values for all three islands for comparative purposes. Figure THM-13, THM-14 and THM-15 shows TTHMFP and THM bromide for Empire Tract, Grand Island and Tyler Island respectively. Drainage from all of the islands contains high concentrations of TTHMFP and THM bromide. The graphs show large fluctuations in TTHMFP.as would be expected in agricultural drainage. Empire Island TTHMFP ranged from 998 to 7458 ug/L and averaged 2945 ug/L. THM bromide ranged from 21.7 to 1239.1 ug/L and averaged 454.4 ug/L.
Grand Island TTHMFP ranged from 273 to 3636 ug/L and averaged 1517 ug/L. THM bromide ranged from 9.3 to 91.7 ug/L and averaged 34.6 ug/L.
Tyler Island TTHMFP ranged from 1064 to 4293 ug/L and averaged 2115 ug/L. THM bromide ranged from 24.3 to 169.0 ug/L and averaged 58.3 ug/L.

Old River at Rock Slough, Clifton Court and Delta Mendota Canal Intake

These stations are the major points of water export from the Delta. All are located on Old River and exhibit similar water quality characteristics. Because of these similarities, these three stations are discussed together.

TTHMFP at Rock Slough ranged from 225 to 775 ug/L and averaged 469 ug/L. THM bromide ranged from 8.4 to 281 ug/L and averaged 63.7 ug/L. Figure THM-16 shows a plot of the TTHMFP and THM bromide and Figure THM-16A shows TTHMFP, chlorophyll and Delta outflow for this station. Delta outflow was negative (reverse flow) late in 1985 which was a factor in increasing THM bromide and TTHMFP at that time.

TTHMFP at Clifton Court ranged from 174 to 910 ug/L and averaged 493 ug/L. THM bromide ranged from 14.2 to 250.1 ug/L and averaged 58.3 ug/L. Figure THM-17 shows a plot of TTHMFP and THM bromide and Figure THM-17A shows TTHMFP, chlorophyll and Delta outflow for this station. Again at the Rock Slough station effect of the negative outflow on THM bromide and TTHMFP is apparent.

TTHMFP at Delta Mendota Canal Intake (DMC) ranged from 222 to 797 ug/L and averaged 479 ug/L. THM bromide ranged from 14.2 to 201.4 and averaged 66.4 ug/L. Figure THM-18 shows the TTHMFP and THM bromide for this station.

Timing of fluctuations in and values for TTHMFP and bromide are very similar for Clifton Court and Delta Mendota Intake. Figure THM-19 shows Clifton Court and Delta Mendota Intake TTHMFP plotted together to exhibit their similarity. With few exceptions, the concentrations of THM and bromide are a product of the quality of water and volume of flow in the Sacramento and San Joaquin rivers. The high quality of water entering the Delta by way of the Cosumnes and the Mokelumne rivers should have some favorable impact on water quality at the subject stations. But, because of their low flow volume the effect is not discernable.

Factors other then the major river inflows that adversely effect Delta water quality are agricultural drainage from Delta Islands, phytoplankton blooms in the southern and central Delta and reverse net outflows that allow sea water intrusion to occur. Figure THM-20 shows THM bromide data plotted for Clifton Court and Vernalis. The effect of sea water intrusion can be easily recognized from the plots of bromide data. Higher concentrations of bromide at Rock Slough (see Figure THM-16) and Clifton Court during the last six months of 1985 are the result of the reverse flows. This intrusion entered Old River as far as Clifton Court, but did not reach the DMC intake in significant amounts.

Chlorophyll data was collected at Clifton Court and near Rock Slough. Figure THM-21 shows TTHMFP and chlorophyll data for Clifton Court and Figure THM-22 shows the same data for Rock Slough. The graphs of this data show increase TTHMFP values in response to the bloom conditions at both stations.

Figure THM-23 was prepared using Clifton Court chlorophyll and DMC TTHMFP data. The same direct TTHMFP increase response to increased chlorophyll concentrations was evident. While these responses are obvious on the graphs, there is, in several instants, a month time lag between the peak chlorophyll and TTHMFP values. The lag is a result of the chlorophyll and TTHMFP samples not being collected at the same time of the month. Dates of sampling are marked on the graphs Future studies should include coordinated monitoring of TTHMFP and chlorophyll data.

Based on the data collected to date, it appears that during the normal type water year, the major source of THM precursors and bromides at the export stations is from the San Joaquin River which averaged 172 ug/L TTHMFP higher than the Sacramento River. To illustrate the differences between TTHMFP sources, Figure THM-24 was prepared showing TTHMFP at Greenes Landing, Vernalis and Rock Slough. THM bromide averages for the San Joaquin and Sacramento rivers were 71.7 and 7.7 ug/L respectively. Figure THM-25 was prepared showing THM bromide data for Mallard Island, Vernalis, Clifton Court and Greenes Landing.
Another source of THM precursors and bromide, currently under investigation, is the agricultural drainage from local islands. Although, this source has not been quantified, TTHMFP and THM bromide values collected from the agriculture drains are of a magnitude to cause concern.

2. Characteristics of Water Sources

The chemistry of a water source is the result of the mineralogy and chemical input of the surrounding environment. When water sources from different areas are chemically characterized, changes attributed to mixing can be measured. Standard practices include the measurement of salinity, electrical conductivity, and concentrations of natural and synthetic tracers such as elements, dyes, and contaminants. In the lower Delta, E.C. measurements can reflect bay water and land derived salts mixing with upstream freshwaters. Discriminating the sources cannot always be accurately made with E.C. measurements alone when multiple sources of highly saline water exist.

In studying the effects of bay water intrusion and freshwater flow on Delta export water quality, the comparison of specific molar ion ratios appears to be a useful tool in addition to E.C. and concentration measurements in identifying the sources and mixing of water types.

In open ocean waters the relative abundance of major ions is nearly invariant regardless of salinity differences. The major ions in seawater are shown in Table ??? (Major Constituents of Seawater) Sodium and chloride are the major ions in seawater with concentrations of about 10,500 mg/l and 19,000 mg/l, respectively. The molar ratio of Na to Cl is about 0.85. Ratios with other constituents such as calcium, potassium, magnesium, and sulphate can also be useful. However, analyses for these ions in Delta waters began recently. Meanwhile, sodium to chloride molar ratios will be used as the conservative behavior of these two highly water soluble elements make them good tracers.

When the mean molar ratios of two distinct water sources are plotted on a line graph, mean ratios between these two values represent the theoretical mixing of the two water types. In figures (??? Theoretical Mixing Lines) the molar Na:Cl ratios at Sacramento River at Greenes Landing and at Mallard Island are used to represent major freshwater and baywater sources, respectively. Molar ratios of some Delta stations known to have water quality resulting from these two major water sources are plotted along the line joining the Greenes Landing and Mallard Island molar ratios. The y-axis (percent mixture) indicates the theoretical proportion of fresh and bay water at the stations. The graph is used as a simple approximation and excludes the effects of Delta agricultural drainage and flow patterns at the stations. However, it is interesting to observe the relative similarities in molar Na:Cl ratios at some stations under different hydrologic conditions.

The average sodium:chloride molar ratios at Mallard Island ranged from slightly above 0.8 to as much as 1.2 depending on seasonal hydrology (Figure ??? "Theoretical Mixing by Calendar Quarter" figure and Table ??? "Ion Ratios by Calendar Quarters"). The higher ratios were observed when Delta outflows were exceptionally high during the record flows of February and March 1986. When Delta outflow was low, the molar ion ratio resembled seawater as Mallard Island water quality is subject to tidal excursions. The ratios could, therefore, be used to identify the geographical extent of a salinity wedge and to estimate the amount of bay and fresh water mixing at a location.

Sacramento River at Greenes Landing sodium and chloride water concentrations are more variable than in the open ocean. Molar Na:Cl ion ratios averaged from 2.3 to 2.5 for the first, second, and fourth calendar quarters. The mean ratio was higher at about 2.9 for the period of July through September. However, because freshwater is significantly lower in sodium and chloride concentrations than in seawater, small changes in their measured concentrations effect the calculated ratios significantly making them appear to be more variable. Nevertheless, the molar ion ratios along with other water quality data enables water characterization of this station and others.

The plotted mean Na:Cl molar ratios show that much of the water in the CVP and SWP and surrounding stations (Rock Slough, Middle River) are more chemically similar to Mallard Island water than Greenes Landing water. However, the lower ratio could also be attributed to agricultural drainage during certain times of the year. Ratios of water taken from the San Joaquin River near Vernalis station also indicated saline water but not as a result of seawater intrusion to the Vernalis station. The similarity in ratio can be explained by the fact that the major water source for the San Joaquin River is the CVP and SWP. The ratio, therefore, shows CVP and SWP waters being returned to the Delta via the San Joaquin River from Central Valley agricultural drainage. The slightly higher molar ratio at Vernalis is likely due to the mixture of upstream freshwater releases (e.g. Merced, Tuolomne) with agricultural drainage. Data collection upstream of Vernalis at the other tributaries would significantly improve characterizing the Vernalis mixture.

Molar ion ratios in Delta agricultural drainage are more difficult to understand as there is much more variability attributed to soil composition, applied water volume, and channel water quality. Data to characterize water quality of Delta drainages are extremely limited to a few tracts and islands. Depending upon location, time, and hydrologic conditions, the chemical molar ion quality of drainages will be dependent on the applied water quality and use of farm chemicals and soil amendments. For example, calcium and sulfates are salts typically used in a variety of farm chemicals. Studying the mineral quality of drainage will help identify and assess their impact on water quality. Some data collection efforts are underway by the Department's Delta Agricultural Drainage Investigation and in this program but more stations need to be established.

Yearly Observations

For most stations, water quality monitoring began in July 1983. Water year 1983 was classified as wet with the March average almost reaching 400,000 cfs and remaining above 20,000 cfs through the calendar year. The high flow created a strong natural hydraulic barrier against seawater intrusion and the Delta as seen by low E.C. values and high molar ratios. Ratios were 1.3 to 1.5 from July through December at the Banks Headwords and Clifton Court Intake (Table ???; "Ion Ratios at Banks Headworks and Clifton Court Intake"). Electrical conductivity were generally less than 300 at the two stations (Figure ??? "Electrical Conductivity 1985-87 Mallard Island, Rock Slough, and Clifton Court intake stations). Molar ratios appeared steady at the other Delta stations and corresponded with steady flows during the last half of the year (Figure ??? "Molar Ion Ratios 1985-87 Mallard Island, Rock Slough, and Clifton Court intake stations").

In 1984 the Delta Outflow Index averaged above 30,000 cfs through March but then fell below 14,000 cfs from May to October. Summer flows were 10,600 cfs in May, 8,000 cfs in June, and 9,800 cfs in July. Molar ratios at Banks and at the Clifton Court Intake were above 1.3 except for June when the Banks ratio was about 1 corresponding to the low June Delta outflow.

In 1985 the ratios at Rock Slough at Old River corresponded to QSAC 5-day averages. The ratios rose from about 1.4 to 1.8 in January through April, thereafter, steadily falling to about 1. The 5-day QSAC flows gradually declined from June to November. Water year 1985 was classified as being dry.

At Mallard Island the ratio was steady at 0.9 to 0.8 from May to December. There was no data to calculate ratios prior to May 1985 at this station. The 5-day QOUT flows were calculated to be near zero or negative, thereby, indicating a reverse flow condition. At Vernalis the ratio fell from 1.7 to 1.3 corresponding to QSJR flows falling from about 4000 cfs in January to 2000 cfs in December. The lower ratio could be attributed to the return of CVP and SWP waters via agricultural drainage.

Vernalis E.C. resembled export water E.C. during the last half of 1985 suggesting that the San Joaquin River might have been a major source of export water (Figure ??? "Electrical Conductivity 1983-87 Vernalis, DMC, and Banks stations"). The molar salt ratio differentiated between the water types leading to the conclusion that the quality of export water was more similar to water flowing into the southern Delta through Old and Middle rivers as QSJR flows were relatively low and unchanged from 1984 (Figure ??? "Molar Ion Ratios 1983-87 "Vernalis, DMC, and Banks stations").

The molar ratios at Banks and Clifton Court intake reflected the low outflows and higher salinity conditions as ratios were high (1.3-1.4) during the early months of the calendar year but progressively decreased after July with ratios under 1 in October through December.

February 1986 will be remembered for the historic rainfall that resulted in extensive flooding in the Sacramento Valley. The ion ratios at Mallard Island rose from 0.8 to 1.5 reflecting the increased freshwater flows. The ion ratio returned to about 0.85 in May and stabilized through September 1986.

The high March flows led to high molar ratios (1.3 and higher) at Banks and the Clifton Court Intake. Clifton Court intake water resembled Rock Slough water through August.

The Vernalis station ratio peaked to 1.6 in March corresponding to high QSJR flows of about 24,000 cfs. The ratio then declined as QSJR flows fell.

Monthly molar ratios reflected the dryness of 1987 as June through December ratios were less than 1.1 at Banks and the intake.

As more data are collected under different hydrologic setting and at more stations in the interior Delta, it will become more possible to measure the effects of Delta outflow, bay water intrusion, and agricultural drainages on export water quality.

3. Clifton Court Forebay Water Quality

Clifton Court Forebay serves as a storage facility for Delta water pumped by the State Water Project. The shallow Forebay averages about 30 feet deep and has a storage capacity of 31,260 acre-feet. Water enters through the Clifton Court intake via gates operated by DWR. Precipitation is the only other known input of water. Exportation begins when water is pumped out by the

Harvey O. Banks Pumping Plant. Data were examined to assess water quality changes that might be attributed to biological productivity and mixing in the Forebay.

A preliminary analysis showed no data for water samples taken inside the Forebay. Analysis is therefore limited to data taken at the intake and Banks Headworks. Daily pumped volumes and monthly water quality data collected from the intake and Headworks were examined. The daily flow data were used to calculate monthly exchange rates and water residence times in the Forebay. The daily flow records showed that pumping at Banks and at the Forebay intake were closely synchronized and about equal in volume to achieve near steady state when pumping occurred. Statistical computations were made to compare the flow volumes by month. The daily low, high, average, and standard deviations by month were computed. However, because of the large range of daily flows within some months, the average values and monthly exchange rates and water residence times may not accurately reflect the true operating conditions in the Forebay for that particular month.

Table ??? ("Clifton Court Intake and Banks Headworks Pumping Data") shows the low, high, monthly total, mean, and standard deviation of pumping at the Forebay Intake gates and Banks Headworks in acre-feet and average monthly exchanges of water and residence time of Forebay waters. The water residence time was estimated by dividing the Forebay volume (31,260 A.F.) by the mean daily pumped volume. The exchange rate was estimated by dividing the monthly total volume pumped by the Forebay volume (31,260 A.F.).

The median residence time is about 5 days and median volume of water exchanged per month about 5. The highly variable pumping schedule can be seen by the range of high and low daily volumes for some months. Pumping ceased on some days and exchanged volumes were less than 1 when there was no pumping for several days. For example, in April 1983 about 7,000 A.F. was the total volume pumped. Molar ion ratios are shown in Table ??? (Molar Sodium to Chloride Ion Ratios by Month and Year--Banks and Clifton Court Intake"). The table shows the months when bay water was exported more frequently during different water year types.

The effects of reduced circulation in the Forebay on SWP water quality was examined with the limited data available. The total THM formation potential changes at Banks from the Forebay Intake were compared by month (Table ??? "Total THM Foramtion Potential Concentrations by Month and Year--Banks and Clifton Court Intake"). Table ??? (Chloroform Percentage by Wt. of TTHMFP by Month and Year at Banks Headworks and Forebay Intake) shows the percentage of chloroform in TTHMFP analyses of monthly water samples at the two stations. Chloroform was chosen for study as the higher percentage by weight of chloroform indicated more freshwater in the Forebay as brominated THMs tend to correlated with sea water.

At Banks and the Intake, the higher chloroform percentages (70 percent or better) correlated with the wet year water quality of 1982, 1983, 1984, and 1986. The effects of drier year water quality conditions were seen for 1985 and 1987 as chloroform percentages were less than 70% in the late summer and fall.

Total THM and brominated THM concentrations over time are shown in Figure ??? ("Clifton Court and Banks Pumping Plant" with legends for THM and Br).

4. Pesticides

Through a selection protocol based on pesticide usage patterns and environmental behavior, water samples are collected for specific pesticide analyses (Appendix D: Pesticide Monitoring Selection Scheme). The data are used to identify potential contamination to raw water supplies and at treatment plants. Attention is focused on chemicals that might present treatment difficulties, such as the highly water soluble compounds. Less soluble compounds tend to be removed more readily by flocculation, settling, and filtration processes because they are generally associated with suspended particulate matter such as silt and clays.

The selection protocol produces a site- and time-specific target list of pesticides for monitoring to improve chances of detecting any chemicals in the water and to eliminate the need for expensive broad scans for hundreds of chemicals. Instead, the target list includes specifically named chemicals and those detectable under the same analystical method. The target lists are developed from the California Department of Food and Agriculture annual pesticide use database, which were sorted by counties and chemicals. chemicals that are water soluble or in high use are identified for each watershed and county where sampling locations are located. The period of application or use of each chemical is also included in the database. Identified chemicals then appear on the monthly target lists for each sampling station.

Sampling primarily focused on the application period (summer), with a sampling run in winter (first major runoff event), and a run in early spring (pre-emergent herbicide applications).

The results are shown in Tables ????. Laboratory quality control and quality assurance results are in Appendix E: Laboratory Quality Assurance.

Almost all of the targeted chemicals were below the analytical detection limit by the laboratories under contract to the Department for this study. Starting in July 1987, Enseco (formerly California Analytical Laboratories) Laboratories became the contract laboratory under the state bidding process. Prior to then, the contractor was Clayton Environmental Consultants (formerly McKesson Environmental Services). Laboratory quality assurance data with Clayton were reported in previous reports of this study during 1987.

Reported chemicals were generally below the State Action Levels for drinking water or were near the low level detection limits of the laboratories. These results indicate that pesticide contaminants are not a major problem to the drinking water quality of Delta water supplies.

C. Future Export Water Quality Conditions

The drinking water quality of the Delta water supplies could change in the near future as a result of new construction and water project operations. Some of these proposals are briefly discussed.

1. Proposed Construction Projects

a. Bedford Delta Island Project

The Bedford Properties, Incorporated Delta Island project is a proposal to create water storage reservoirs to impound high winter flows on four Delta Islands. Water would be diverted onto the islands only during periods when the Delta is uncontrolled by State Water Resources Control Board Decision 1485. The stored water would be released during late spring and early summer months when river inflow is low. Discharge from the islands would be completed by late July. Stored water would be sold to the California Department of Water Resources and/or the U. S. Bureau of Reclamation, who would in turn market the water for municipal and agricultural purposes. During the months (August-December) when water is not stored on the islands, they would be revegetated and operated for private duck hunting clubs. The land would be managed to produce wet- land vegetation and would be shallowly flooded in the autumn for waterfowl habitat and hunting.

Applications to the SWRCB Division of Water Rights to appropriate 382,520 acre-feet of water for the project. Bedford have been submitted along with applications to the U. S. Army Corps of Engineers for the construction of siphons and docks pertaining to the project. Except for the locations of intake siphons and discharge pipes, the project would affect only the resources on the interior sides of levees. An Environmental Impact Study is currently underway and numerous permits from a variety of agencies need to be obtained for approval.

The Delta Island Project would be located on Bouldin Island, Webb Tract, Holland Tract, and Bacon Island (Figure 1). The following water storage facilities are proposed for each of the islands:

Bouldin Island: Bedford Properties propose to construct a levee on the south side of Highway 12 across Bouldin Island and create a 96,000 acre-foot capacity reservoir with a surface area of 4,630 acres between the new levee and the existing levee on the south side. The reservoir would be created by gravity flow from Little Potato Slough, the Mokelumne River, the San Joaquin River, and Potato Slough by various existing pipe siphons. The maximum rate of diversion to offstream storage would not exceed 3,000 cubic feet per second (cfs)

Webb Tract: A 106,$00 acre-foot capacity offstream reservoir with a surface area of 5,260 acres is proposed. The reservoir would cover all of the property located within Webb Tract. Water would be diverted to the reservoir by gravity flow from Old River, False River, Fishermans Cut, and the San Joaquin River by various existing siphons and gates in the existing levees. Ten 48-inch diameter pipe siphons would be constructed. The maximum rate of diversion to offstream storage would not exceed 5,000 cfs.

Holland Tract: A 69,050 acre-foot capacity offstream reservoir with a surface area of ,100 acres is proposed and would cover all of the property located within Holland Tract. Water would be diverted to the reservoir by gravity flow from Holland Cut, Rock Slough, Sand Mound Slough, and Roosevelt Cut through various existing siphons and gates in the existing levees and four proposed 48-inch diameter pipe siphons. The maximum rate of diversion to offstream storage will not exceed 3,000 cfs.

Bacon Island: Bedford would create a 110,570 acre-foot capacity offstream reservoir with a surface area of 5,450 acres. The proposed reservoir would cover all of the property located within Bacon Island. Water would be diverted to the reservoir by gravity flow frcm Middle River, Santa Fe Dredge Cut, Old River, and Connection Slough via various existing siphons and gates in the existing levees and 10 proposed 48-inch diameter pipe siphons. The maximum rate of diversion to offstream storage will not exceed 5,000 cfs. The main point of the diversion would be at Connection Slough.

Bedford proposes to flood the islands starting on or about January 1 of each year in which appropriated water is available. The depth of flooding would vary between 3-4 feet above sea level, depending on the characteristics of the particular island. Water would be held at that level until approximately May 1. At that time, the stored water would be pumped back into the natural channels for use by the DWR and the USBR in fulfilling the obligations of water contracts. Pumping would continue until the islands have been dewatered to a moist soil condition. They would remain in this state throughout the balance of the summer months to encourage the growth of waterfowl food plants. Water will not be diverted for storage between May 1 and December 15 of each year.

The applicant intends to divert water under a riparian claim to maintain wetland habitat on the islands between July 31 and December 15. Riparian water will be diverted as needed to flood parcels for waterfowl habitat and duck club use between September 15 and the time of reflooding the islands for water storage after December 15.

On each island, Bedford Properties proposed to develop private duck hunting clubs consisting of a clubhouse and related facilities. The islands would be revegetated in the summer and managed during fall and early winter to maximize wildlife usage and hunting opportunities for club members.

In view of the size of the project, potential for increased total THM formation potential, and proximity to the SWP and CVP, water quality is a major concern.

b. South Delta Water Problems

Agriculture in the southern Delta relies heavily on south Delta channels for crop irrigation. Problems resulting water levels, circulation, local drainage, and inflowing channel water quality have occurred.

Pumps and siphons used to take water from the channels need adequate draft. To maintain sufficient water in the Tom Paine Slough area during low tide, a tidal gate has been installed at the lower end. However, inspite of high tides, at times there is insufficient head on the outside of the slough to force water into the slough for local diversion. This condition is further aggravated by the CVP and SWP diversions during high tides.

In the Middle River area because of silt buildup at its upper reach, the river can go dry when local diversions exceed the river's capacity to convey water to the diversion points. In this case, the condition is exacerbated by CVP and SWP diversions at low tides.

Channel water quality problems occur because of the inflow of San Joaquin River and local agricultural drainage returns resulting from poor circulation. High local diversion rates pull water from both ends of the channel where irrigation return discharges occur (Figure ???; DWR-347). This cycling results in undesirable water quality for crops.

In response to these problems, both the Department and Bureau of Reclamation have been working with the South Delta Water Agency in implementing interim solutions and a plan for a permanent solution.

Interim mitigation provides for dredging and construting needed siphons in Tom Paine Slough and building a seasonal tidal barrier in Middle River (Figure ???; DWR-349--Figure 2). In addition, the Department will operate the Clifton Court intake gates according to criteria defined in the interim agreement (Appendix G).

The Bureau agreed to release water from New Melones Reservoir to maintain at the San Joaquin River near Vernalis station: (1) a 7-day running average minimum of 500 cfs, (2) a 14-day running average TDS of 450 mg/l throughout the April-October irrigation season, and (3) meet other criteria in the interim agreement.

Permanent solutions are under study (Figure ???; DWR-349--Figure 3). A combination of alternatives include:

Physical Facilities

- Middle River tide gate
  - Near Highway 4
  - Near Tracy Road Bridge
- Old River tide gate with boat lock
- Flow restrictors
- Grant Line Canal tie gate with boat lock near DMC intake
- Tom Paine Slough pumps and siphons
- Additional intake to Clifton Court Forebay
- Enlarged Clifton Court Forebay with new gate at north end

Dredging

- Tom Paine Slough
- Old River West of Sugar Cut
- Middle River between Old River and Highway 4
- Victoria Canal and Middle River north of Highway 4

Modification of Project Operations

With respect to drinking water quality, it is uncertain how export water quality might be affected in the future. In a special study of Old and Middle River mineral quality during different tide stages, a high saline source of water near Victoria Canal was observed in (October??) 1986. A combination of San Joaquin River and local drainage are the suspected source. Samples for trihalomethane formation were not collected so there is no data to indicate if there might also be a high THM precursor source.

Water quality monitoring needs to be extended to collect background and monitor changes attributed to the proposed solutions.

2. Proposed Water Quality Standards

Changes in water quality standards and regulations could also determine if additional treatment of water supplies might be necessary.

a. EPA THM drinking water standard

A lower trihalomethane drinking water standard is under review by the Environmental Protection Agency. The current standard is 100 ug/l for finished water. The relationship of total trihalomethane formation potential and distributions system THMs are being studied by the Metropolitan Water District of Southern California.

Export water quality have high THM formation potentials because of high organic matter and bromides. The primary source of bromides is seawater. DWR data also indicates that agricultural drainages are a potential major source of THM precursors.

Depending on how much the THM drinking water standards are lowered, treatment costs are expected to rise. If the Metropolitan Water District of Southern California was forced to use granular activated carbon filtration for further THM reductions, the estimated costs for installation range from $500 million to $5 billion with annual costs of $90 million to $744 million. They concluded that if THM precursors were reduced at the water source (Delta), there would be dramatic reductions in the capital and operating costs of treatment to meet a new low THM standard.

b. SWRCB Bay-Delta Water Rights Hearings

The State Water Resources Control Board is currently in the second phase of Bay-Delta Hearings on salinity control and pollution policy making. As with Decision 1485, the Board's decision on modifying any Delta water quality standards would effect CVP and SWP operations. The Department has recommended changes in chloride standards. These include:

1. Eliminating the 250 mg/l chloride standard at the City of Vallejo intake at Cache slough because the Vallejo diversion will be moved to the North Aqueduct intake.

2. Adding a 250 mg/l chloride standards at:
   a. the North Bay Aqueduct intake at Barker Slough.
   b. Contra Costa Canal--Old River near Rock Slough
   c. North Bay Aqueduct--Cache Slough near Junction Point

3. Eliminating the 150 mg/l chloride standard at Contra Costa Canal or Antioch.

The proposed construction and standard changes point to the need to increase monitoring of Delta water quality prior to and after such changes occur.

FILE:REFERS.DOC

California State Water Resources Control Board, Water Right Decision 1485, Sacramento-San Joaquin Delta and suisun Marsh, August 1978.

California Department of Water Resources, Investigation of the Sacramento-San Joaquin Delta, Report No. 4, Quantity and Quality of Waters Applied to and Drain from the Delta Lowlands, July 1956.

Committee for Delta Resources Improvement, Working Paper Regarding the Sacramento-San Joaquin Delta/San Francisco Bay Estuary, December 1986.

California Department of Water Resources, California Water: Looking to the Future, Bulletin 160-87, November 1987.

California Department of Water Resources, Sacramento-San Joaquin Delta Atlas, August 1987.

California Department of Water Resources, DAYFLOW Program Documentation and DAYFLOW Data Summary, February 1986.

Department of Water Resources, Water Quality Conditions in the Sacramento--San Joaquin Delta During 1983, August 1984.

Department of Water Resources, Water Quality Conditions in the Sacramento--San Joaquin Delta During 1984, August 1985.

Department of Water Resources, Water Quality Conditions in the Sacramento--San Joaquin Delta During 1985, August 1986.

Department of Water Resources, Water Quality Conditions in the Sacramento--San Joaquin Delta During 1986, August 1987.

Figures and Tables (Temporary List)
by order of appearance and report sections

NOTE: These tables and figures are in draft form; not all may be in the final report as some can be combined or eliminated. Readers suggestions are welcomed.

Section: Floods

Atlas Figure 29: Islands Posing Threat to Water Quality if Permanently Flooded.

Atlas Figure 23: Islands Flooded Snce 1980.

Section: Water Exportation and Diversions

Atlas Figure 16: Water Development Facilities.

Exhibit DWR 62: Flow Distribution with Exports Illustrating Carriage Water.

Exhibit DWR 63: Export-Outflow Requirements.

Section: Flows and Patterns

Exhibit DWR 46: Delta Hydrologic Scheme Used In DAYFLOW.

Exhibit DWR 43: Location Map Key Water Quality and Flow Stations.

Exhibit DWR 78: DELFLO and DELSAL Grid.

Exhibit DWR 51C: Delta Circulation Patterns Low Flows Low Export.

Exhibit DWR 51D: Delta Circulation Patterns Low Flows High Export--Delta Cross Channel Open.

Exhibit DWR 51E: Delta Circulation Patterns High Flows High Export--Delta Cross Channel Open.

Section: Total Trihalomethane Formation Potential

FIGURES labelled THM-1 through THM-25

Section: Characteristics of Water Sources

Table--Major Constituents of Seawater

Figure--Theoretical Mixing of Delta Waters Based on Na:Cl Ion Ratios--1984.

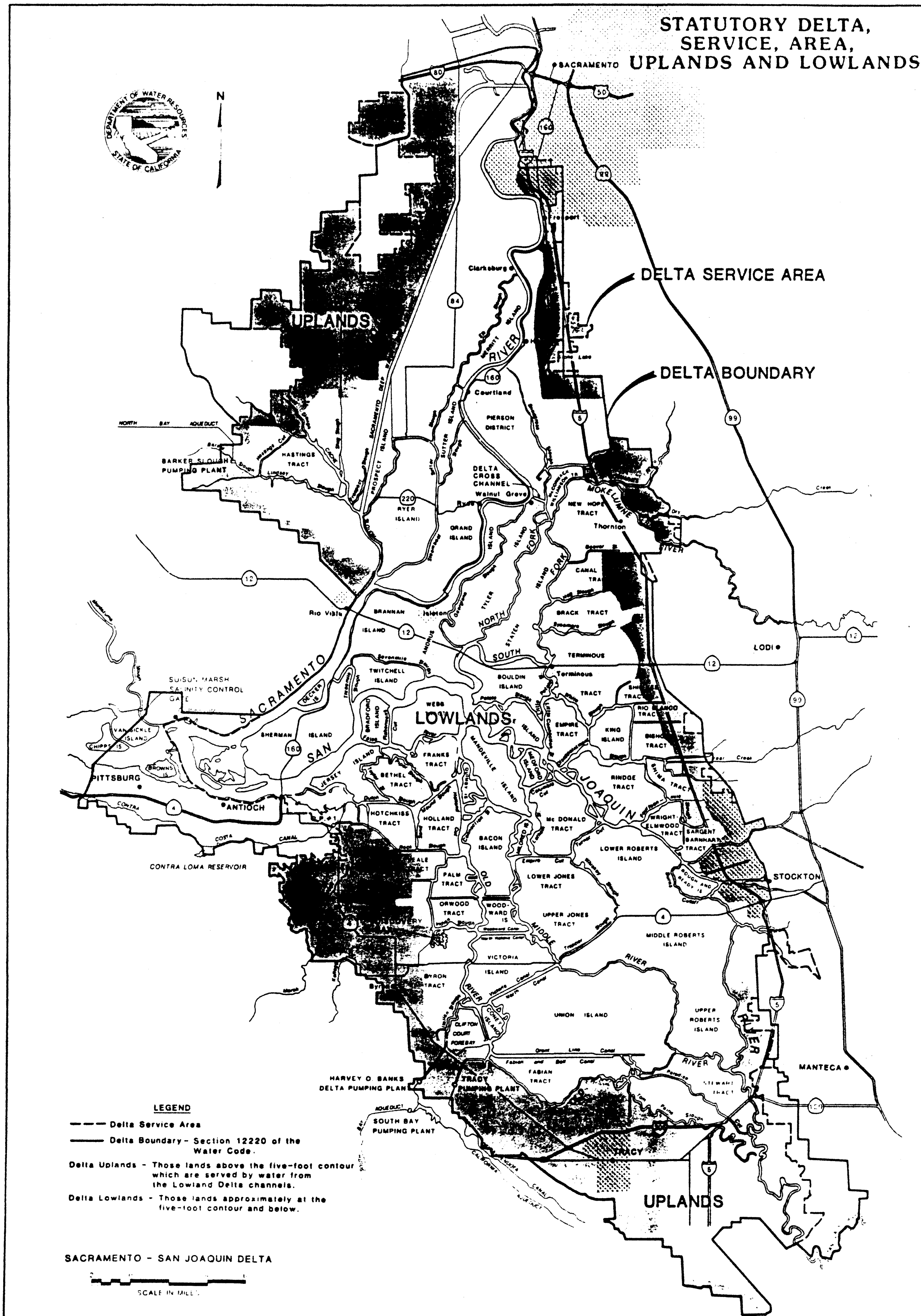
Figure--Theoretical Mixing of Delta Waters Based on Na:Cl Ion Ratios--1985.

Figure---Theoretical Mixing of Delta Waters Based on Na:Cl Ion Ratios--1986.

Table--Summary of Molar Sodium to Chloride Ion Ratios at All Delta Stations.

Figure---Electrical Conductivity 1985-87 at Mallard Island, Rock Slough, & Clifton Court intake stations.

Figure--Molar Ion Ratios 1985-87 at Mallard Island, Rock Slough, & Clifton Court intake stations.



STATUTORY DELTA, SERVICE, AREA, UPLANDS AND LOWLANDS
DEPARTMENT OF WATER RESOURCES STATE OF CALIFORNIA
N
SACRAMENTO
UPLANDS
DELTA SERVICE AREA
DELTA BOUNDARY
LOWLANDS
UPLANDS
Clarksburg
Courtland
PIERSON DISTRICT
DELTA CROSS CHANNEL
Walnut Grove
NORTH BAY AQUEDUCT
BARKER SLOUGH PUMPING PLANT
HASTINGS TRACT
PROSPECT ISLAND
RYER ISLAND
GRAND ISLAND
NEW HOPE TRACT
Thornton
MOKELUMNE
RIVER
CANAL TRACT
BRACK TRACT
TERMINOUS
Terminous
LODI
Rio Vista
BRANNAN ISLAND
Isleton
ANDRUS
TYLER
NORTH
STATEN
SOUTH
SACRAMENTO
SUISUN MARSH SALINITY CONTROL GATE
TWITCHELL ISLAND
BOULDIN ISLAND
WEBB
SHERMAN ISLAND
SAN
JERSEY ISLAND
BRADFORD ISLAND
BETHEL TRACT
FRANKS TRACT
MANDEVILLE ISLAND
EMPIRE TRACT
KING ISLAND
BISHOP TRACT
RIO BLANCO TRACT
RINDGE TRACT
JOAQUIN
PITTSBURG
ANTIOCH
CONTRA COSTA CANAL
CONTRA LOMA RESERVOIR
HOTCHKISS TRACT
HOLLAND TRACT
BACON ISLAND
Mc DONALD TRACT
WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
LOWER ROBERTS ISLAND
STOCKTON
PALM TRACT
OLD
LOWER JONES TRACT
UPPER JONES TRACT
ORWOOD TRACT
WOODWARD IS
MIDDLE
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
BYRON TRACT
RIVER
UNION ISLAND
UPPER ROBERTS ISLAND
CLIFTON COURT FOREBAY
Grant Line Canal
FABIAN TRACT
RIVER
MANTECA
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
SOUTH BAY PUMPING PLANT
TRACY
STEWART TRACT
LEGEND
Delta Service Area
Delta Boundary - Section 12220 of the Water Code.
Delta Uplands - Those lands above the five-foot contour which are served by water from the Lowland Delta channels.
Delta Lowlands - Those lands approximately at the five-foot contour and below.
SACRAMENTO - SAN JOAQUIN DELTA
SCALE IN MILES

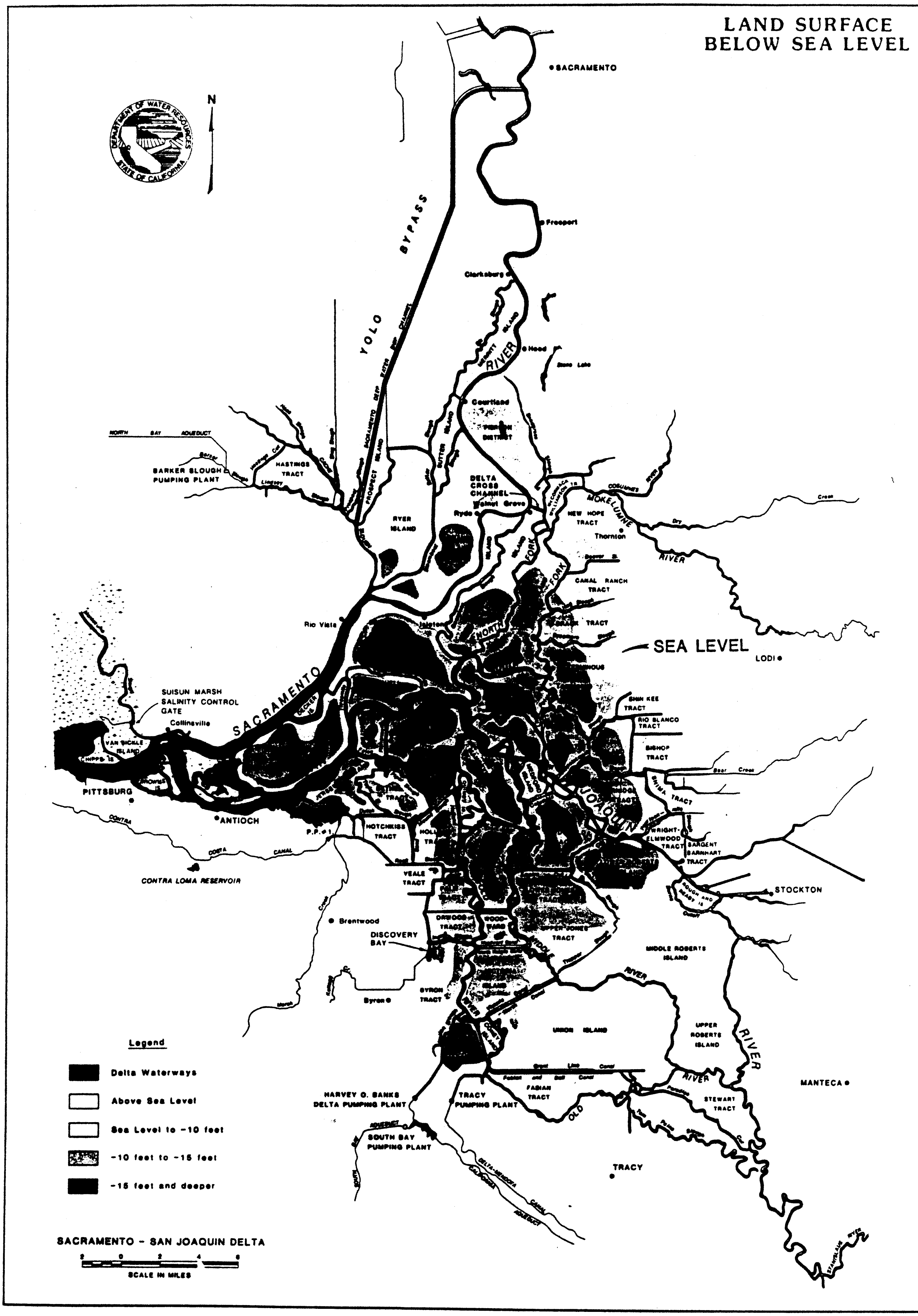

LAND SURFACE
BELOW SEA LEVEL
SACRAMENTO
N
DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA
YOLO
BYPASS
Freeport
Clarksburg
RIVER
Hood
Courtland
DELTA
CROSS
CHANNEL
Walnut Grove
Ryde
NORTH BAY AQUEDUCT
BARKER SLOUGH
PUMPING PLANT
HASTINGS
TRACT
RYER
ISLAND
PROSPECT ISLAND
MOKELUMNE
COSUMNES RIVER
NEW HOPE
TRACT
Thornton
RIVER
FORK
CANAL RANCH
TRACT
TRACT
SEA LEVEL
LODI
Rio Vista
Isleton
NORTH
SUISUN MARSH
SALINITY CONTROL
GATE
Collinsville
SACRAMENTO
VAN SICKLE
ISLAND
CHIPPS IS
PITTSBURG
ANTIOCH
CONTRA
COSTA
CANAL
CONTRA LOMA RESERVOIR
HOTCHKISS
TRACT
P.P. #1
SHIN KEE
TRACT
RIO BLANCO
TRACT
BISHOP
TRACT
Bear Creek
SHIMA TRACT
JOAQUIN
WRIGHT-
ELMWOOD
TRACT
SARGENT
BARNHART
TRACT
STOCKTON
ROUGH AND
READY IS
YEALE
TRACT
Brentwood
DISCOVERY
BAY
ORWOOD
TRACT
WOODWARD
UPPER JONES
TRACT
MIDDLE
MIDDLE ROBERTS
ISLAND
RIVER
Byron
BYRON
TRACT
UNION ISLAND
UPPER
ROBERTS
ISLAND
RIVER
MANTECA
Legend
Delta Waterways
Above Sea Level
Sea Level to -10 feet
-10 feet to -15 feet
-15 feet and deeper
HARVEY O. BANKS
DELTA PUMPING PLANT
TRACY
PUMPING PLANT
FABIAN
TRACT
OLD
RIVER
STEWART
TRACT
SOUTH BAY
PUMPING PLANT
TRACY
SACRAMENTO - SAN JOAQUIN DELTA
2 0 2 4 6
SCALE IN MILES

Table 5

DELTA STATISTICS

Demography

Population: 200,000
Counties: Alameda, Contra Costa, Sacramento, San Joaquin, Solano, Yolo
Incorporated Cities Entirely Within the Delta: Antioch, Brentwood, Isleton, Pittsburg, Tracy
Major Cities Partly Within the Delta: Sacramento, Stockton, West Sacramento
Unincorporated Towns and Villages: 14

Geography

Area (acres):

Agriculture	520,000
Cities and Towns	35,000
Water Surface	50,000
Undeveloped	133,000
Total Acres	738,000

Levees (miles):

Project	165
Direct Agreement	110
Nonproject	825
Total Miles	1,100

Rivers Flowing Into the Delta (These plus their tributaries carry 47% of the State's total runoff):
Sacramento, San Joaquin, Mokelumne, Cosumnes, Calaveras

Diversions Via Aqueducts Through or Around the Delta:
- San Francisco Public Utilities Commission
- East Bay Municipal Utility District

Diversions Directly From the Delta:
- Western Delta Industry
- City of Vallejo
- 1,800+ Agricultural Users
- Contra Costa Canal
- State Water Project
- Central Valley Project

Economy

Valuation (1980):

Land	$1,600,000,000
Pipelines	100,300,000
Marinas	100,000,000
Roads	68,000,000
Gas Wells	26,900,000
Railroads	11,000,000
Utilities	1,300,000
Total	$1,907,500,000

Agriculture:
Average Annual Gross Value = $375 million
Main Crops: Corn, Grain and Hay, Sugarbeets, Alfalfa, Pasture, Tomatoes, Asparagus, Fruit, Safflower

Recreation:

User-Days Annually	12 million
Registered Pleasure Boats	82,000
Commercial Recreation Facilities	116
Public Recreation Facilities	22
Private Recreation Associations	22
Berths	8,534
Docks	119
Launch Facilities	27

Transportation: Interstate Highways 5, 80, 205
State Highways 4, 12, 160
Railroads: Southern Pacific, Western Pacific, Atchison, Topeka & Santa Fe; Sacramento Northern
Deepwater Ship Channels to Sacramento and Stockton transport 6 million tons of cargo annually.

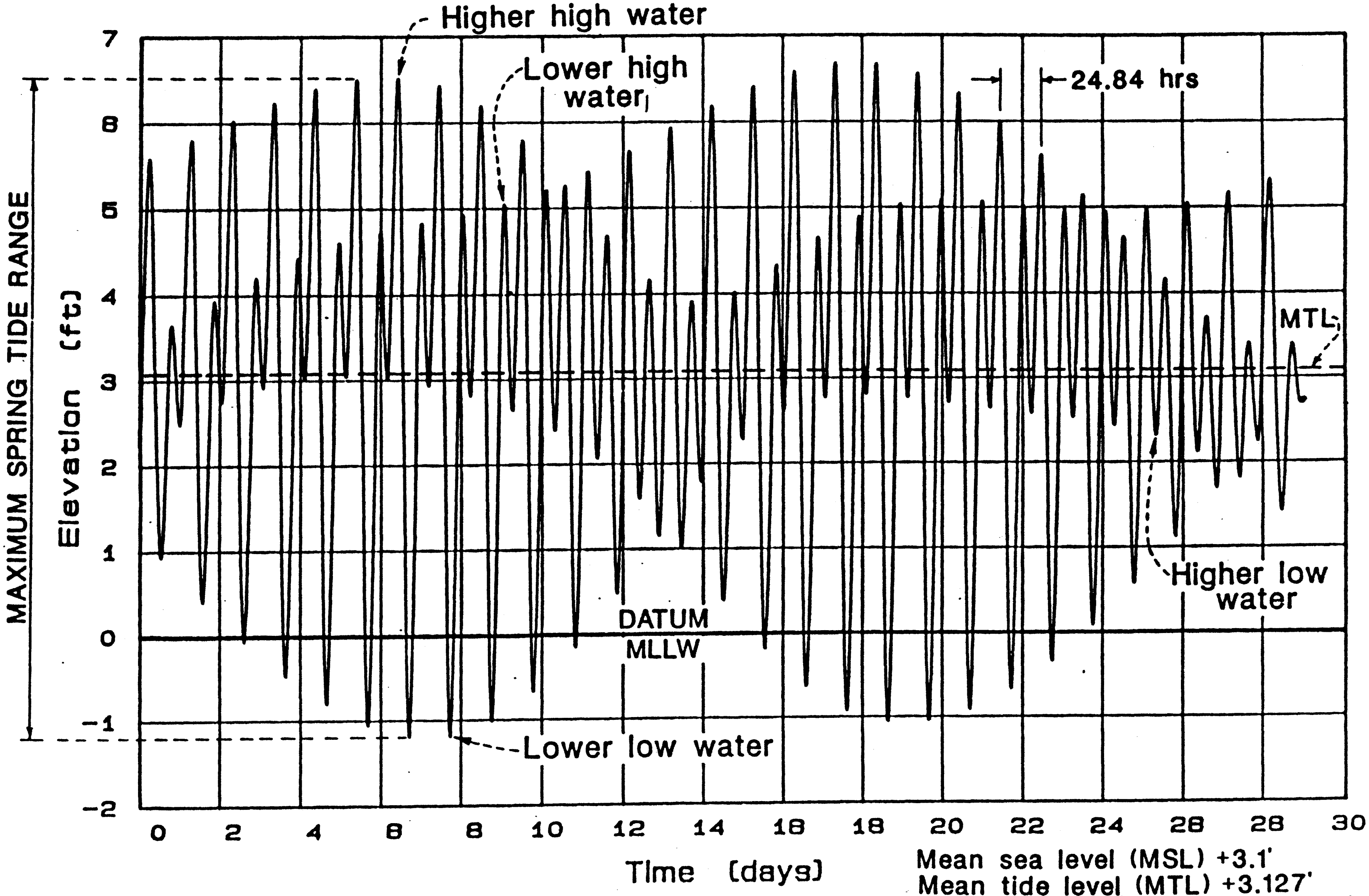
Fish and Wildlife

Birds	200 species
Mammals	45 species
Fish	45 species
Reptiles	15 species
Amphibians	8 species
Flowering Plants	150 species

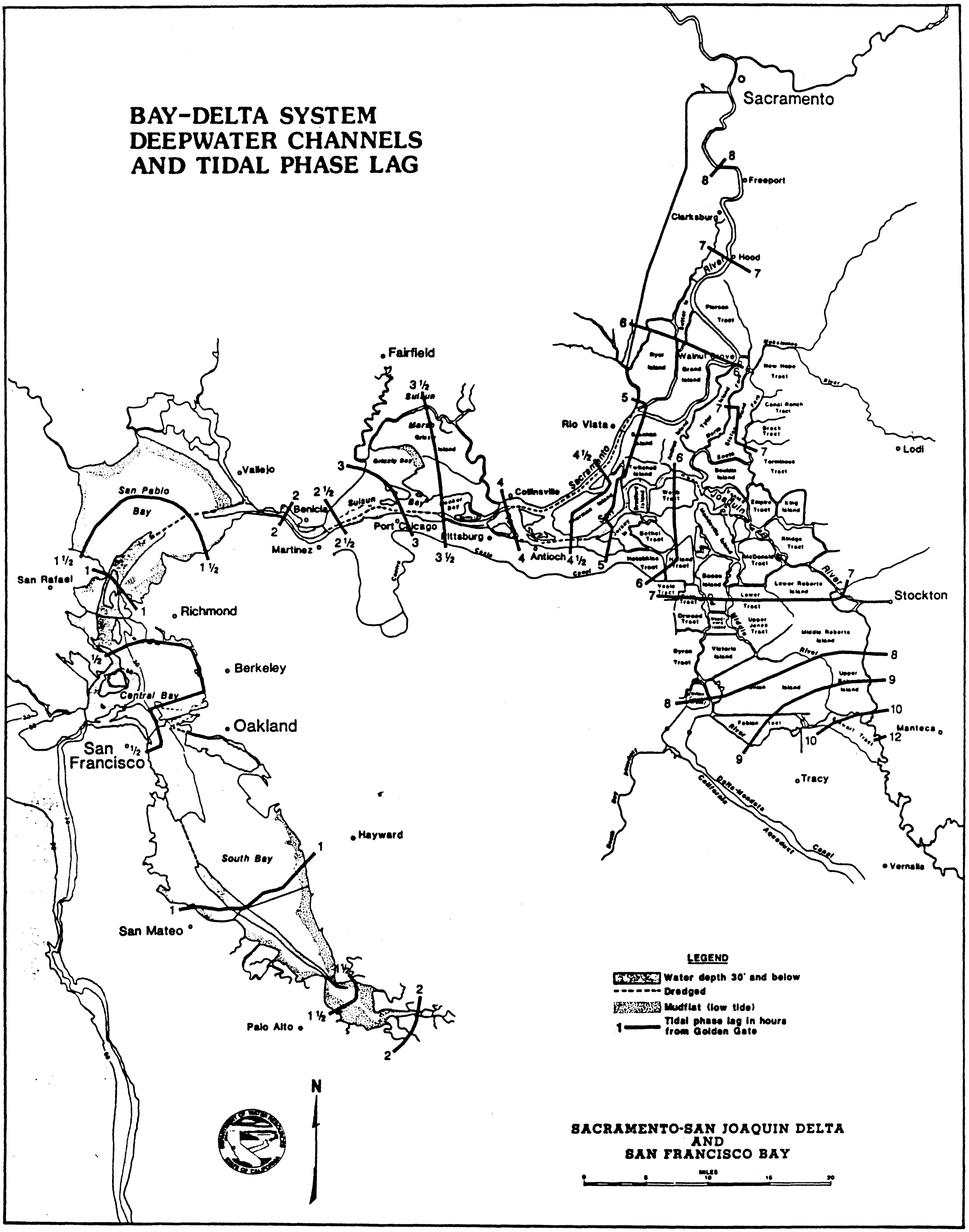
Major Anadromous Fish: Salmon, Striped Bass, Steelhead Trout, American Shad, Sturgeon

DWR-39

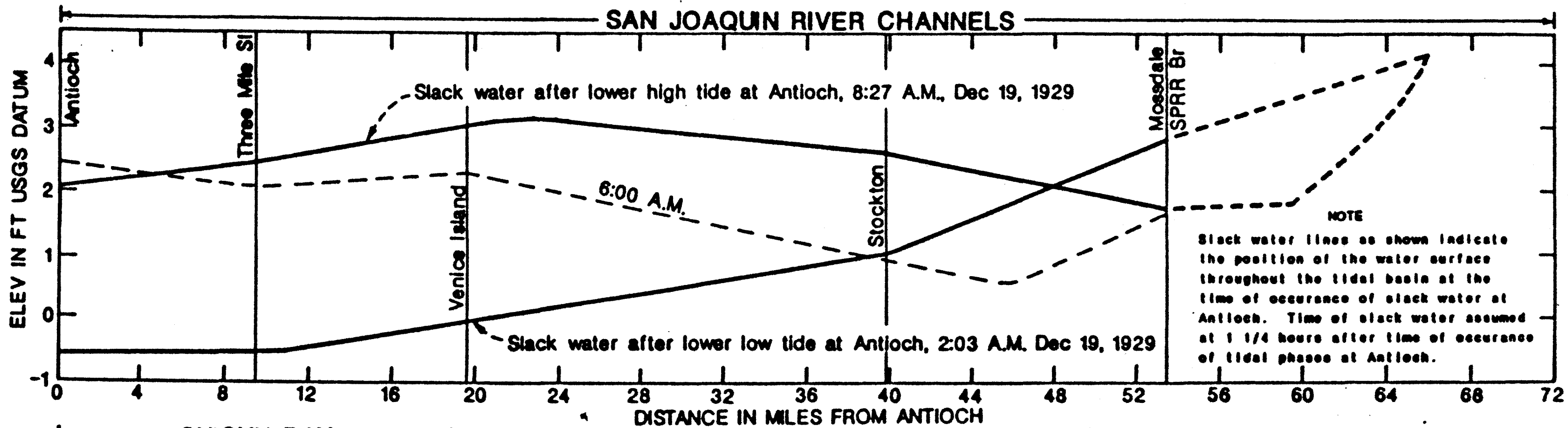
28-DAY, 19-YEAR MEAN TIDAL CYCLE, TIDAL WAVE AT GOLDEN GATE BRIDGE

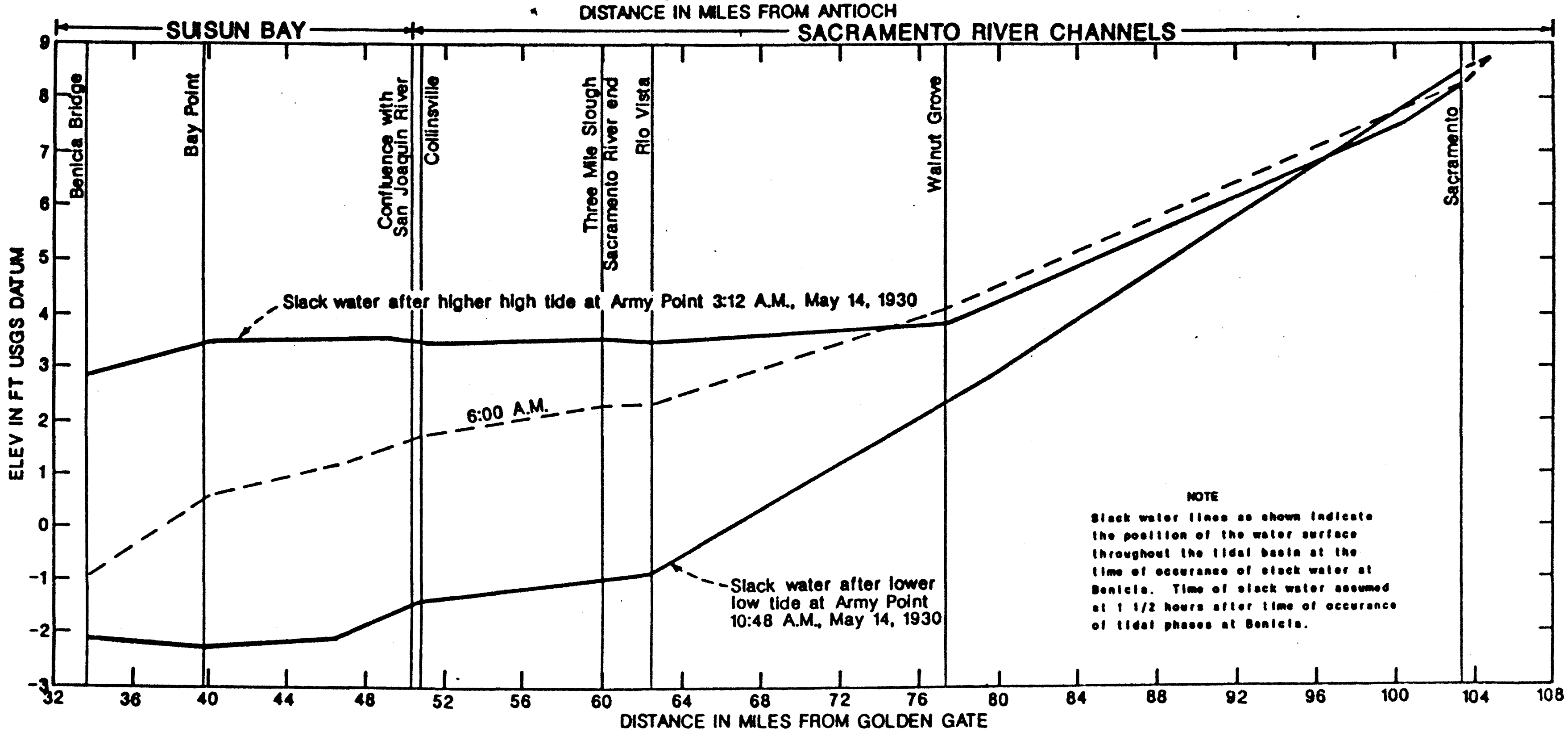


28 Day Variable Tide (NOAA)

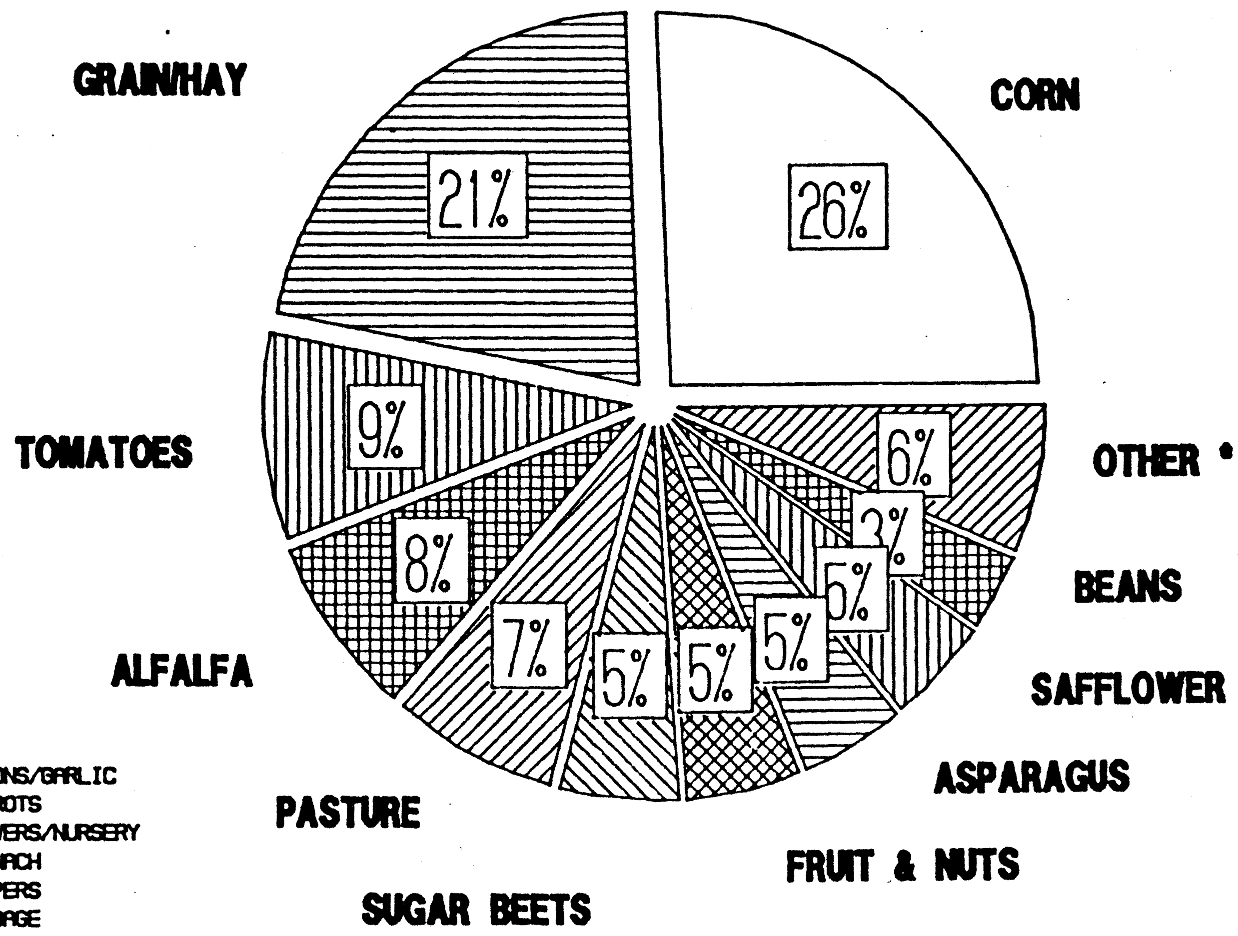

BAY-DELTA SYSTEM
DEEPWATER CHANNELS
AND TIDAL PHASE LAG
Sacramento
Freeport
Clarksburg
Hood
Walnut Grove
Rio Vista
Fairfield
Suisun Bay
Vallejo
San Pablo Bay
Benicia
Martinez
Port Chicago
Pittsburg
Collinsville
Antioch
Lodi
Stockton
Manteca
Tracy
Vernalis
San Rafael
Richmond
Berkeley
Central Bay
Oakland
San Francisco
Hayward
South Bay
San Mateo
Palo Alto
LEGEND
Water depth 30' and below
Dredged
Mudflat (low tide)
Tidal phase lag in hours from Golden Gate
N
SACRAMENTO-SAN JOAQUIN DELTA
AND
SAN FRANCISCO BAY
MILES

DWR-40
INSTANTANEOUS LONGITUDINAL VARIATION IN TIDAL STAGE WITHIN SUISUN BAY AND SACRAMENTO-SAN JOAQUIN RIVER CHANNELS





DELTA SERVICE AREA
CROP ACREAGE DISTRIBUTION (1977/80/81/82/84) [1]



* OTHERS INCLUDE:

SUNFLOWER	ONIONS/GARLIC
MILO	CARROTS
SUDAN	FLOWERS/NURSERY
RICE	SPINACH
POTATOES	PEPPERS
MELONS	CABBAGE
LETTUCE	NON-SPECIFIED

DWR 308

1. 1977/80/81/82/84 ACREAGE OF AGRICULTURAL AND NON-AGRICULTURAL AREAS, SACRAMENTO, SAN JOAQUIN DELTA SERVICE AREA.

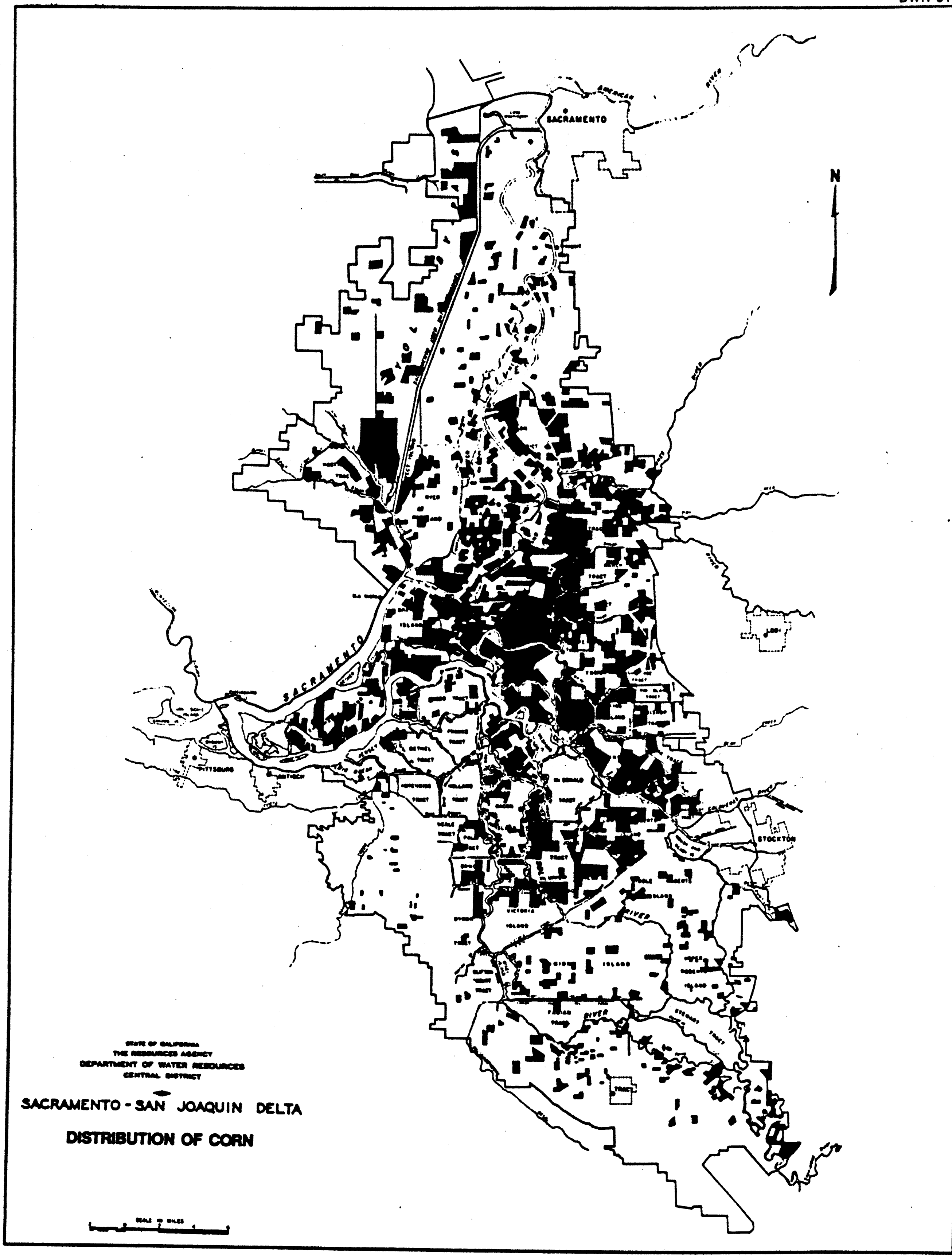
CROP ACREAGES FOR SELECTED YEARS 1/
Delta Service Area 2/
(Acres)

Crop	1931	1938	1948	1955	1968	1976	1977	1977/80/81/82/84
Corn	55,798	40,457	34,671	52,012	82,550	131,700	128,160	132,770
Grain/Hay	80,794	104,172	122,334	95,708	NA 3/	117,240	103,410	110,900
Tomatoes	---	---	18,410	40,810	54,360	42,710	49,540	43,100
Alfalfa	26,882	31,342	28,739	62,276	57,910	44,470	55,090	39,770
Pasture	12,748	12,386	23,708	62,616	55,720	40,380	41,160	37,600
Beets	30,915	36,311	28,912	34,519	26,250	45,680	30,880	27,650
Fruit	10,775	6,196	5,486	22,896	28,360	24,830	24,510	25,960
Asparagus	70,580	77,311	86,295	82,830	40,950	22,560	20,100	23,400
Safflower	---	---	---	5,623	24,290	6,470	29,270	23,530
Beans	26,992	10,997	3,357	3,911	---	8,360	10,690	17,580
Field (Misc)	---	---	---	---	6,850	1,830	4,830	7,140
Truck (Misc)	6,498	11,999	7,887	6,151	20,900	5,640	5,870	9,410
Milo	---	---	---	30,146	38,320	13,760	6,160	4,580
Vineyard	---	---	---	766	760	3,360	3,330	4,870
Sudan	---	---	---	522	---	7,510	4,240	2,180
Potatoes	18,042	10,650	7,511	8,539	6,480	2,920	2,600	2,160
Rice	---	---	720	5,765	3,020	700	480	1,810
Onions	3,769	1,304	911	1,193	190	290	640	590
Celery	6,303	6,914	4,221	1,083	---	---	---	---
Seed	8,967	3,235	2,869	---	---	---	---	---
TOTAL	359,063	353,274	376,031	517,366	---	520,410	520,960	515,000

1/ Data for 1931, 1938, 1948, and 1955 from Water Supervision Reports;
Data for 1968, 1976, 1977, and 1977/80/81/82/84 (counties surveyed in different years) from DWR Land Use Surveys
2/ Prior to 1955, the area survey was limited to approximately the Lowland only.
3/ Not available.
--- No acreage reported.

DWR 312

DWR 311

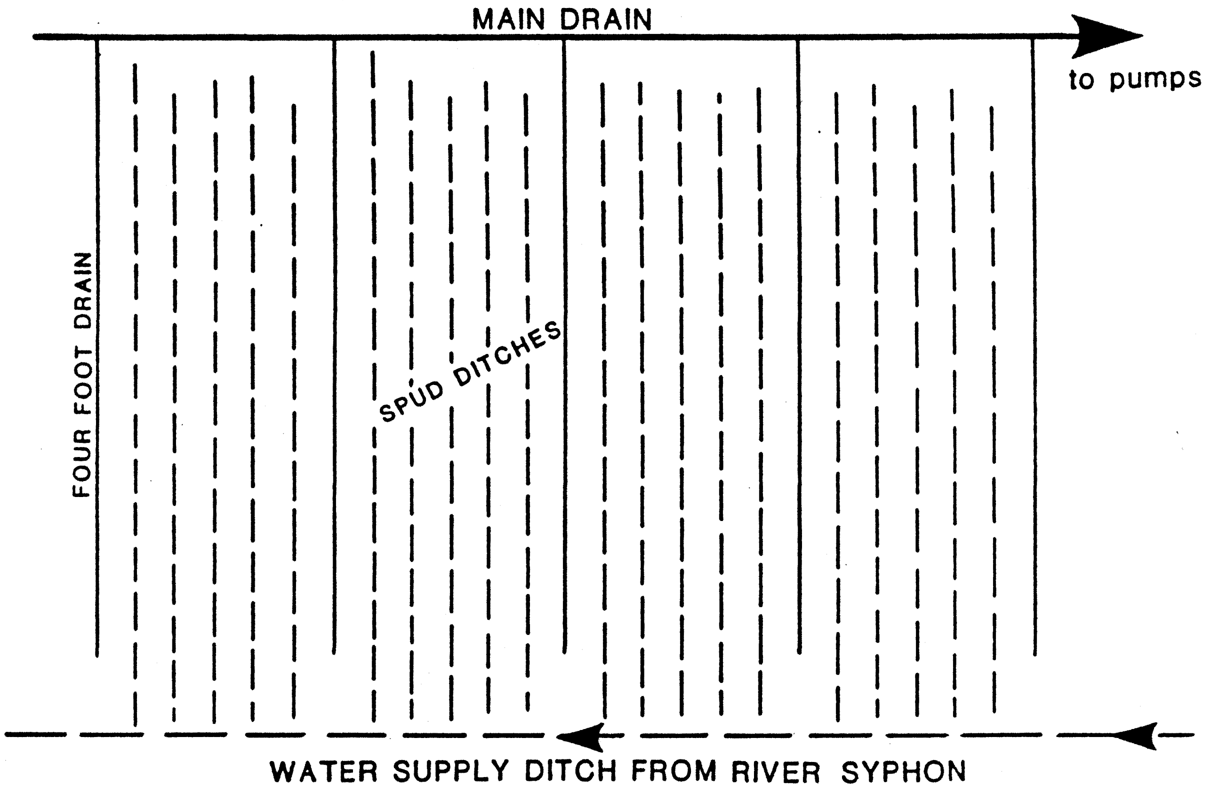


STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT

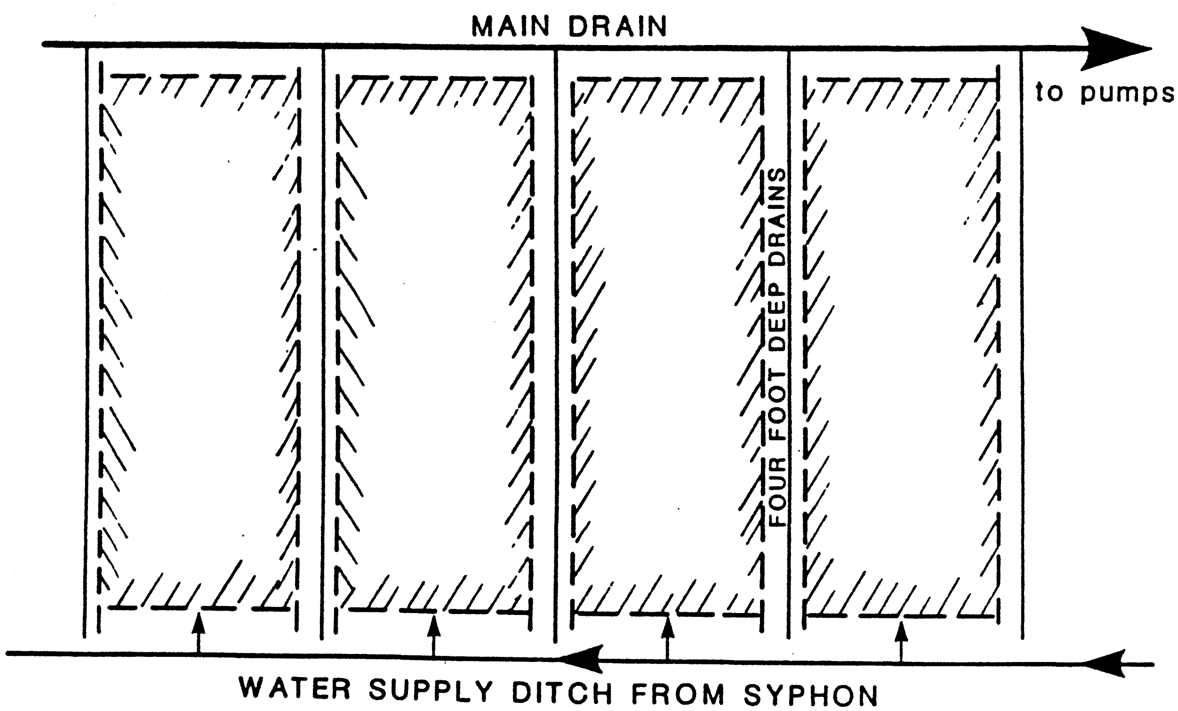
SACRAMENTO - SAN JOAQUIN DELTA

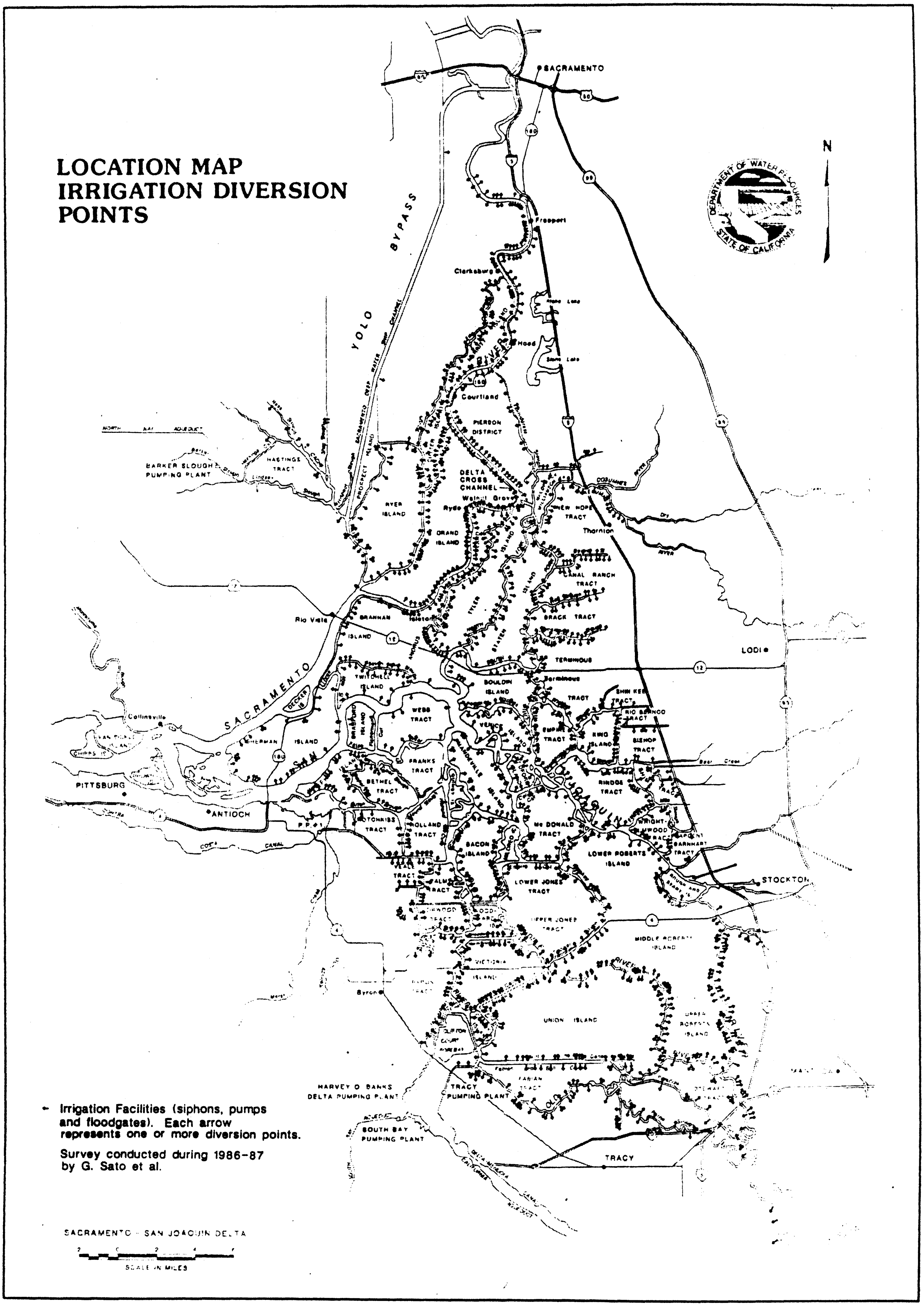
DISTRIBUTION OF CORN

A. **FALL SUB-IRRIGATION:** using spud ditches to wet the peat prior to winter rains



B. **WINTER PONDING:** flooding using four foot drains and drainage pumps to maintain drainage



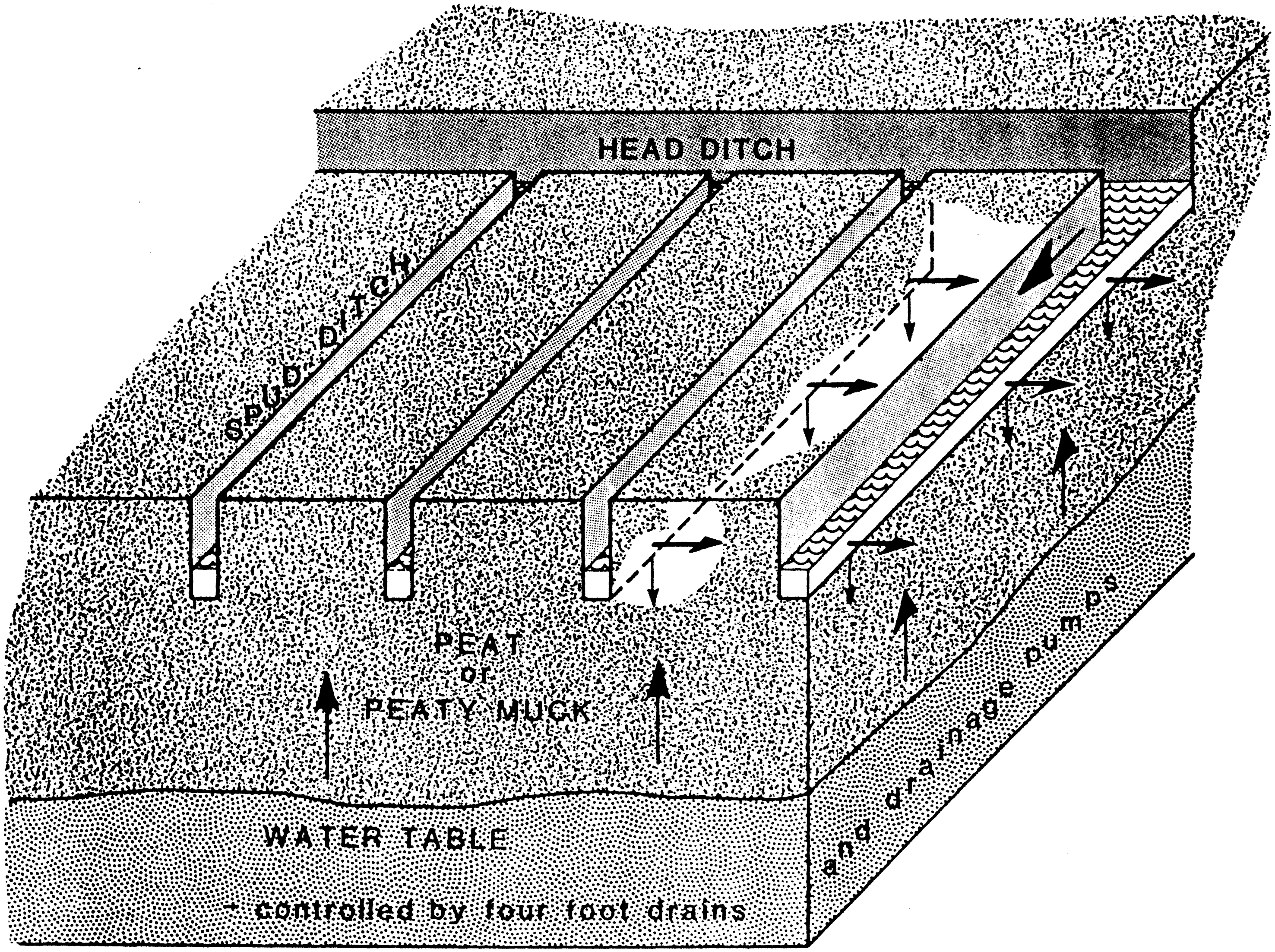


LOCATION MAP IRRIGATION DIVERSION POINTS

← Irrigation Facilities (siphons, pumps and floodgates). Each arrow represents one or more diversion points.

Survey conducted during 1986-87 by G. Sato et al.

DELTA SUB-IRRIGATION



01

DWR 321

DELTA ISLAND
IRRIGATION & DRAINAGE SCHEME

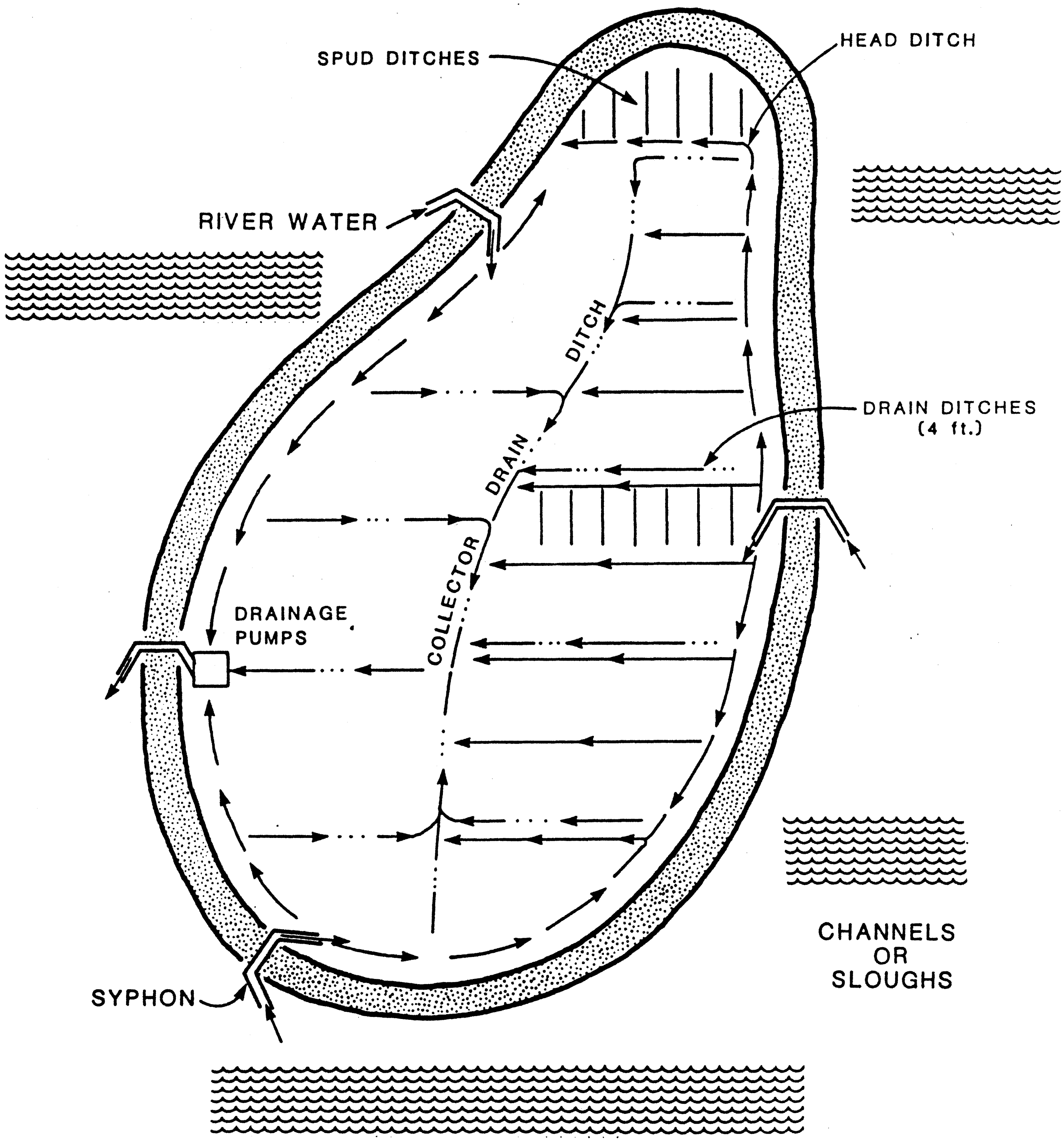


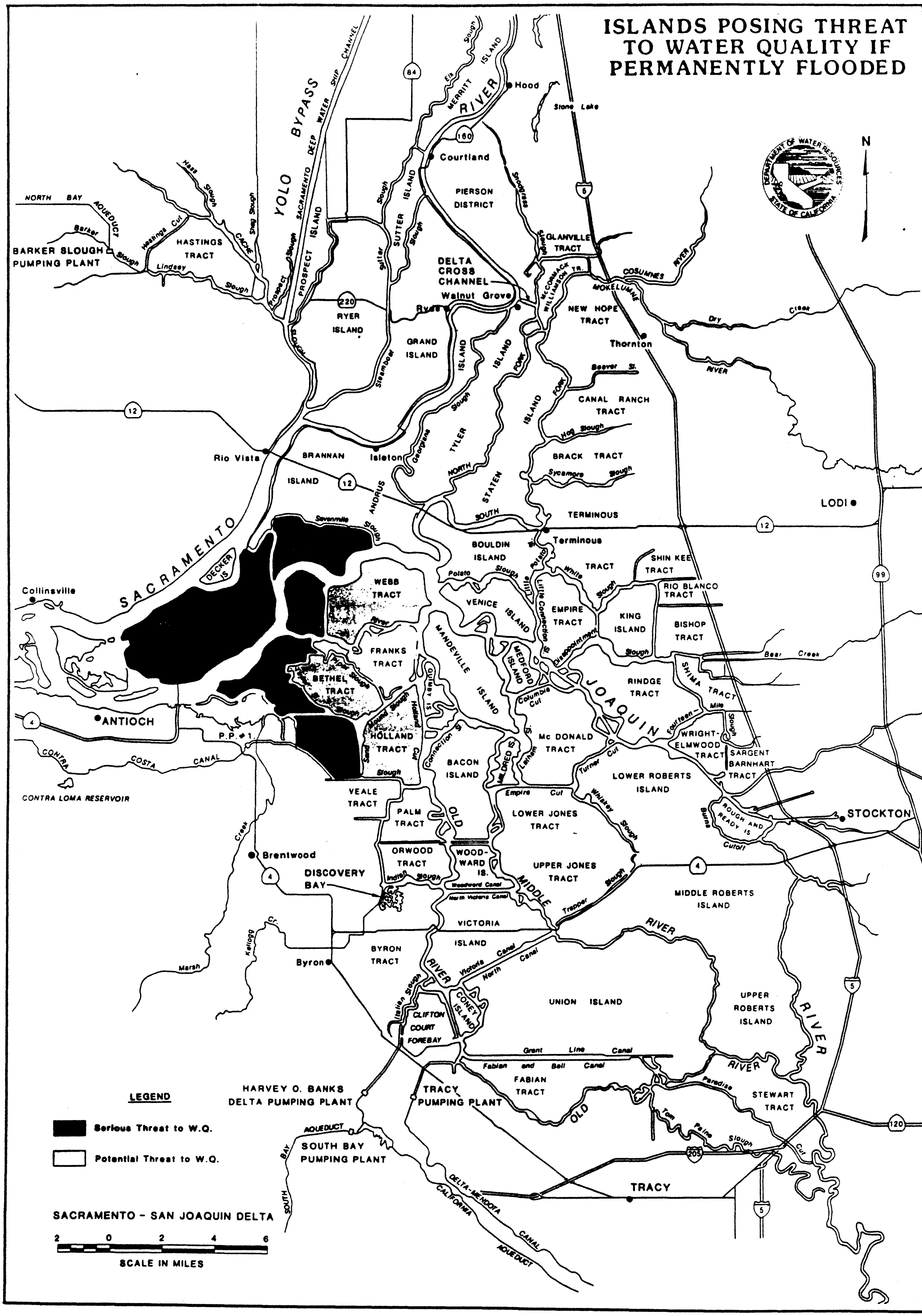
TABLE 10

DRAINAGE FROM DELTA LOWLANDS

In acre-feet

Unit	Acreage	1954								1955									
		May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
2	11202	45	0	0	0	0	179	0	672	582	90	0	90	0	0	0	0	0	134
3	5465	639	552	662	526	234	147	225	387	594	558	475	403	541	401	667	573	299	43
6	33027	617	388	339	299	359	358	1480	2541	2944	2159	771	401	293	235	314	269	227	320
7	7510	510	117	104	60	64	44	183	379	669	367	221	229	259	189	214	120	122	59
8	22103	4126	2984	2227	2935	2997	3932	2867	1917	1046	1086	1752	2018	2354	3267	3817	2830	2411	1577
9	16085	1238	1628	2074	2081	1495	952	696	979	841	252	401	1057	742	1301	1408	1647	1067	710
10	11067	395	865	1057	975	350	261	313	486	637	352	245	443	535	757	874	860	624	450
11	14365	1620	1697	1337	1350	770	530	753	1383	1516	865	637	889	792	1349	1433	1411	591	417
12	16877	2408	3144	3559	2971	1450	1029	1481	2916	3105	1689	1690	2582	2171	3921	3927	3690	971	621
13	16641	886	1529	2022	1602	357	459	529	1288	1303	777	767	1081	964	1575	2356	2022	1049	435
14	14671	1730	2131	2053	926	648	1227	1483	2166	1961	1645	1983	2307	1614	1773	2264	846	545	891
15	26424	2583	2463	3005	2879	2055	2957	3425	4851	5721	2871	2782	2544	1801	2425	2805	3398	2079	2021
16	18343	2114	2434	2321	3181	2147	1521	1076	2804	4008	1470	1041	1854	1707	2457	2336	2044	1811	1511
17	10191	992	955	1379	1013	739	1159	1185	3597	3198	1039	1291	1823	1585	1613	2000	1499	1153	603
18	18504	4710	8676	11051	8210	6748	6994	4025	5759	4836	2425	1942	1439	3509	5603	10156	8081	3432	2884
19	17917	2507	3570	4636	4307	2688	1516	1268	2753	2454	1221	826	1301	2618	3160	3759	3282	1963	1275
20	21302	5456	9197	10223	10410	4627	4582	5639	10209	14637	3840	2016	3533	6521	10456	11726	11870	8521	3505
21	14846	3154	4000	5245	4705	2698	2691	3792	7388	7472	2765	1935	2350	3873	5340	5398	4576	3392	2175
22	19357	12368	15756	15252	12942	8629	9306	8637	10635	12773	7385	5127	3949	10734	16862	15557	12826	6142	5302
23	24493	2396	3032	3917	3259	1974	3790	3514	9308	11828	3229	2103	1843	2018	2481	2056	2818	1663	1981
24	32879	2125	2500	2964	2839	1849	2103	2795	8907	9189	3410	2053	2135	2355	2649	2862	2929	2285	1974
25	33212	2335	2197	3773	2289	1237	892	971	3812	3678	2188	1958	2540	2233	2553	3574	3217	2068	922
26	2810	96	131	144	149	99	88	140	399	412	150	92	95	107	133	155	153	113	93
27	10148	669	627	1231	949	343	100	60	195	264	127	311	722	487	584	948	1209	588	114
Total	419439	55719	70573	80575	70857	44557	46817	46537	85731	95668	41960	32419	37628	49813	71084	80606	72170	43116	30017
Acre-feet per acre		0.13	0.17	0.19	0.17	0.11	0.11	0.11	0.20	0.23	0.10	0.08	0.09	0.12	0.17	0.19	0.17	0.10	0.07

LOCATION MAP AGRICULTURAL DRAINAGE RETURN POINTS


ISLANDS POSING THREAT
TO WATER QUALITY IF
PERMANENTLY FLOODED
LEGEND
Serious Threat to W.Q.
Potential Threat to W.Q.
SACRAMENTO - SAN JOAQUIN DELTA
2 0 2 4 6
SCALE IN MILES
N
DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA
YOLO BYPASS
SACRAMENTO DEEP WATER SHIP CHANNEL
NORTH BAY AQUEDUCT
BARKER SLOUGH PUMPING PLANT
HASTINGS TRACT
PROSPECT ISLAND
SUTTER ISLAND
MERRITT ISLAND
Hood
Stone Lake
Courtland
PIERSON DISTRICT
GLANVILLE TRACT
DELTA CROSS CHANNEL
Walnut Grove
Ryde
RYER ISLAND
GRAND ISLAND
NEW HOPE TRACT
Thornton
COSUMNES RIVER
MOKELUMNE RIVER
CANAL RANCH TRACT
BRACK TRACT
TYLER ISLAND
STATEN ISLAND
TERMINOUS
Terminous
LODI
Rio Vista
BRANNAN ISLAND
Isleton
ANDRUS
SACRAMENTO
DECKER IS.
Collinsville
WEBB TRACT
BOULDIN ISLAND
VENICE ISLAND
EMPIRE TRACT
SHIN KEE TRACT
RIO BLANCO TRACT
KING ISLAND
BISHOP TRACT
FRANKS TRACT
BETHEL TRACT
MANDEVILLE ISLAND
MEDFORD ISLAND
RINDGE TRACT
SHIMA TRACT
JOAQUIN
ANTIOCH
P.P. # 1
CONTRA COSTA CANAL
CONTRA LOMA RESERVOIR
HOLLAND TRACT
BACON ISLAND
MILDRED IS.
Mc DONALD TRACT
WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
LOWER ROBERTS ISLAND
VEALE TRACT
PALM TRACT
LOWER JONES TRACT
ROUGH AND READY IS.
STOCKTON
Brentwood
DISCOVERY BAY
ORWOOD TRACT
WOODWARD IS.
UPPER JONES TRACT
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
BYRON TRACT
Byron
UNION ISLAND
UPPER ROBERTS ISLAND
CONEY ISLAND
CLIFTON COURT FOREBAY
FABIAN TRACT
STEWART TRACT
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
SOUTH BAY PUMPING PLANT
SOUTH BAY AQUEDUCT
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT
TRACY

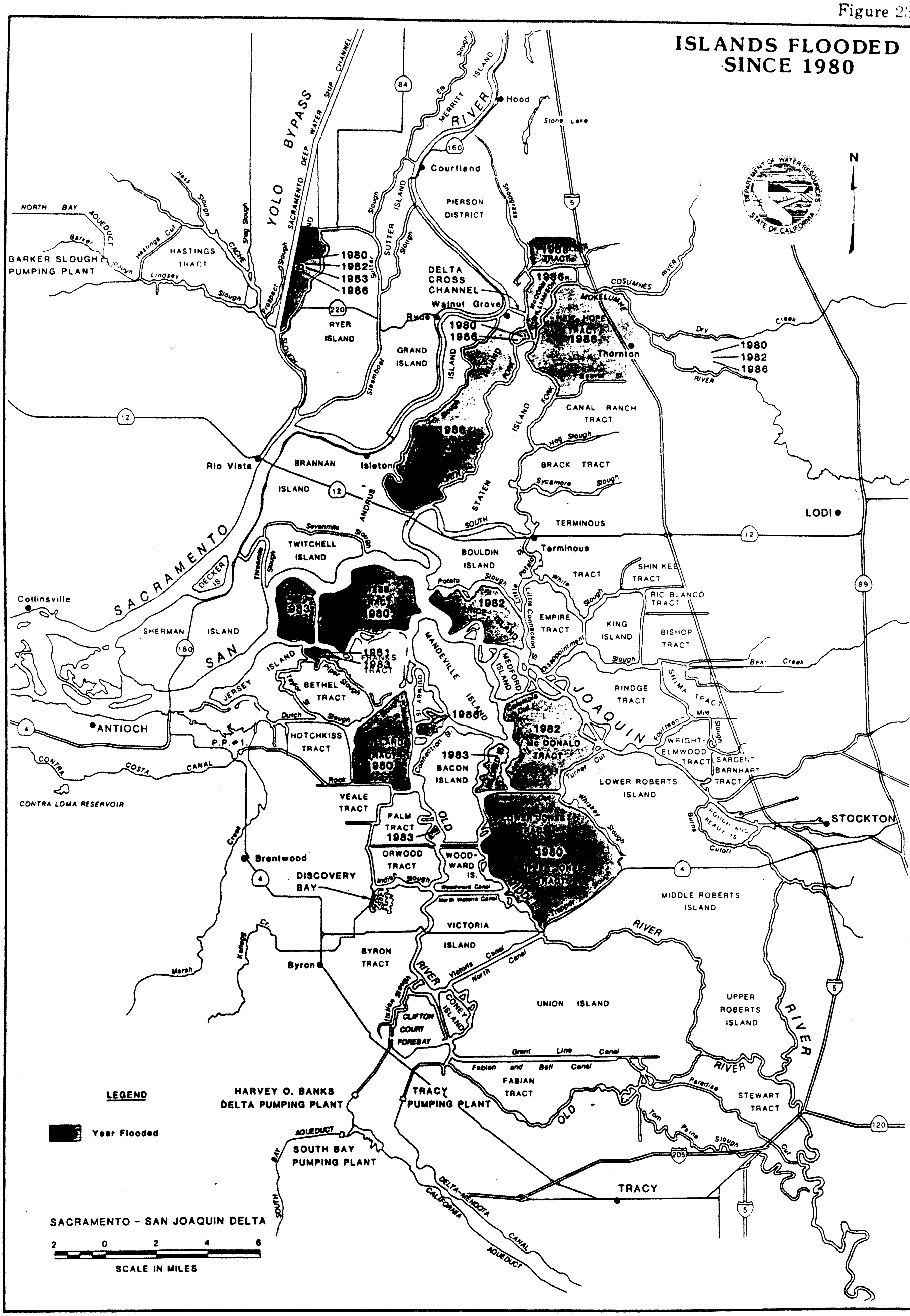

ISLANDS FLOODED SINCE 1980
YOLO BYPASS
SACRAMENTO DEEP WATER SHIP CHANNEL
NORTH BAY AQUEDUCT
BARKER SLOUGH PUMPING PLANT
HASTINGS TRACT
RYER ISLAND
GRAND ISLAND
SUTTER ISLAND
PIERSON DISTRICT
MERRITT ISLAND
Hood
Courtland
Walnut Grove
Ryde
DELTA CROSS CHANNEL
Thornton
NEW HOPE TRACT
COSUMNES RIVER
MOKELUMNE
CANAL RANCH TRACT
BRACK TRACT
STATEN
TERMINOUS
Terminous
LODI
Rio Vista
BRANNAN ISLAND
Isleton
ANDRUS
TWITCHELL ISLAND
BOULDIN ISLAND
SHERMAN ISLAND
DECKER IS
Collinsville
SACRAMENTO
SAN JOAQUIN
MANDEVILLE ISLAND
EMPIRE TRACT
KING ISLAND
BISHOP TRACT
RIO BLANCO TRACT
SHIN KEE TRACT
MEDFORD ISLAND
RINDGE TRACT
SHIMA TRACT
JERSEY ISLAND
BETHEL TRACT
ANTIOCH
HOTCHKISS TRACT
P.P. #1
CONTRA COSTA CANAL
CONTRA LOMA RESERVOIR
BACON ISLAND
VEALE TRACT
PALM TRACT
ORWOOD TRACT
WOODWARD IS.
LOWER ROBERTS ISLAND
WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
STOCKTON
Brentwood
DISCOVERY BAY
VICTORIA ISLAND
MIDDLE ROBERTS ISLAND
BYRON TRACT
Byron
CLIFTON COURT FOREBAY
UNION ISLAND
UPPER ROBERTS ISLAND
COONEY ISLAND
Grant Line Canal
Fabian and Bell Canal
FABIAN TRACT
STEWART TRACT
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
SOUTH BAY PUMPING PLANT
TRACY
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT
1980
1981
1982
1983
1986
DEPARTMENT OF WATER RESOURCES STATE OF CALIFORNIA
N
LEGEND
Year Flooded
SACRAMENTO - SAN JOAQUIN DELTA
2 0 2 4 6
SCALE IN MILES

Figure 3. MONTHLY AVERAGE FLOWS

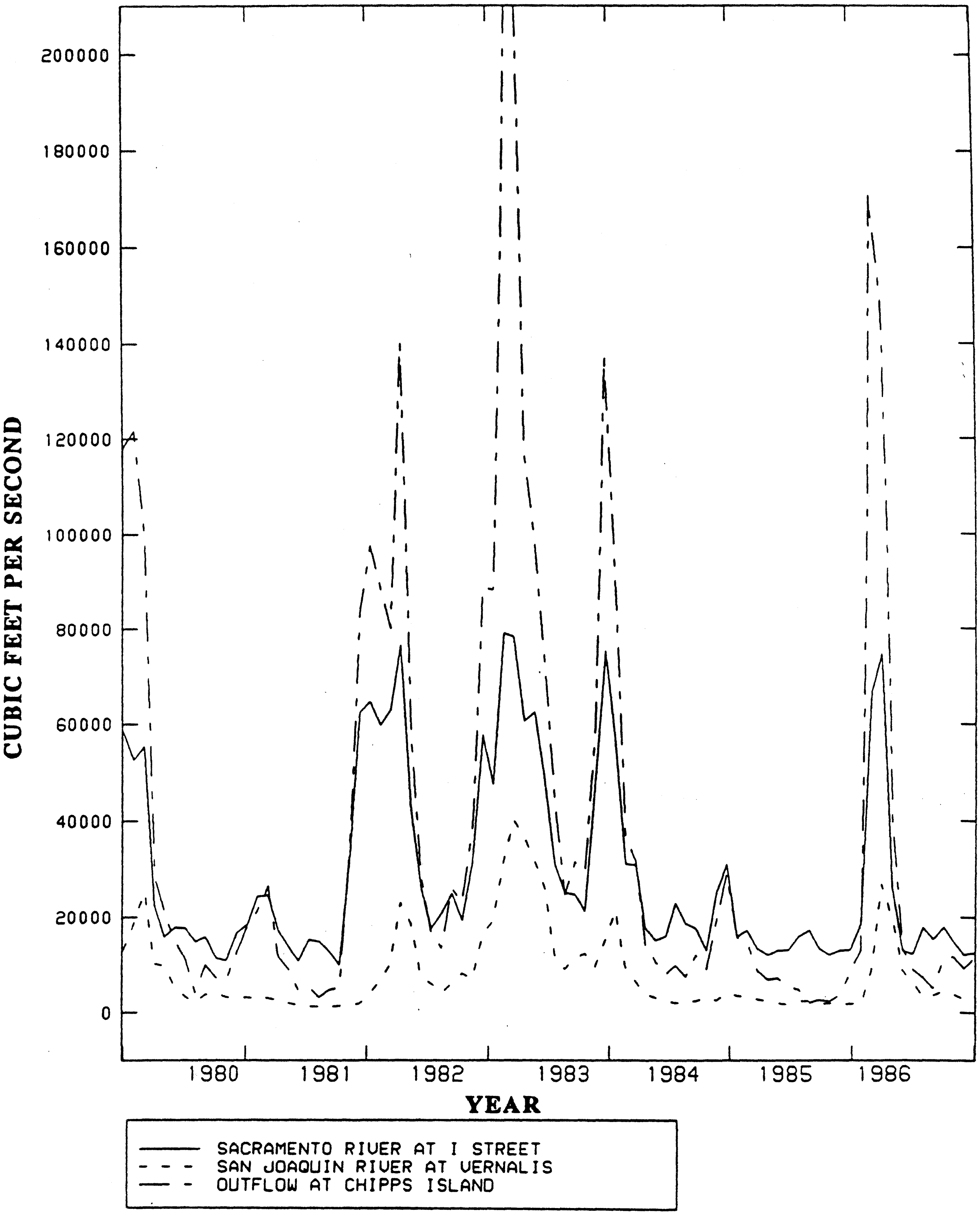
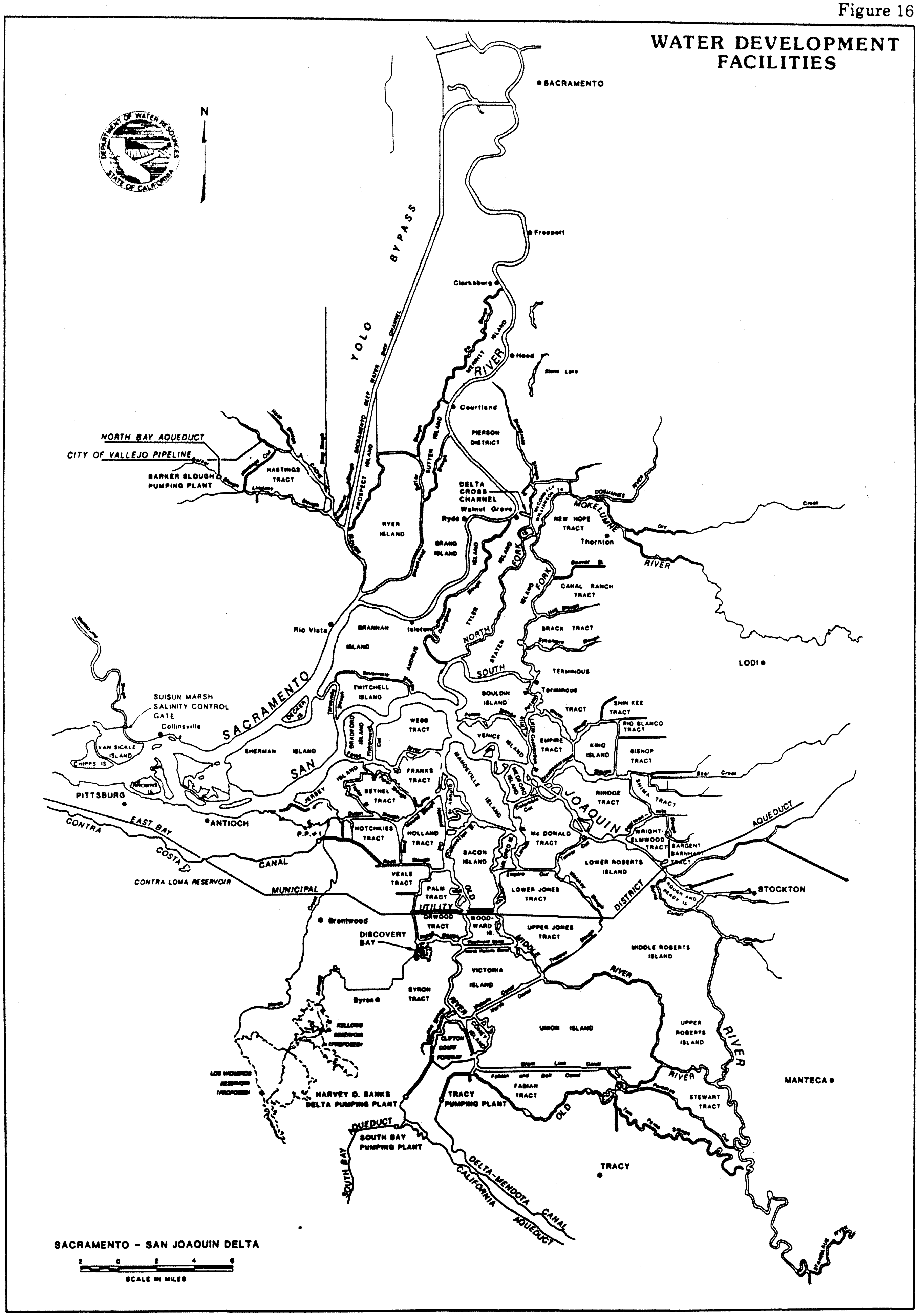
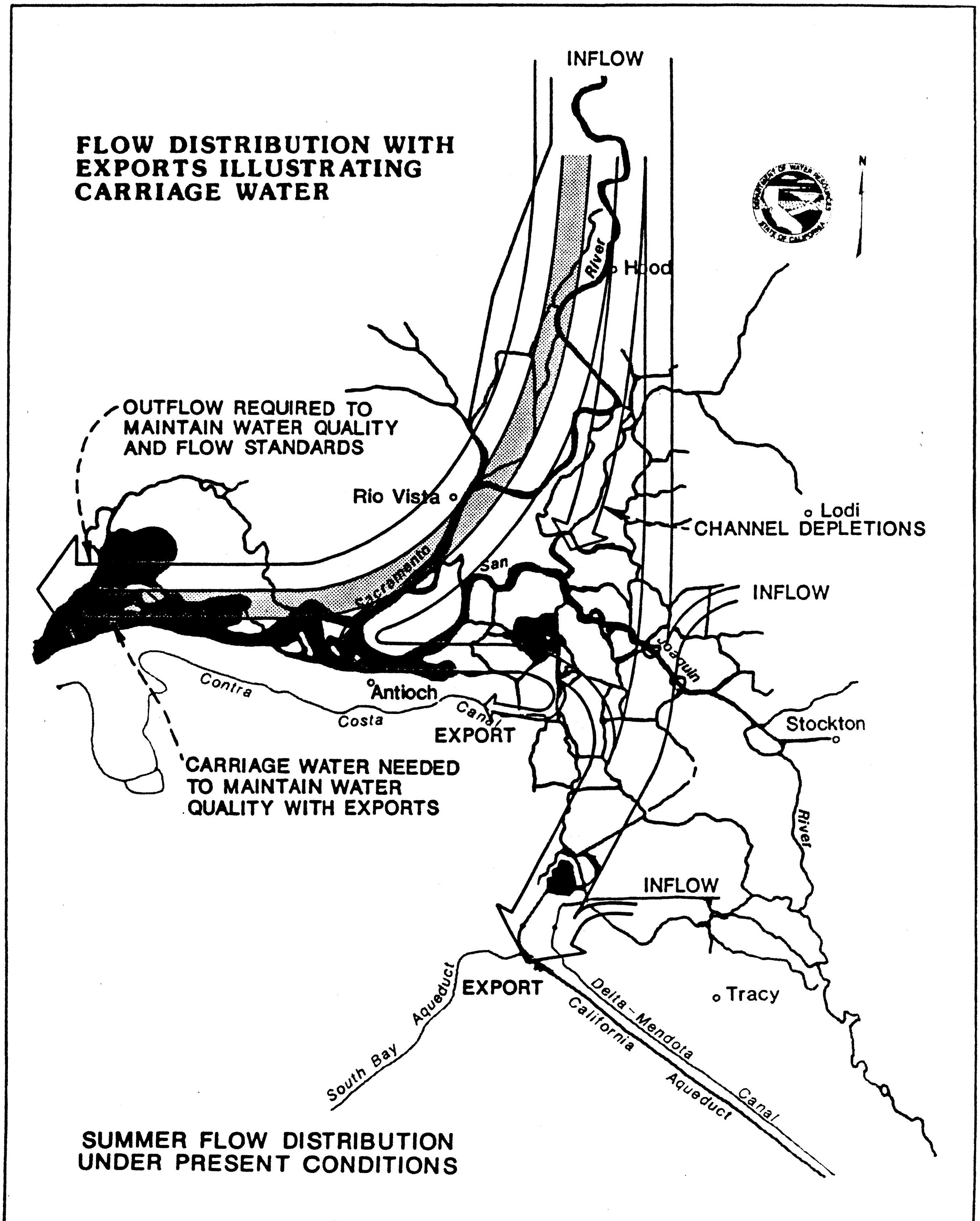
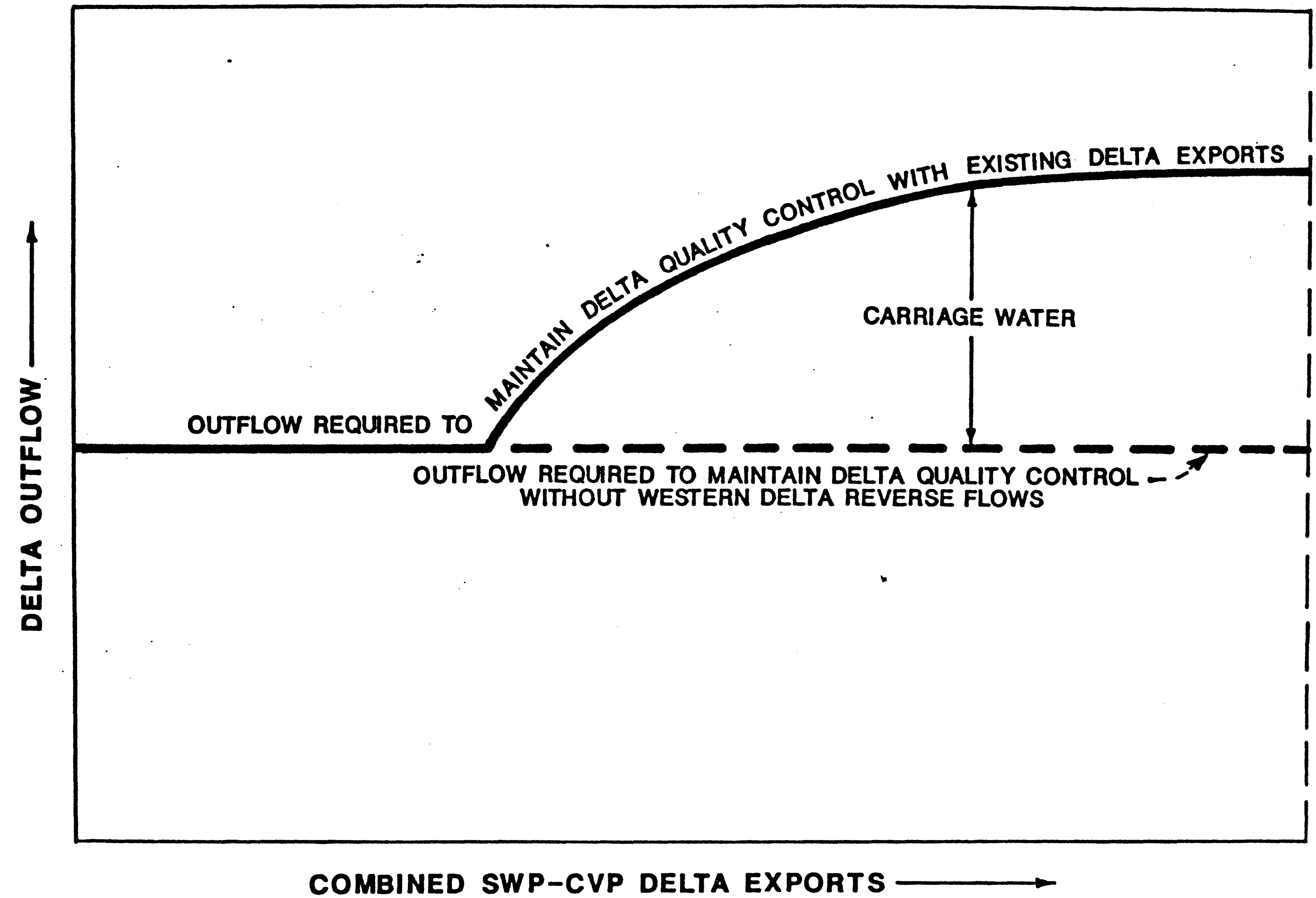


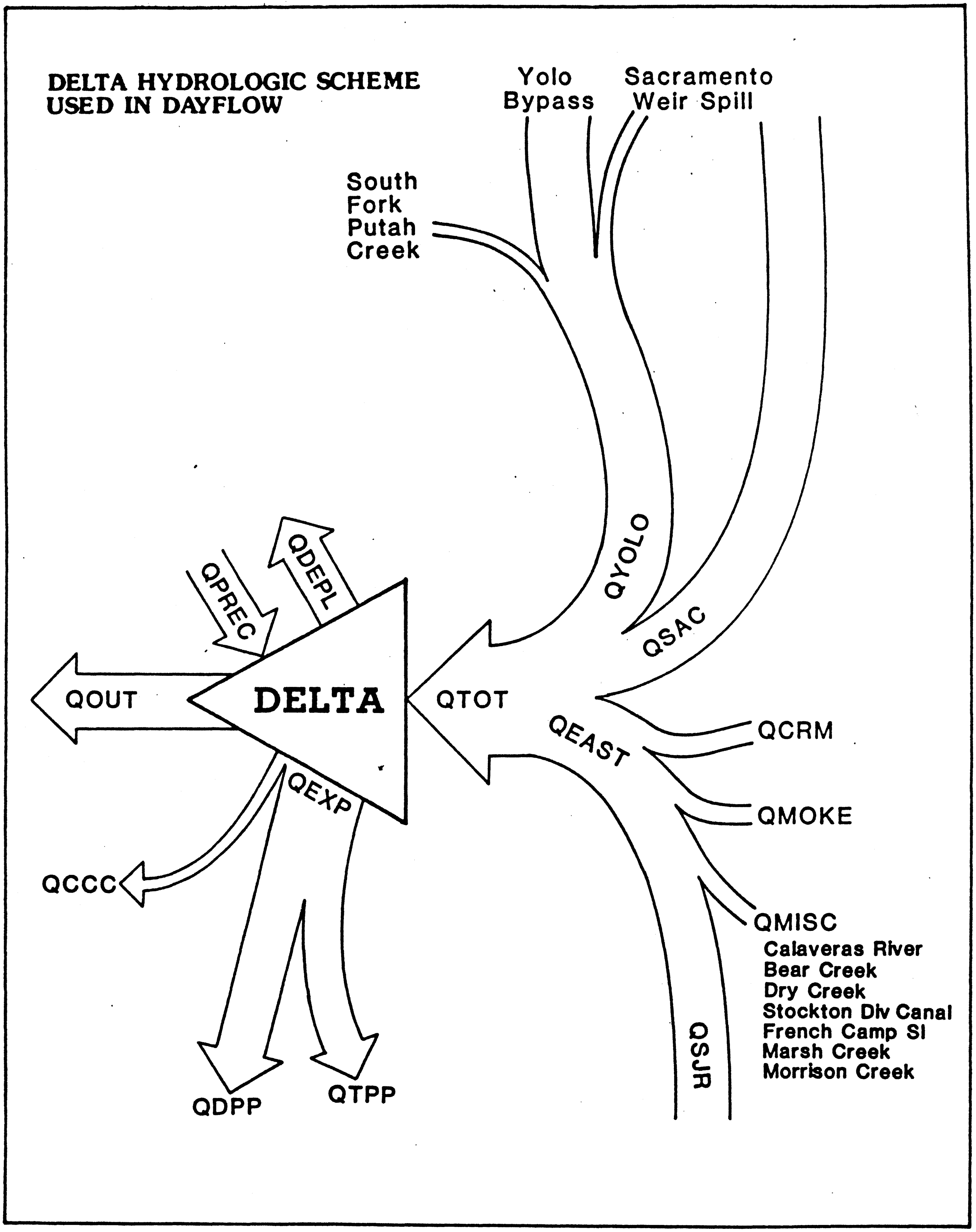
Figure 16

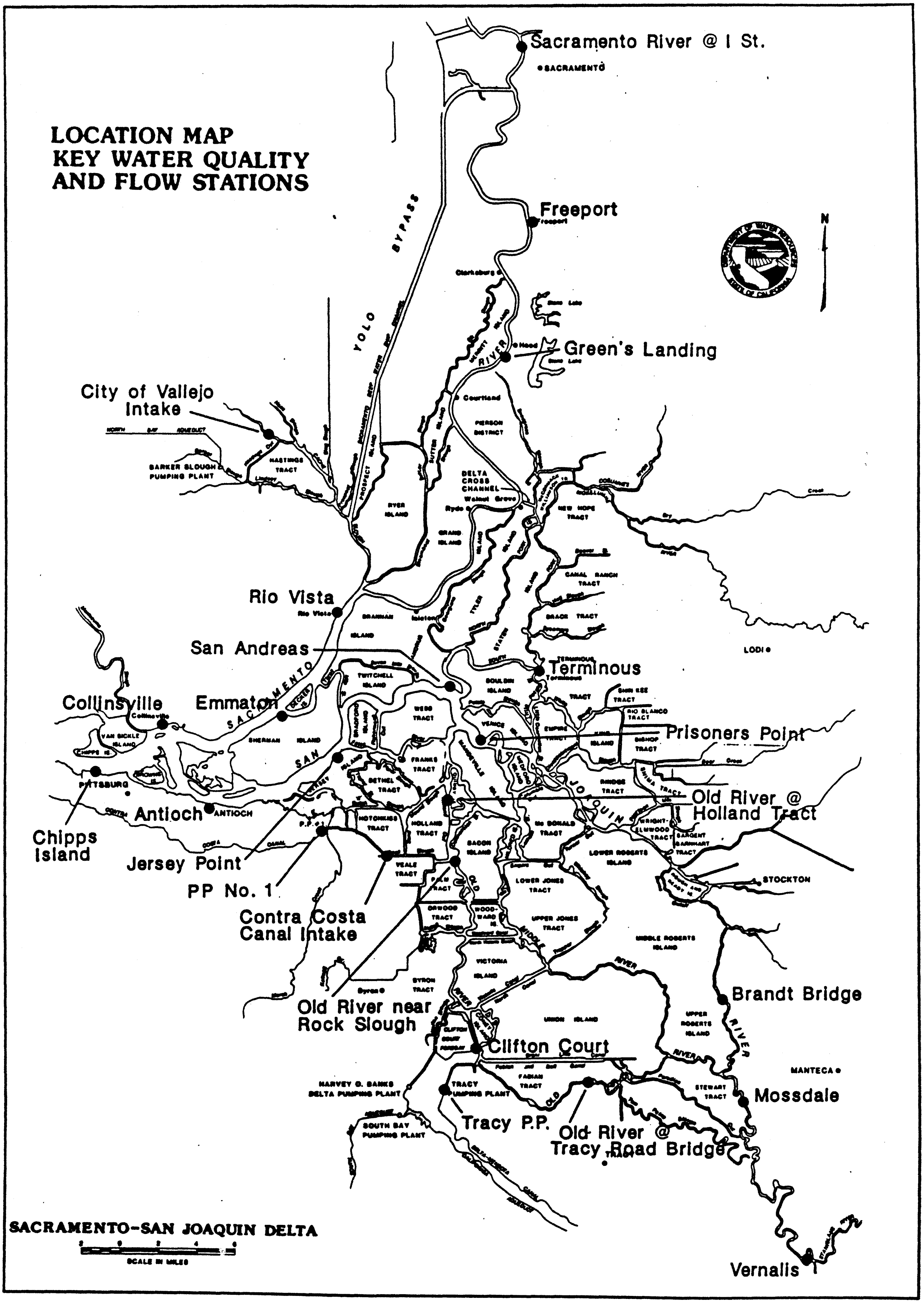

WATER DEVELOPMENT
FACILITIES
SACRAMENTO
N
DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA
YOLO BYPASS
SACRAMENTO DEEP WATER SHIP CHANNEL
Freeport
Clarksburg
Hood
RIVER
Courtland
PIERSON DISTRICT
NORTH BAY AQUEDUCT
CITY OF VALLEJO PIPELINE
BARKER SLOUGH PUMPING PLANT
HASTINGS TRACT
PROSPECT ISLAND
SUTTER ISLAND
DELTA CROSS CHANNEL
Walnut Grove
Ryde
RYER ISLAND
GRAND ISLAND
MOKELUMNE RIVER
NEW HOPE TRACT
Thornton
COSUMNES RIVER
CANAL RANCH TRACT
BRACK TRACT
TERMINOUS
Terminous
LODI
Rio Vista
BRANNAN ISLAND
Isleton
TYLER ISLAND
NORTH FORK
SOUTH
STATEN ISLAND
SUISUN MARSH SALINITY CONTROL GATE
Collinsville
SACRAMENTO
TWITCHELL ISLAND
BOULDIN ISLAND
SHIN KEE TRACT
RIO BLANCO TRACT
VAN SICKLE ISLAND
CHIPPS IS
SHERMAN ISLAND
DECKER IS
BRADFORD ISLAND
WEBB TRACT
VENICE ISLAND
EMPIRE TRACT
KING ISLAND
BISHOP TRACT
SAN
JERSEY ISLAND
BETHEL TRACT
FRANKS TRACT
MANDEVILLE ISLAND
MEDFORD ISLAND
RINDGE TRACT
SHIMA TRACT
JOAQUIN
PITTSBURG
ANTIOCH
EAST BAY
CONTRA COSTA CANAL
P.P. #1
HOTCHKISS TRACT
HOLLAND TRACT
BACON ISLAND
Mc DONALD TRACT
WRIGHT-ELMWOOD TRACT
BARGENT BARNHART TRACT
AQUEDUCT
LOWER ROBERTS ISLAND
CONTRA LOMA RESERVOIR
MUNICIPAL
UTILITY
DISTRICT
VEALE TRACT
PALM TRACT
OLD
LOWER JONES TRACT
STOCKTON
Brentwood
ORWOOD TRACT
WOODWARD IS
UPPER JONES TRACT
DISCOVERY BAY
MIDDLE
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
Byron
BYRON TRACT
RIVER
UNION ISLAND
UPPER ROBERTS ISLAND
CLIFTON COURT FOREBAY
KELLOGG RESERVOIR (PROPOSED)
LOS VAQUEROS RESERVOIR (PROPOSED)
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
FABIAN TRACT
OLD
MANTECA
STEWART TRACT
SOUTH BAY AQUEDUCT
SOUTH BAY PUMPING PLANT
TRACY
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT
SACRAMENTO - SAN JOAQUIN DELTA
2 0 2 4 6
SCALE IN MILES

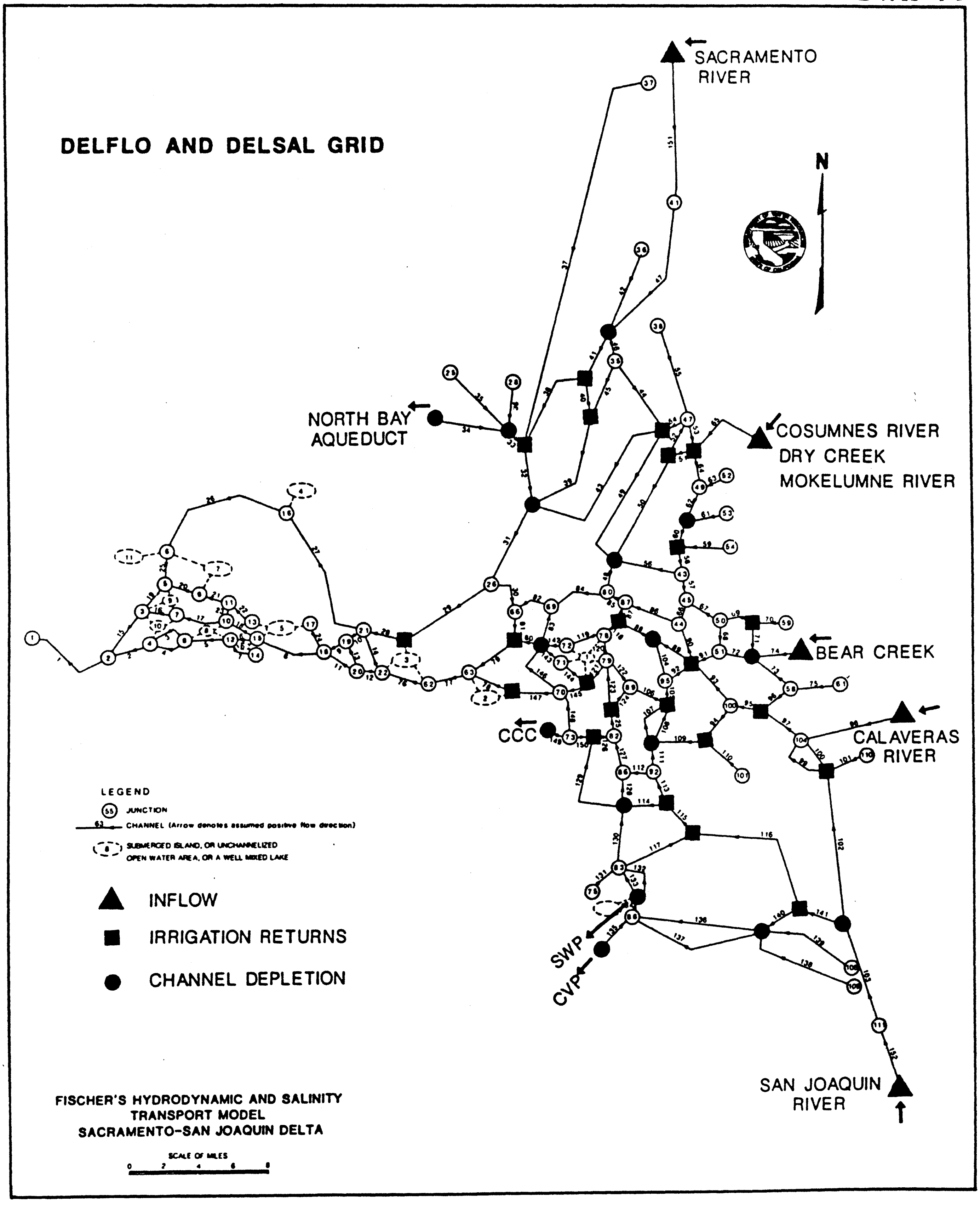

INFLOW
FLOW DISTRIBUTION WITH
EXPORTS ILLUSTRATING
CARRIAGE WATER
River
Hood
OUTFLOW REQUIRED TO
MAINTAIN WATER QUALITY
AND FLOW STANDARDS
Rio Vista
Lodi
CHANNEL DEPLETIONS
Sacramento
San
INFLOW
Joaquin
Contra
Antioch
Costa
Canal
EXPORT
Stockton
CARRIAGE WATER NEEDED
TO MAINTAIN WATER
QUALITY WITH EXPORTS
River
INFLOW
EXPORT
Tracy
South Bay Aqueduct
Delta-Mendota Canal
California Aqueduct
SUMMER FLOW DISTRIBUTION
UNDER PRESENT CONDITIONS

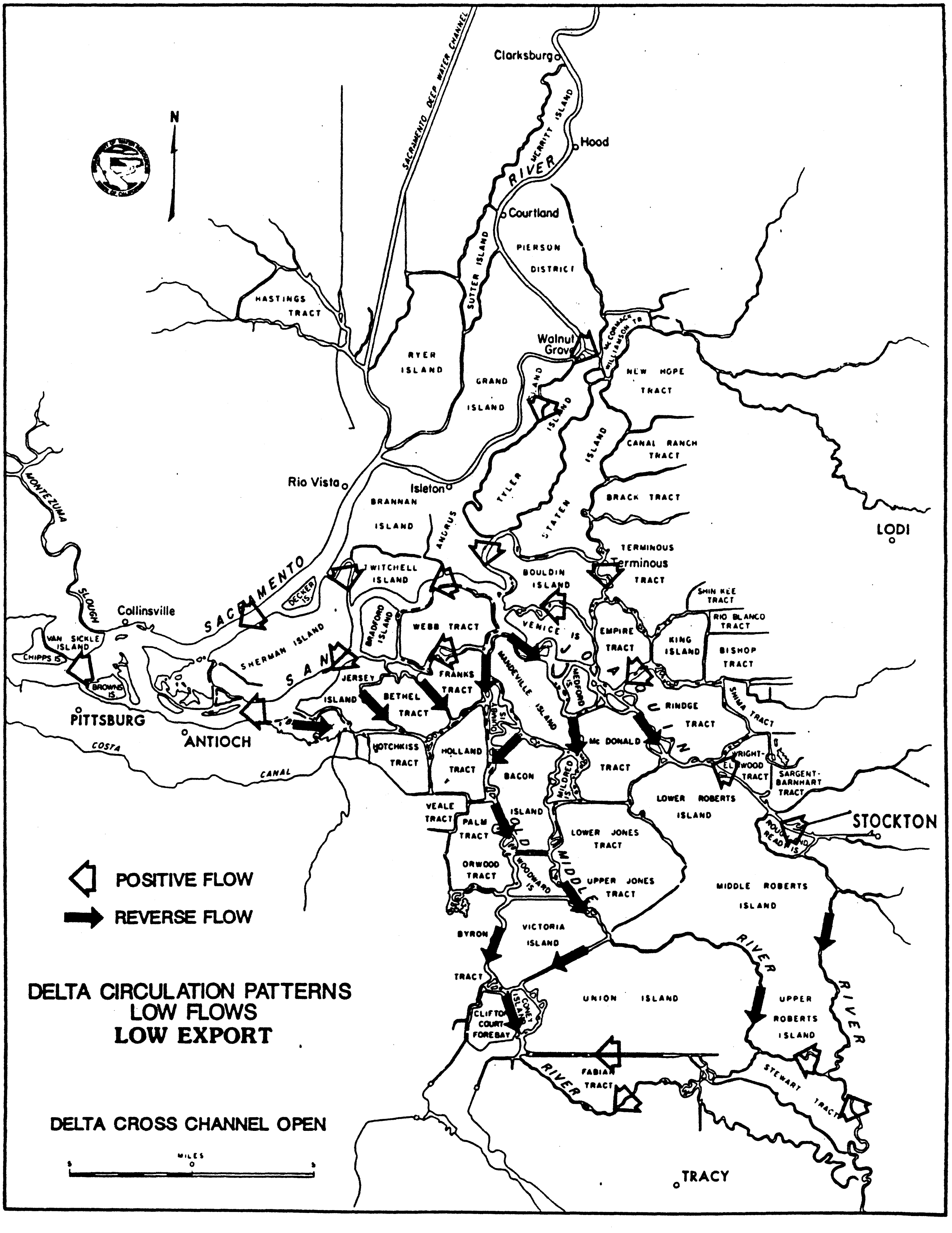
DWR-63
EXPORT-OUTFLOW REQUIREMENTS



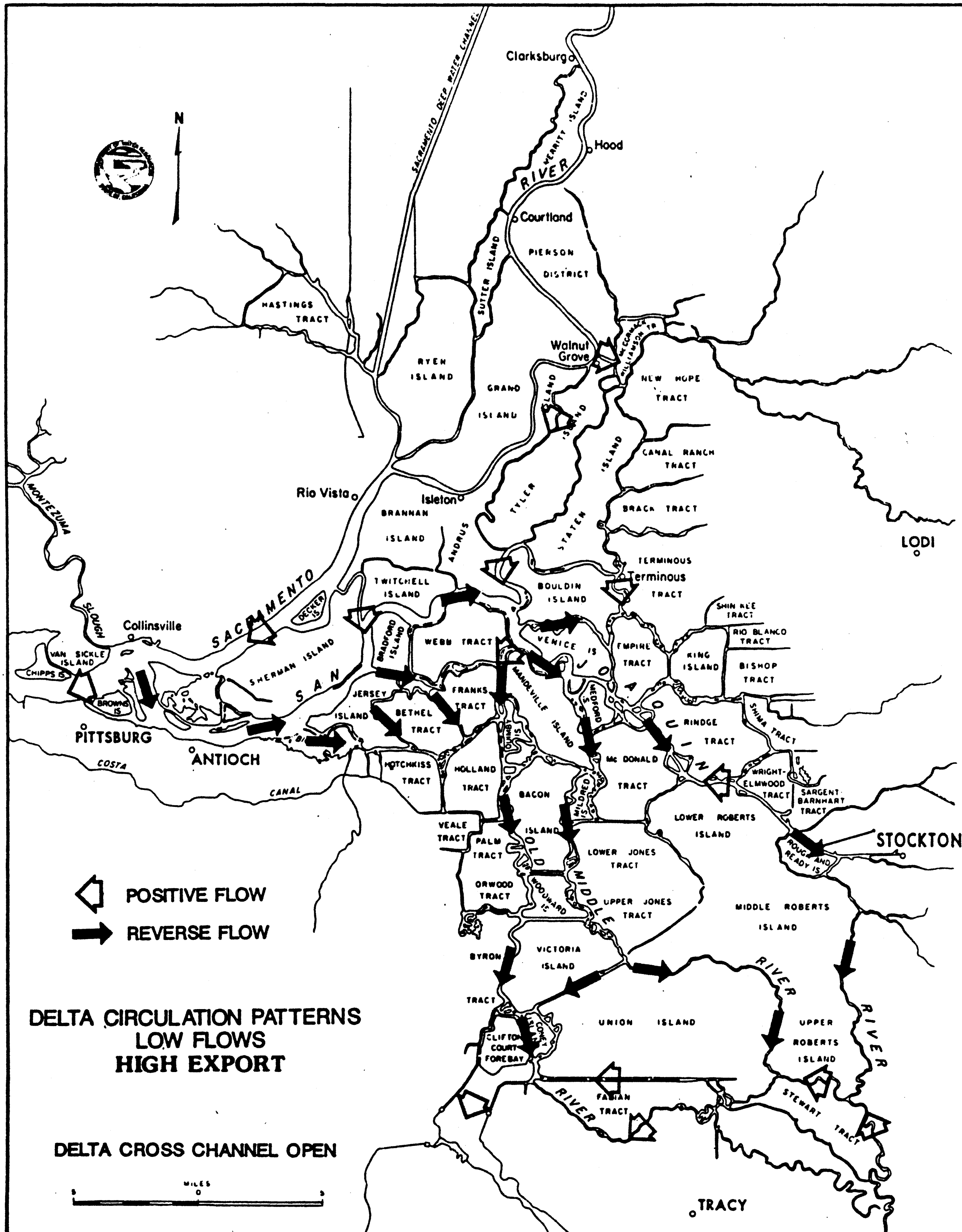

DELTA HYDROLOGIC SCHEME
USED IN DAYFLOW
Yolo Bypass
Sacramento Weir Spill
South Fork Putah Creek
QYOLO
QSAC
QDEPL
QPREC
QOUT
DELTA
QTOT
QEAST
QCRM
QMOKE
QMISC
Calaveras River
Bear Creek
Dry Creek
Stockton Div Canal
French Camp Sl
Marsh Creek
Morrison Creek
QEXP
QCCC
QSJR
QDPP
QTPP


LOCATION MAP
KEY WATER QUALITY
AND FLOW STATIONS
Sacramento River @ I St.
SACRAMENTO
Freeport
YOLO
BYPASS
Green's Landing
City of Vallejo Intake
BARKER SLOUGH PUMPING PLANT
HASTINGS TRACT
PROSPECT ISLAND
RYER ISLAND
GRAND ISLAND
SUTTER ISLAND
PIERSON DISTRICT
DELTA CROSS CHANNEL
Walnut Grove
Courtland
Rydo
NEW HOPE TRACT
CANAL RANCH TRACT
BRACK TRACT
Rio Vista
San Andreas
TYLER
LODI
Terminous
TWITCHELL ISLAND
BOULDIN ISLAND
Collinsville
Emmaton
SACRAMENTO
SAN
WEBB TRACT
SHERMAN ISLAND
VAN SICKLE ISLAND
Prisoners Point
RIO BLANCO TRACT
BISHOP TRACT
PITTSBURG
Antioch
ANTIOCH
BETHEL TRACT
FRANKS TRACT
JOAQUIN
Old River @ Holland Tract
RINDGE TRACT
Chipps Island
Jersey Point
PP No. 1
HOTCHKISS TRACT
HOLLAND TRACT
BACON ISLAND
Mc DONALD TRACT
LOWER ROBERTS ISLAND
STOCKTON
Contra Costa Canal Intake
VEALE TRACT
ORWOOD TRACT
WOODWARD IS
LOWER JONES TRACT
UPPER JONES TRACT
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
BYRON TRACT
Byron
Old River near Rock Slough
UNION ISLAND
Brandt Bridge
UPPER ROBERTS ISLAND
Clifton Court
MANTECA
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
FABIAN TRACT
STEWART TRACT
Mossdale
Tracy P.P.
Old River @ Tracy Road Bridge
TRACY
SOUTH BAY PUMPING PLANT
Vernalis
SACRAMENTO-SAN JOAQUIN DELTA
SCALE IN MILES
N


DELFLO AND DELSAL GRID
SACRAMENTO RIVER
N
NORTH BAY AQUEDUCT
COSUMNES RIVER
DRY CREEK
MOKELUMNE RIVER
BEAR CREEK
CALAVERAS RIVER
CCC
SWP
CVP
SAN JOAQUIN RIVER
LEGEND
JUNCTION
CHANNEL (Arrow denotes assumed positive flow direction)
SUBMERGED ISLAND, OR UNCHANNELIZED OPEN WATER AREA, OR A WELL MIXED LAKE
INFLOW
IRRIGATION RETURNS
CHANNEL DEPLETION
FISCHER'S HYDRODYNAMIC AND SALINITY TRANSPORT MODEL
SACRAMENTO-SAN JOAQUIN DELTA
SCALE OF MILES
0 2 4 6 8

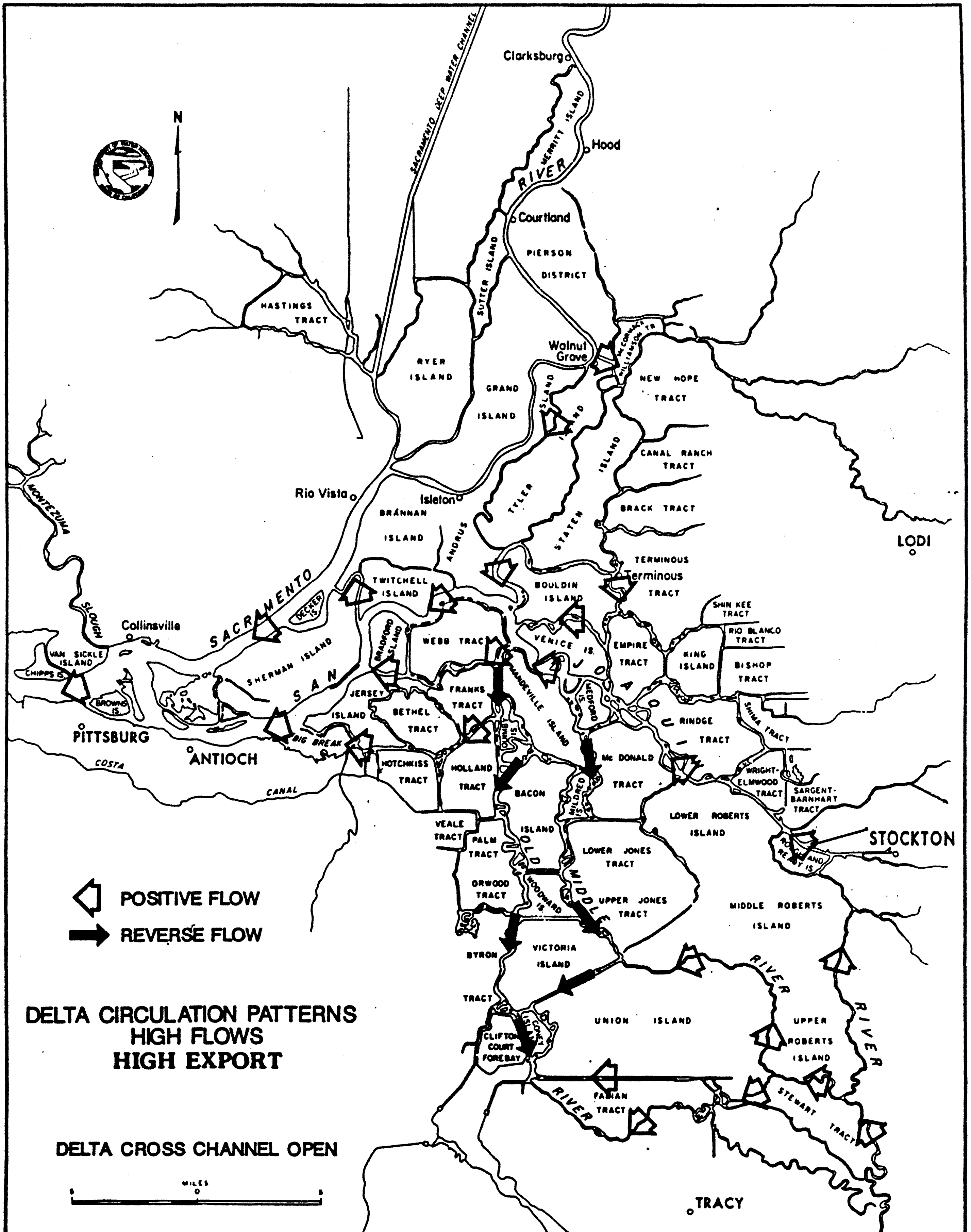


DELTA CIRCULATION PATTERNS
LOW FLOWS
LOW EXPORT



DELTA CIRCULATION PATTERNS
LOW FLOWS
HIGH EXPORT

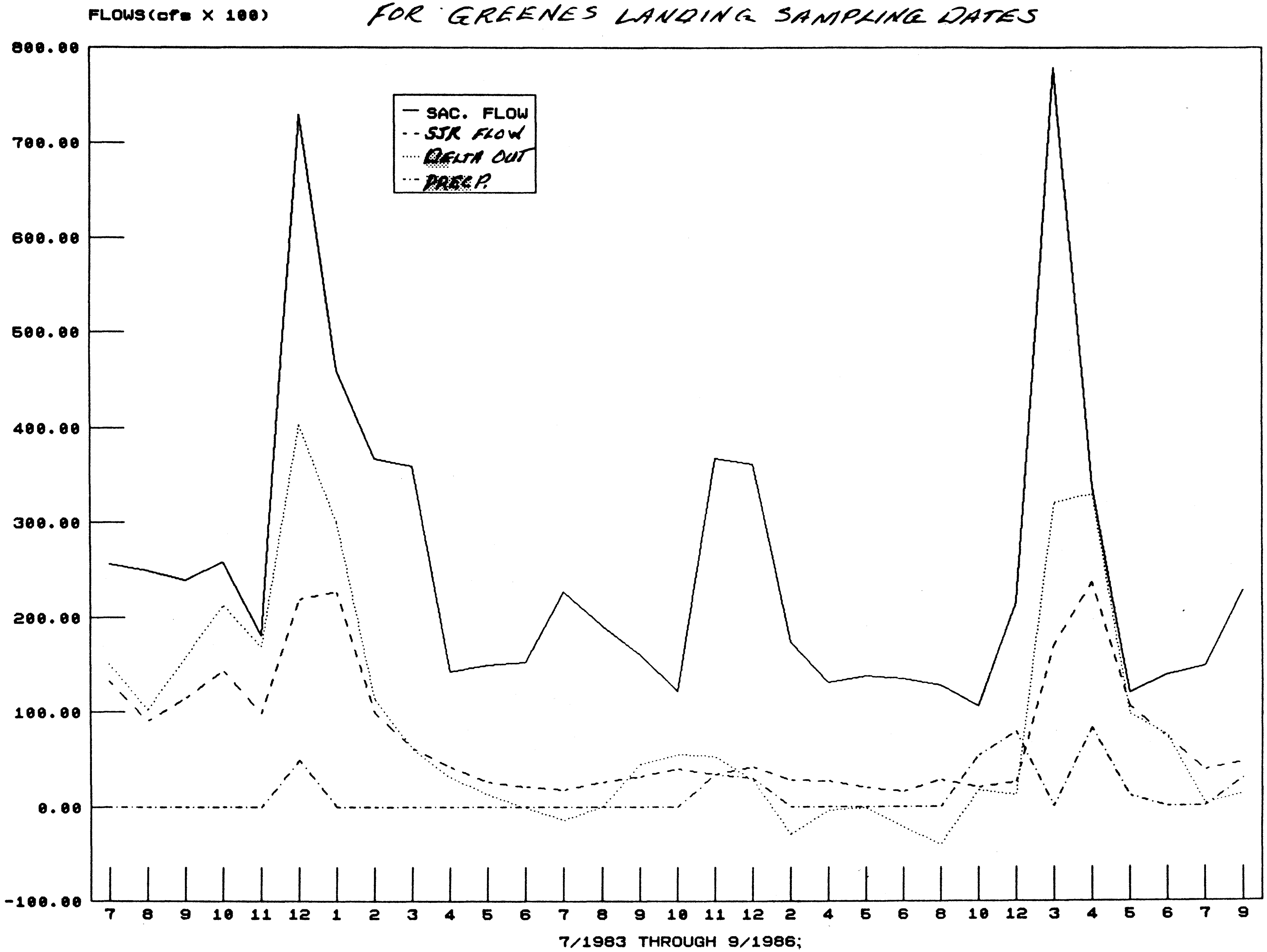
DELTA CROSS CHANNEL OPEN



DELTA CIRCULATION PATTERNS
HIGH FLOWS
HIGH EXPORT

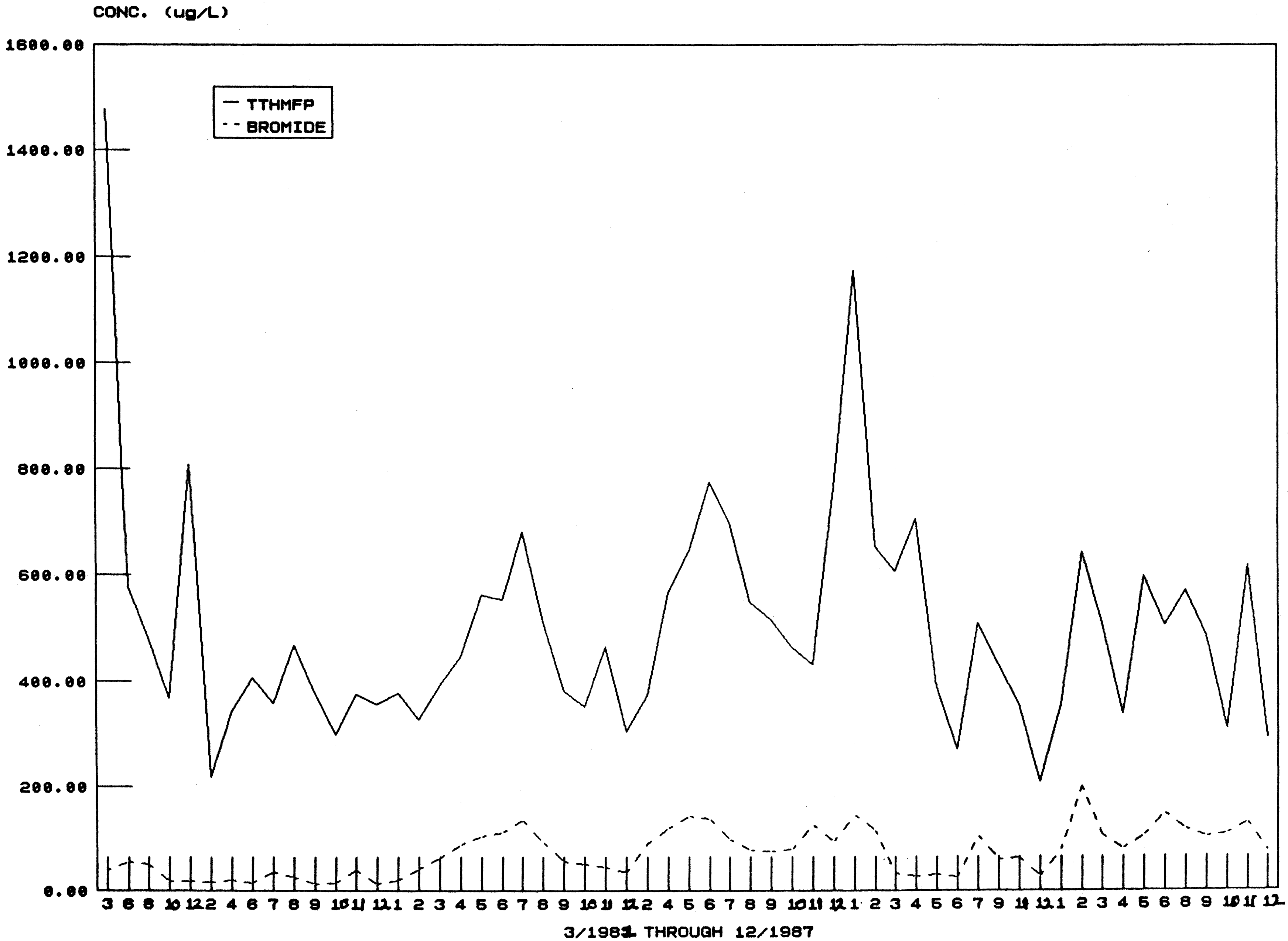
RIVER FLOW, DELTA OUTFLOW AND PRECIPITATION DATA

FOR GREENES LANDING SAMPLING DATES



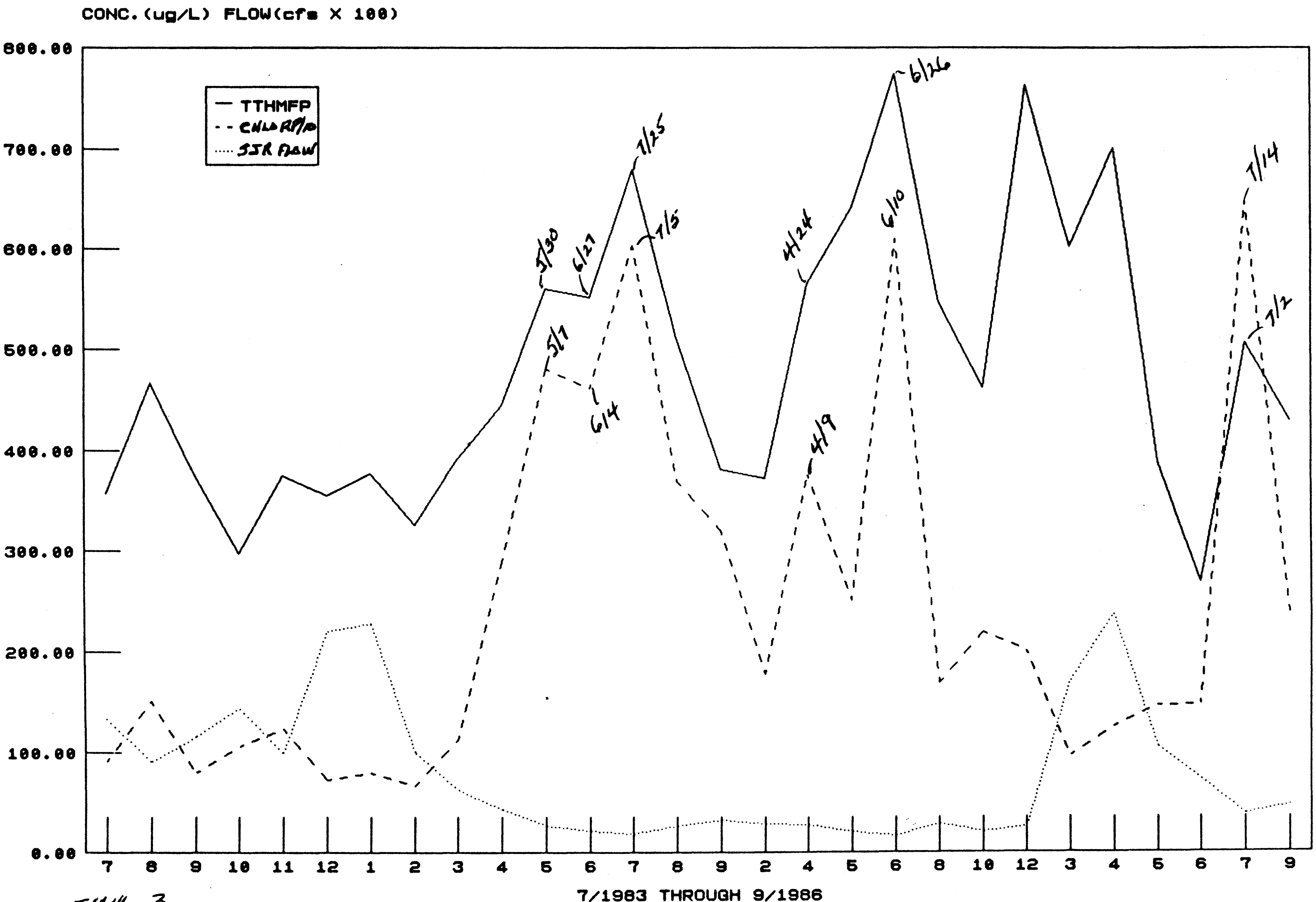
THM-1

SAN JOAQUIN RIVER AT VERNALIS



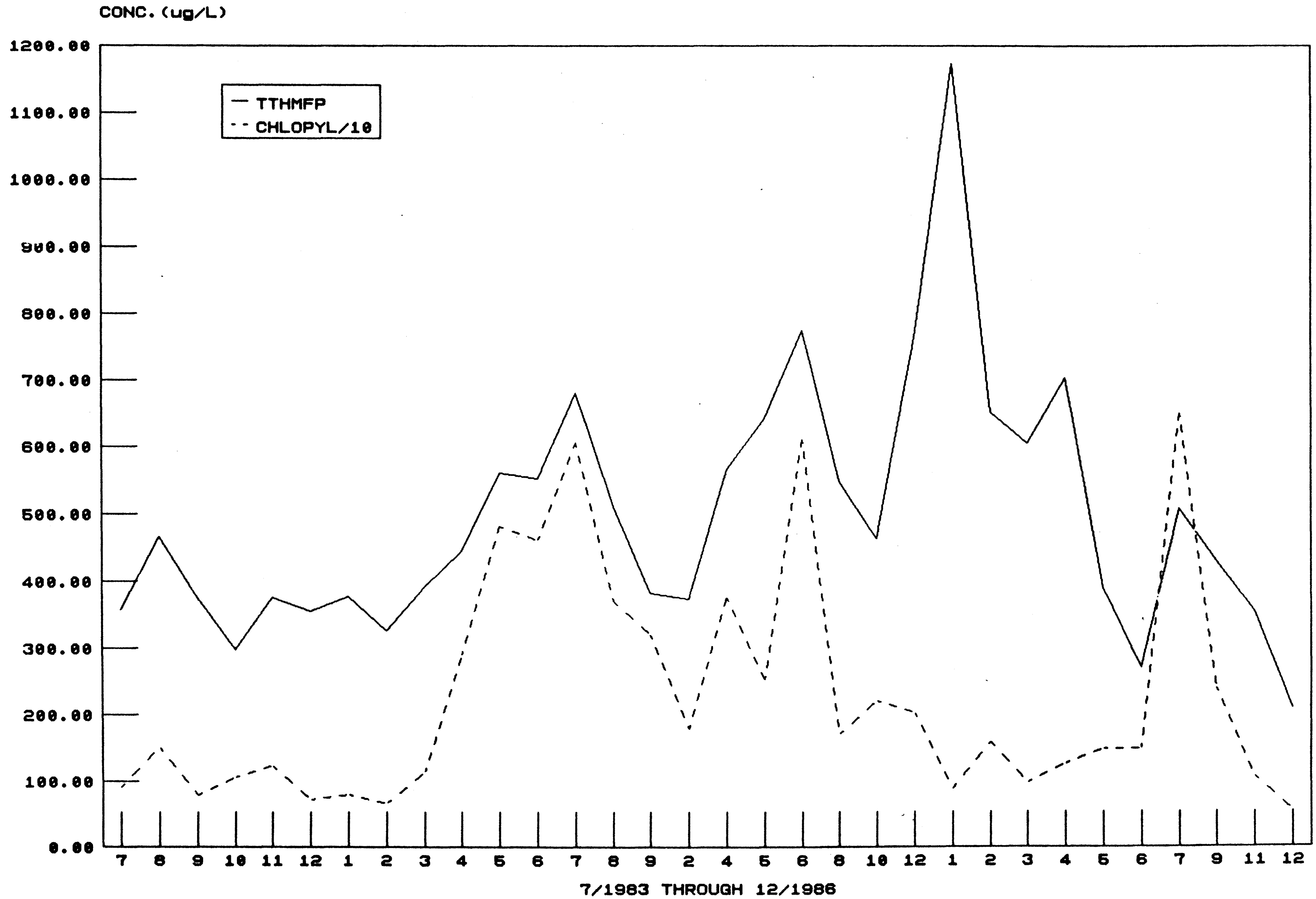
THM-2

SAN JOAQUIN RIVER
AT VERNALIS



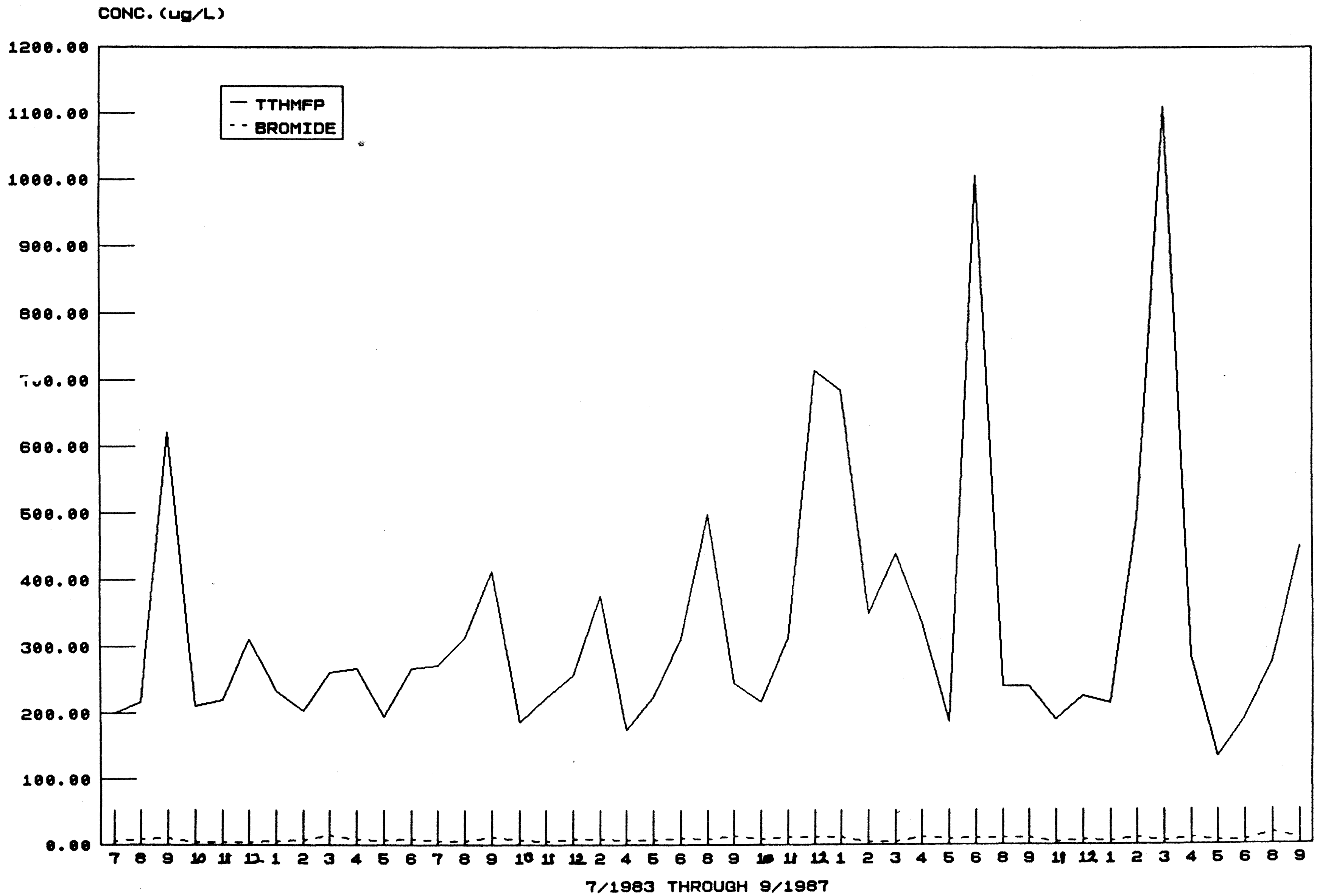
THM-3

SAN JOAQUIN RIVER AT VERNALIS



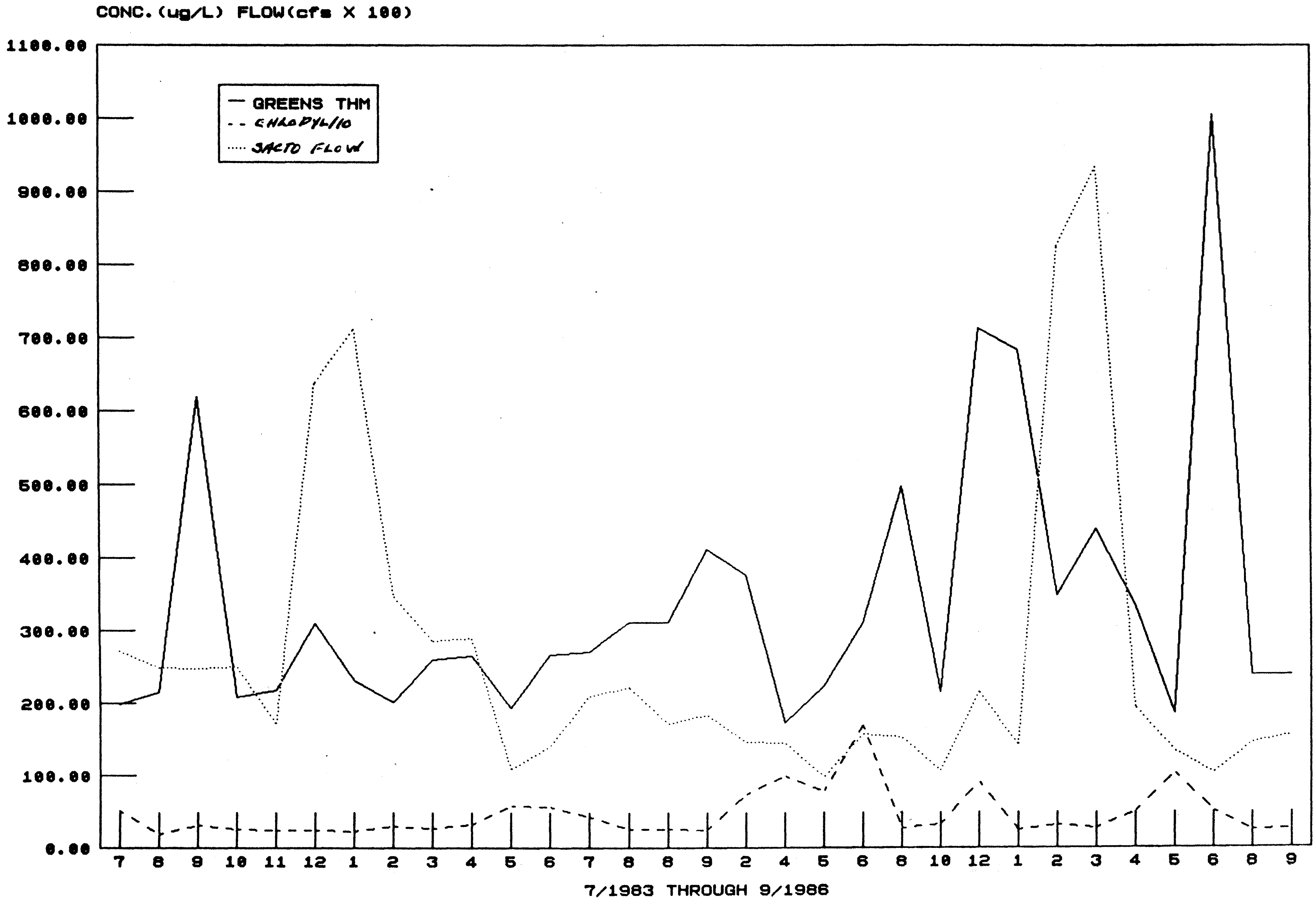
THM-4

SACRAMENTO RIVER AT GREENES LANDING



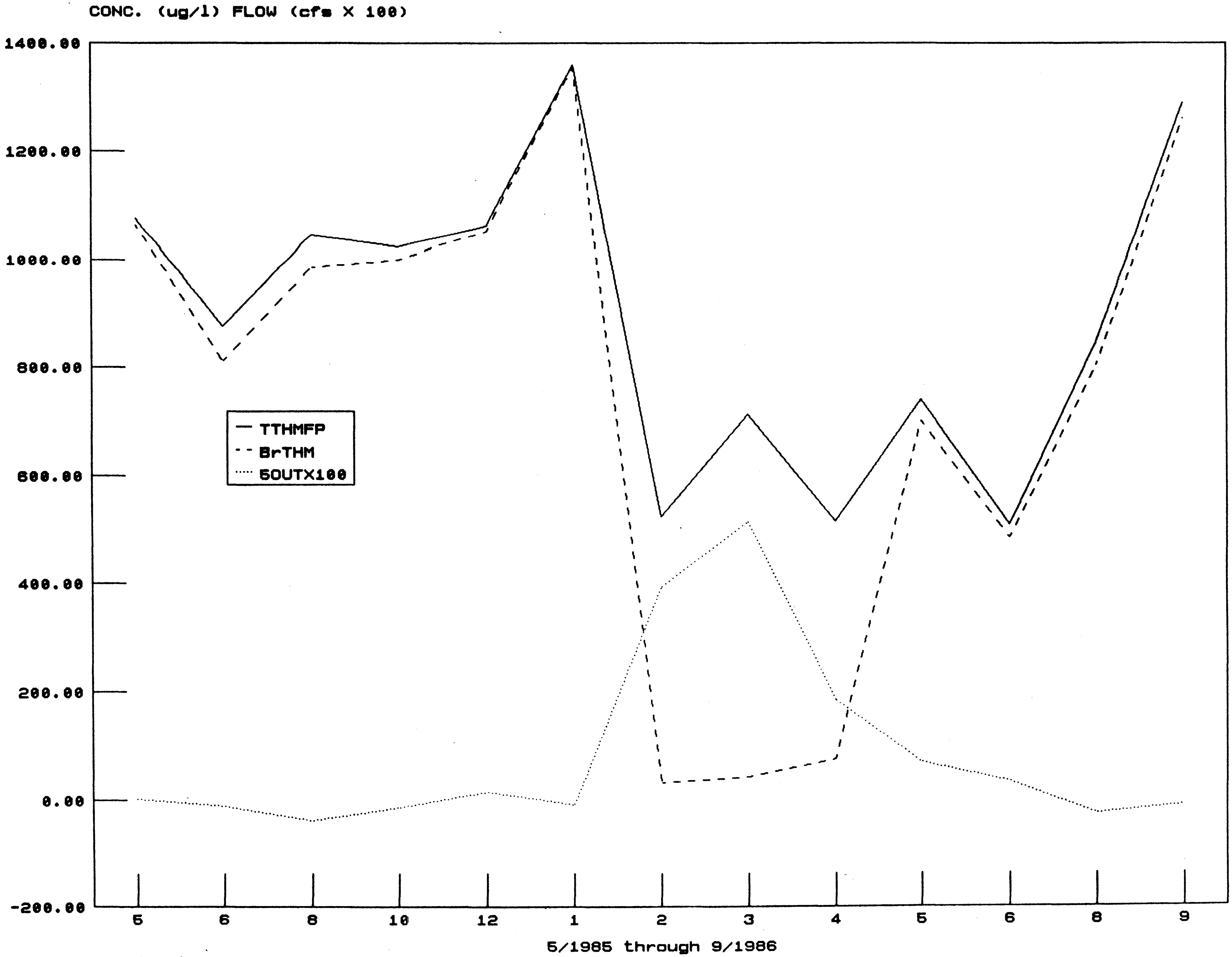
THM-5

SACRAMENTO RIVER AT GREENES LANDING



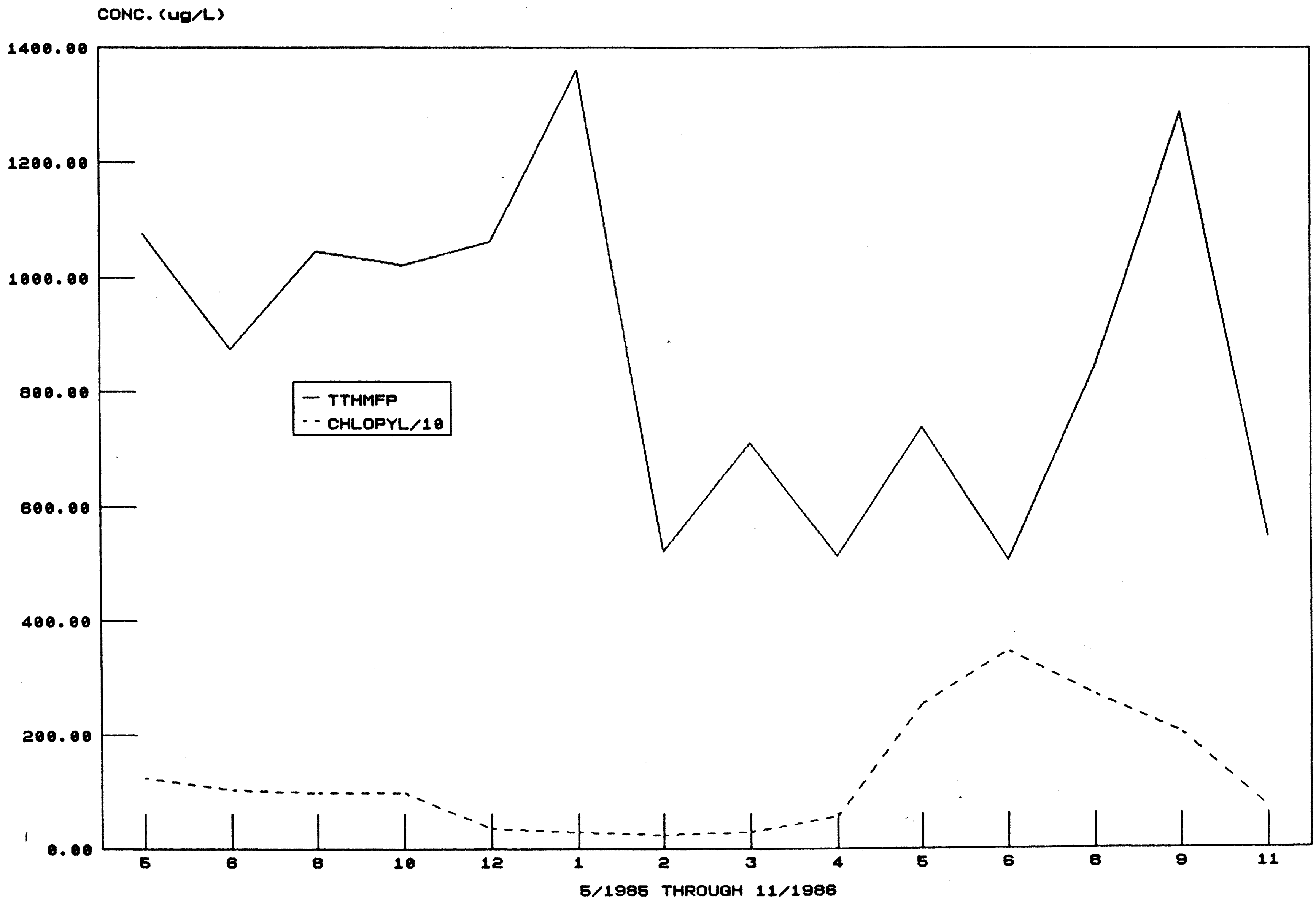
THM-6

SACRAMENTO RIVER AT MALLARD ISLAND
TTHMFP, THM Br and Delta Outflow



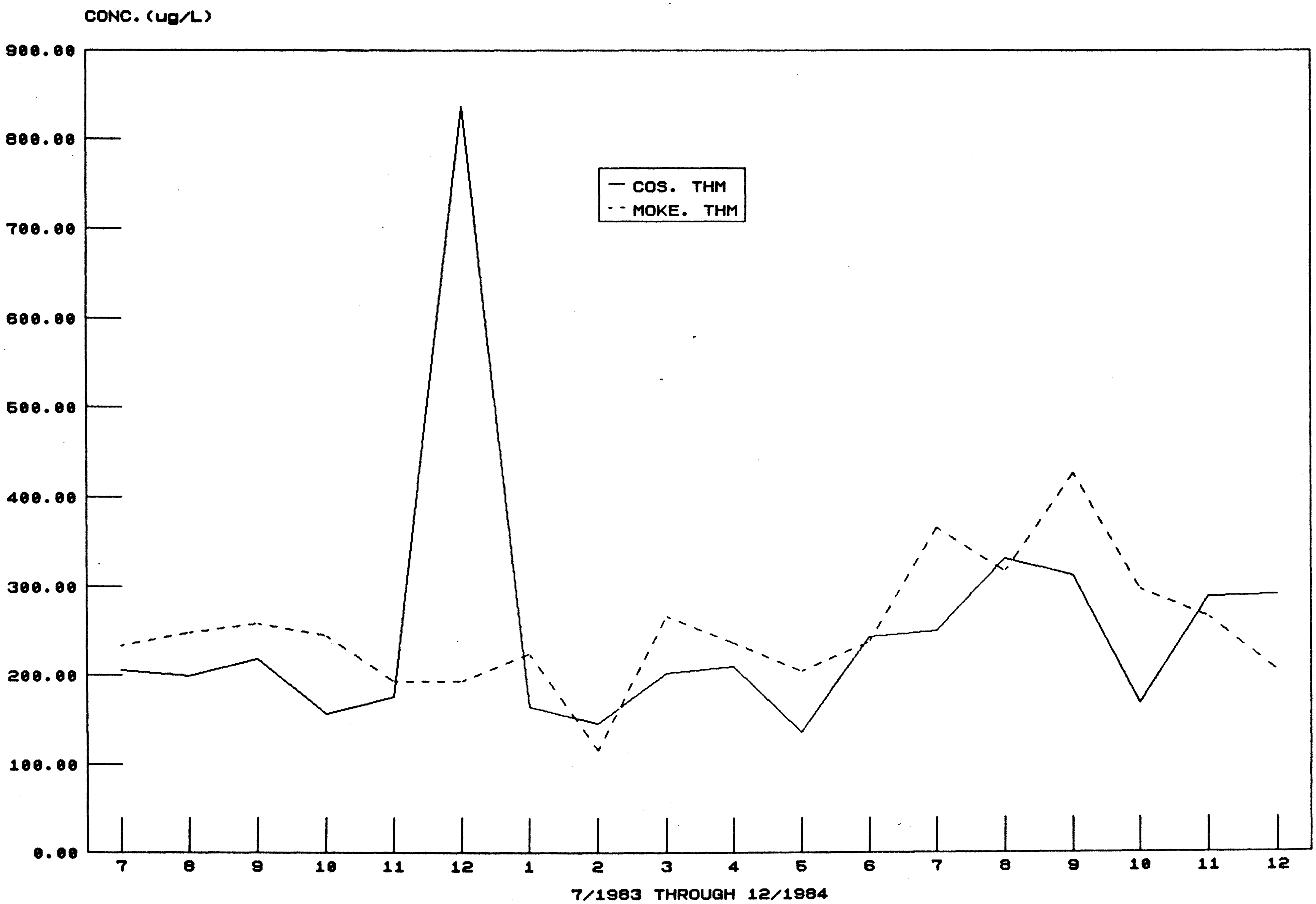
THM-8

SACRAMENTO RIVER AT MALLARD ISLAND



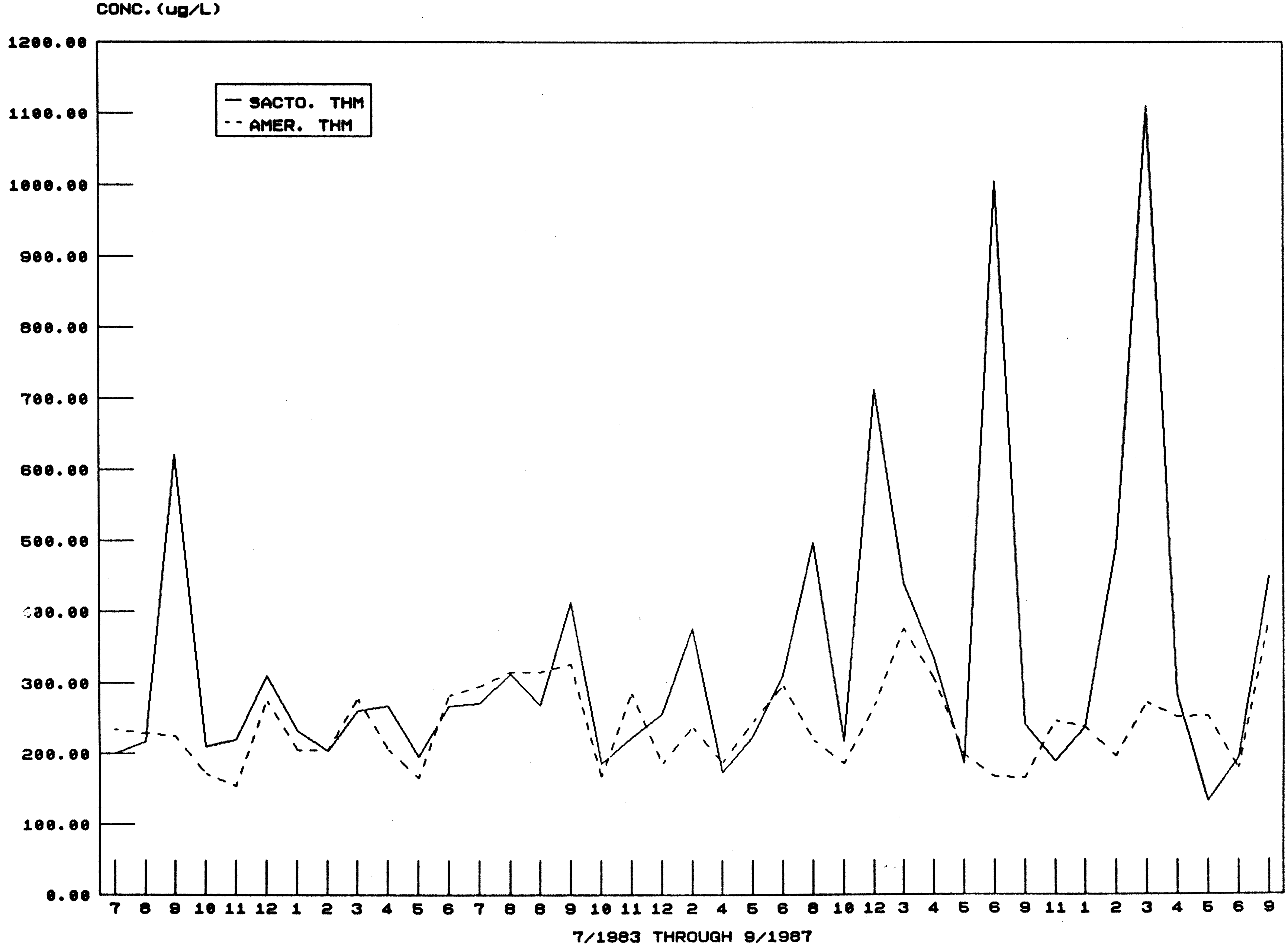
THM-9

COSUMNES RIVER AND MOKELUMNE RIVER



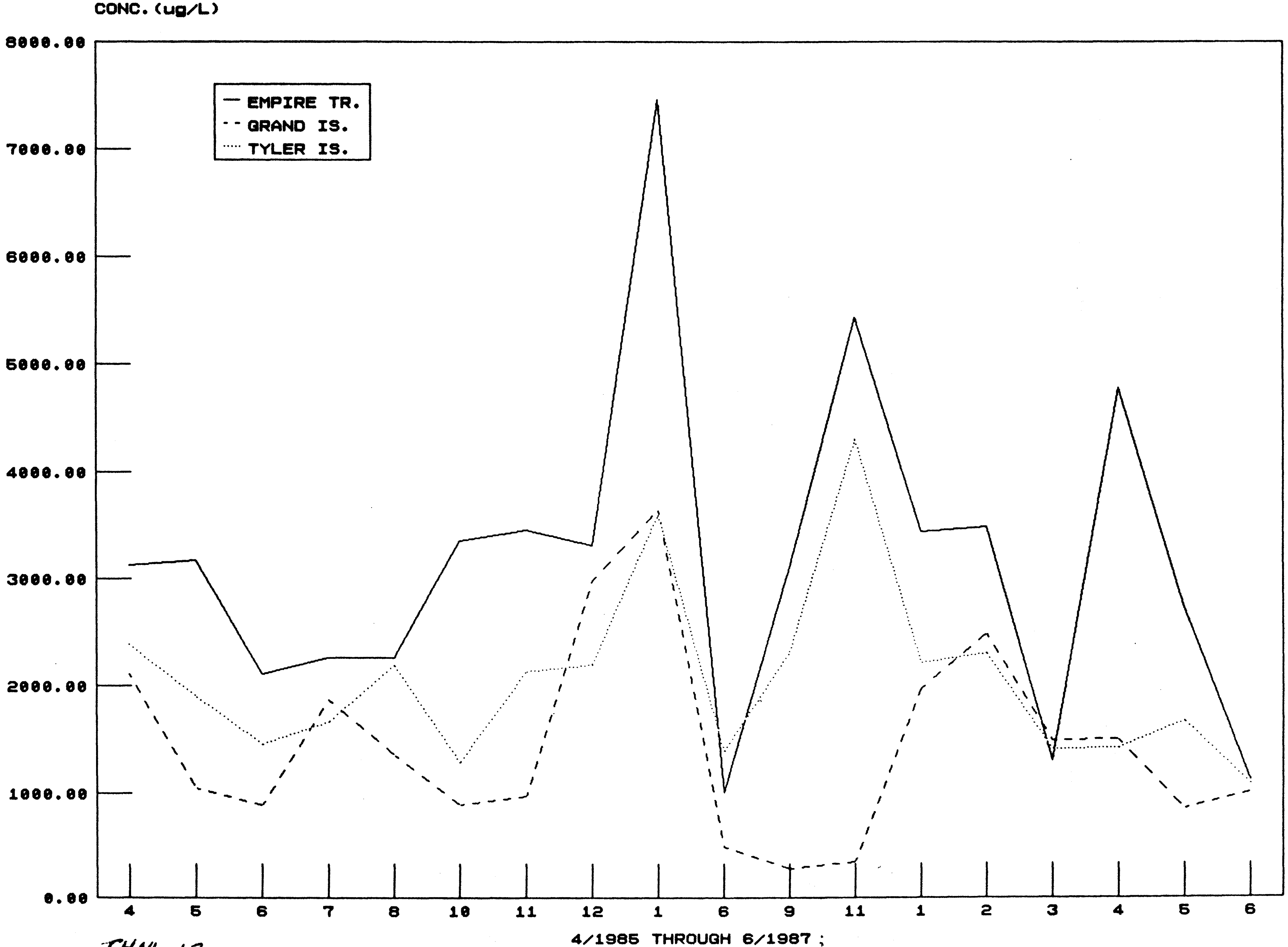
THM-10

SACRAMENTO RIVER AND AMERICAN RIVER



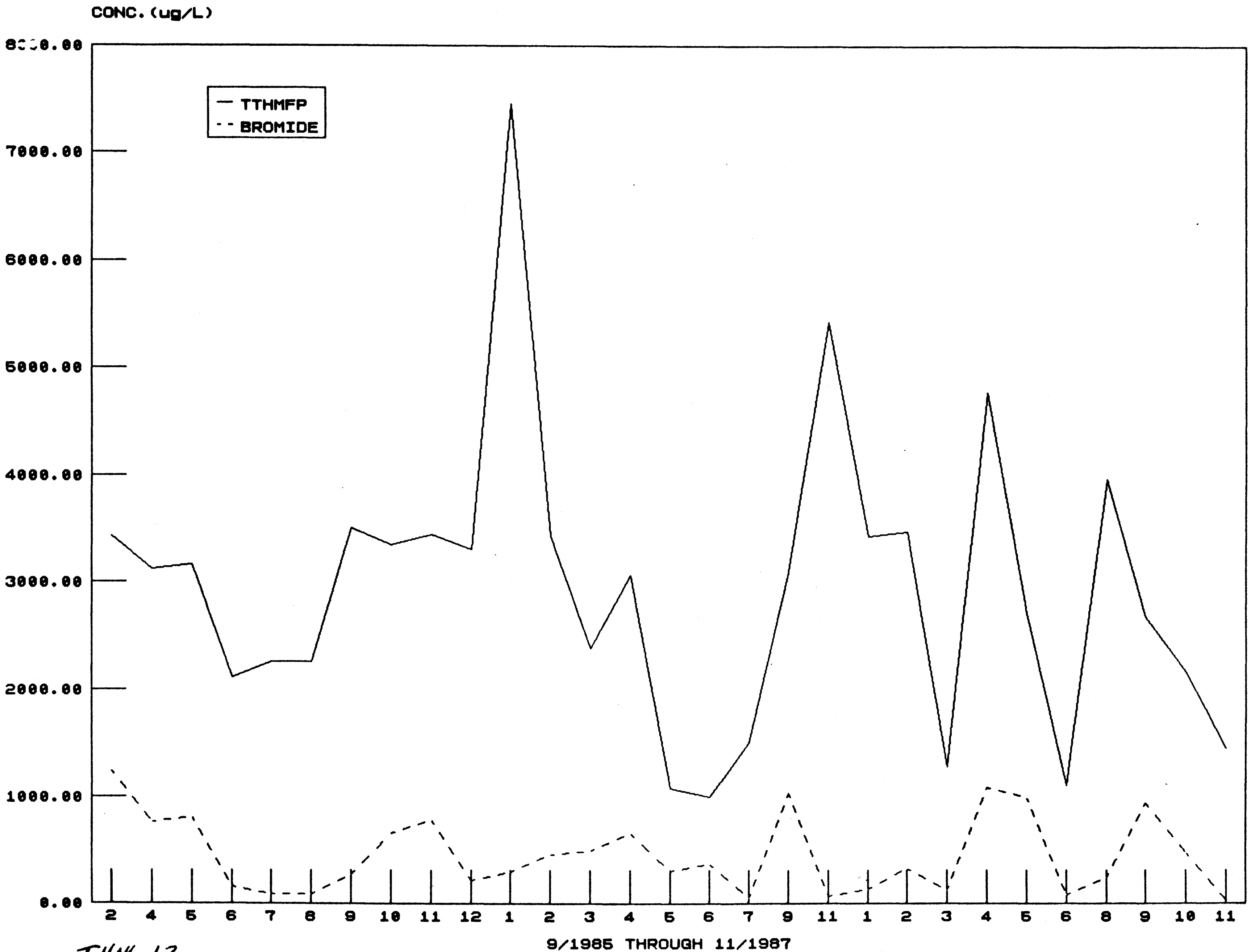
THM-11

AGRICULTURAL DRAINS
TOTAL TRIHALOMETHANE



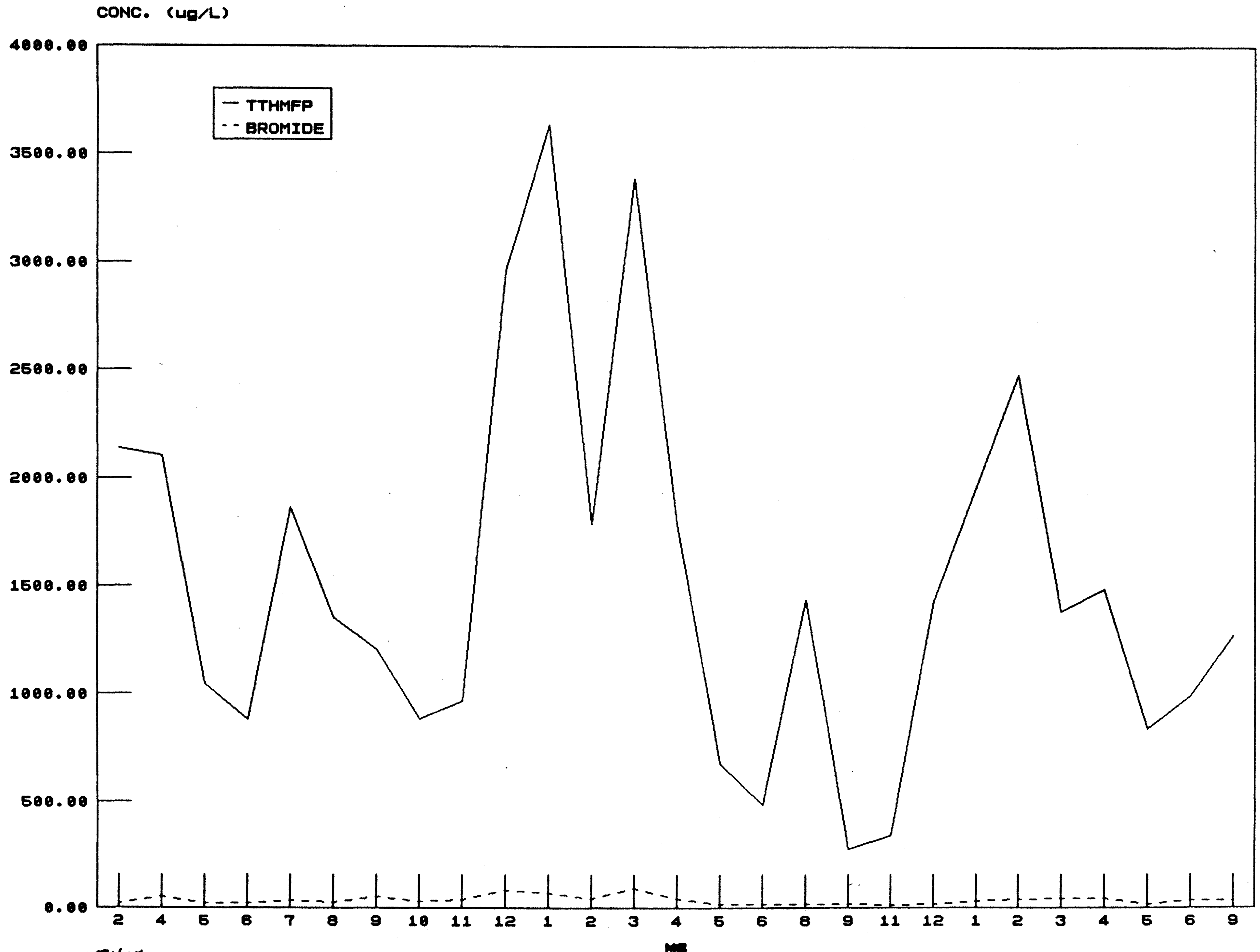
THM-12

EMPIRE TRACT



THM-13

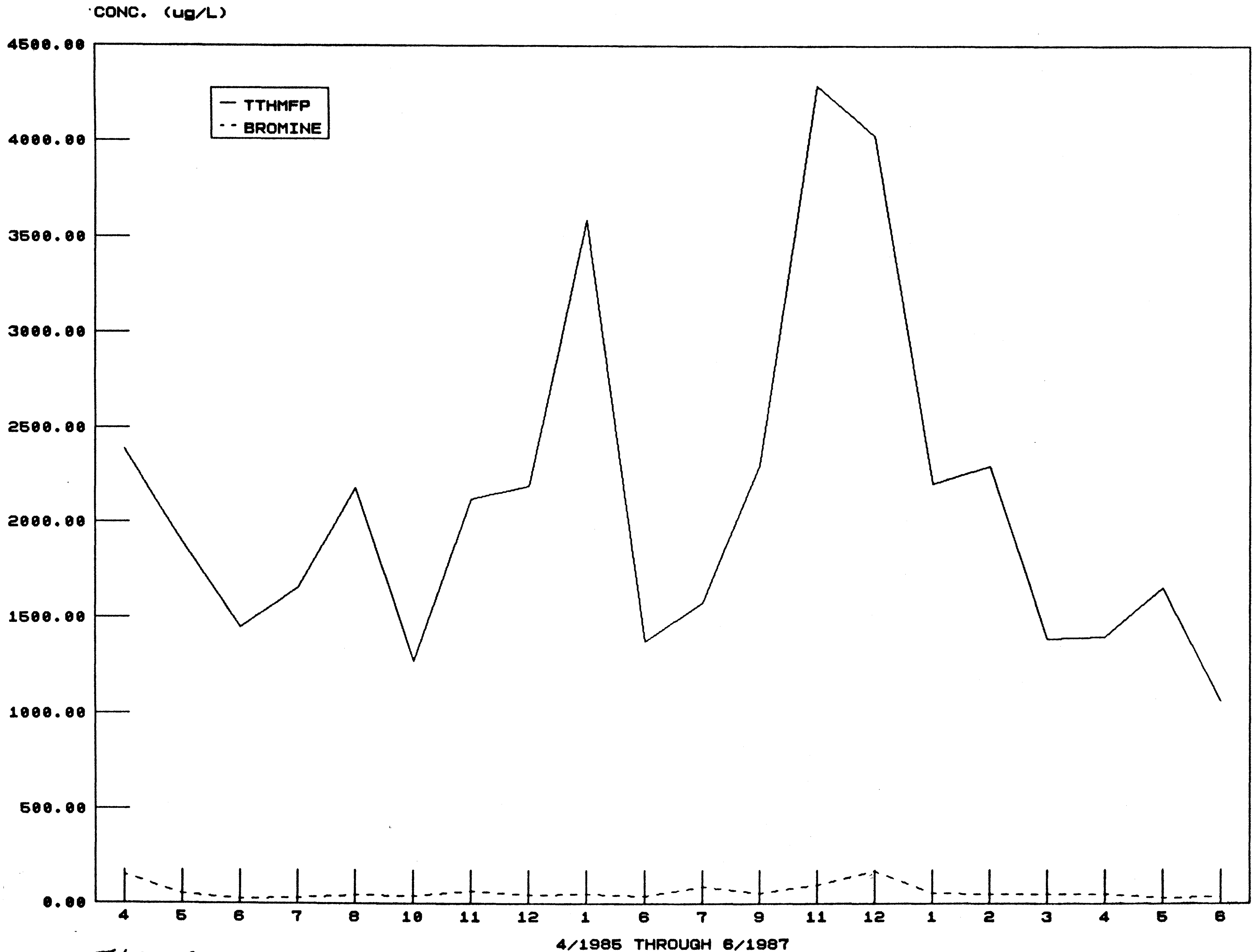
GRAND ISLAND



THM-14

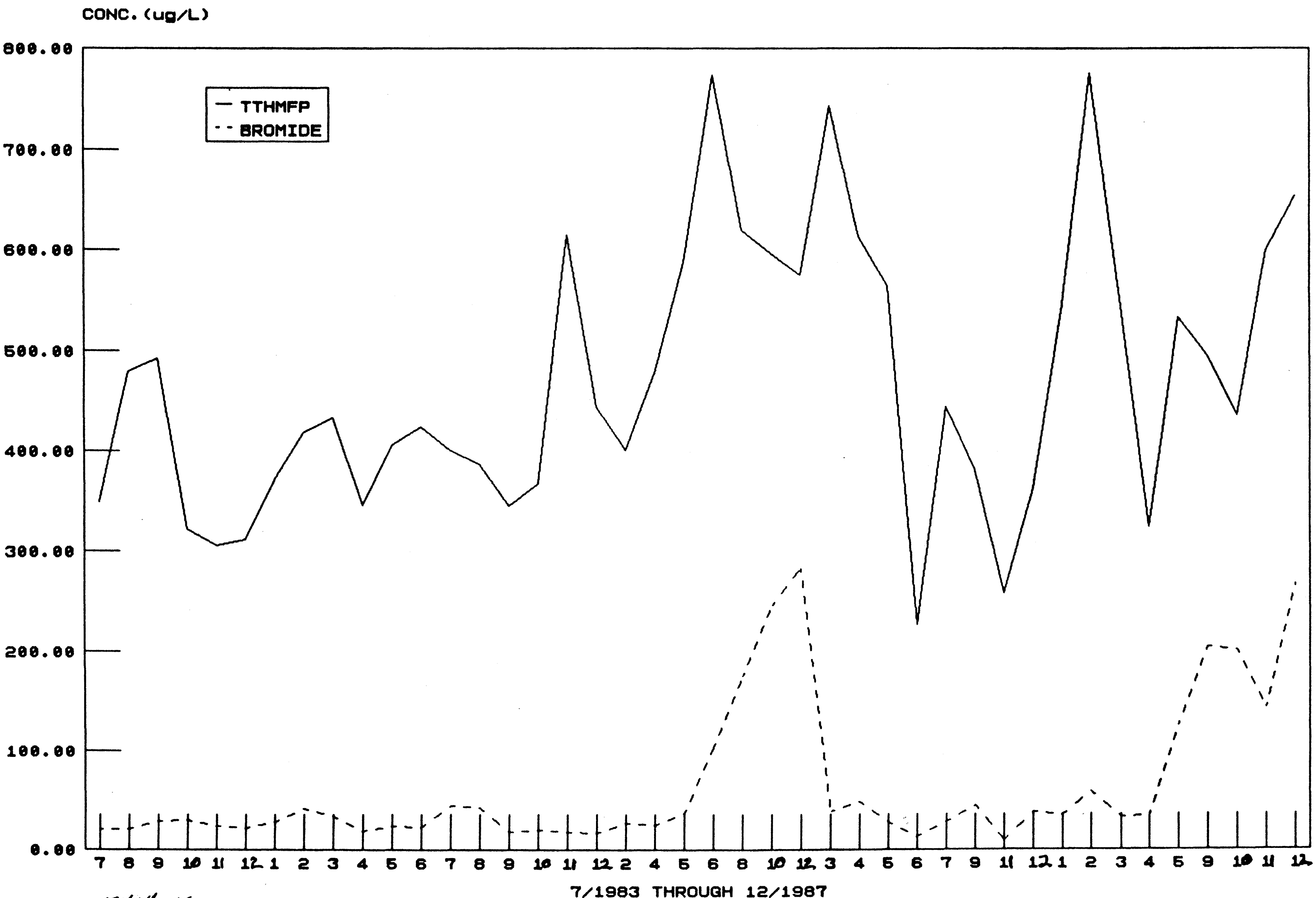
2/1985 THROUGH 9/1987

TYLER ISLAND



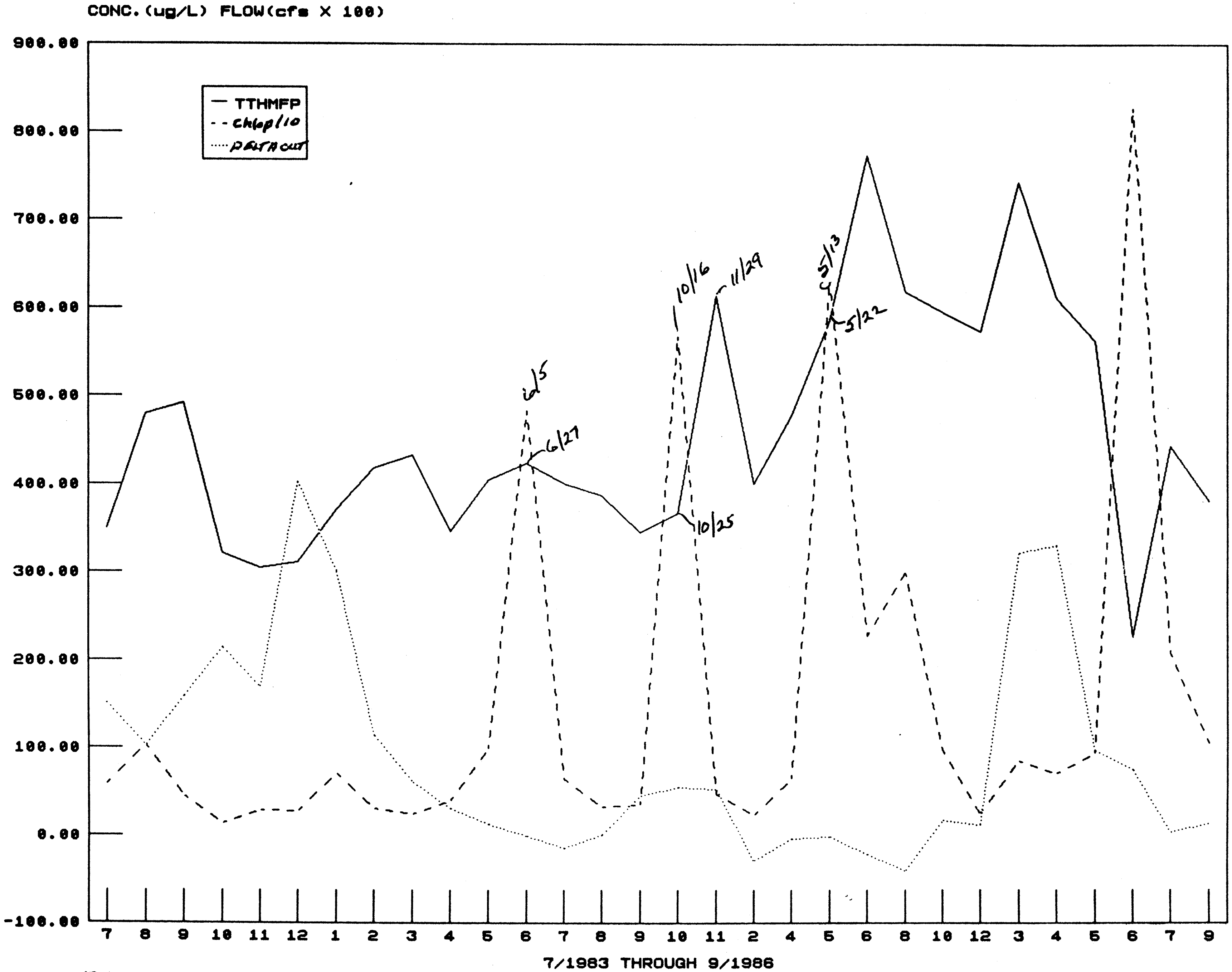
THM-15

OLD RIVER AT ROCK SLOUGH



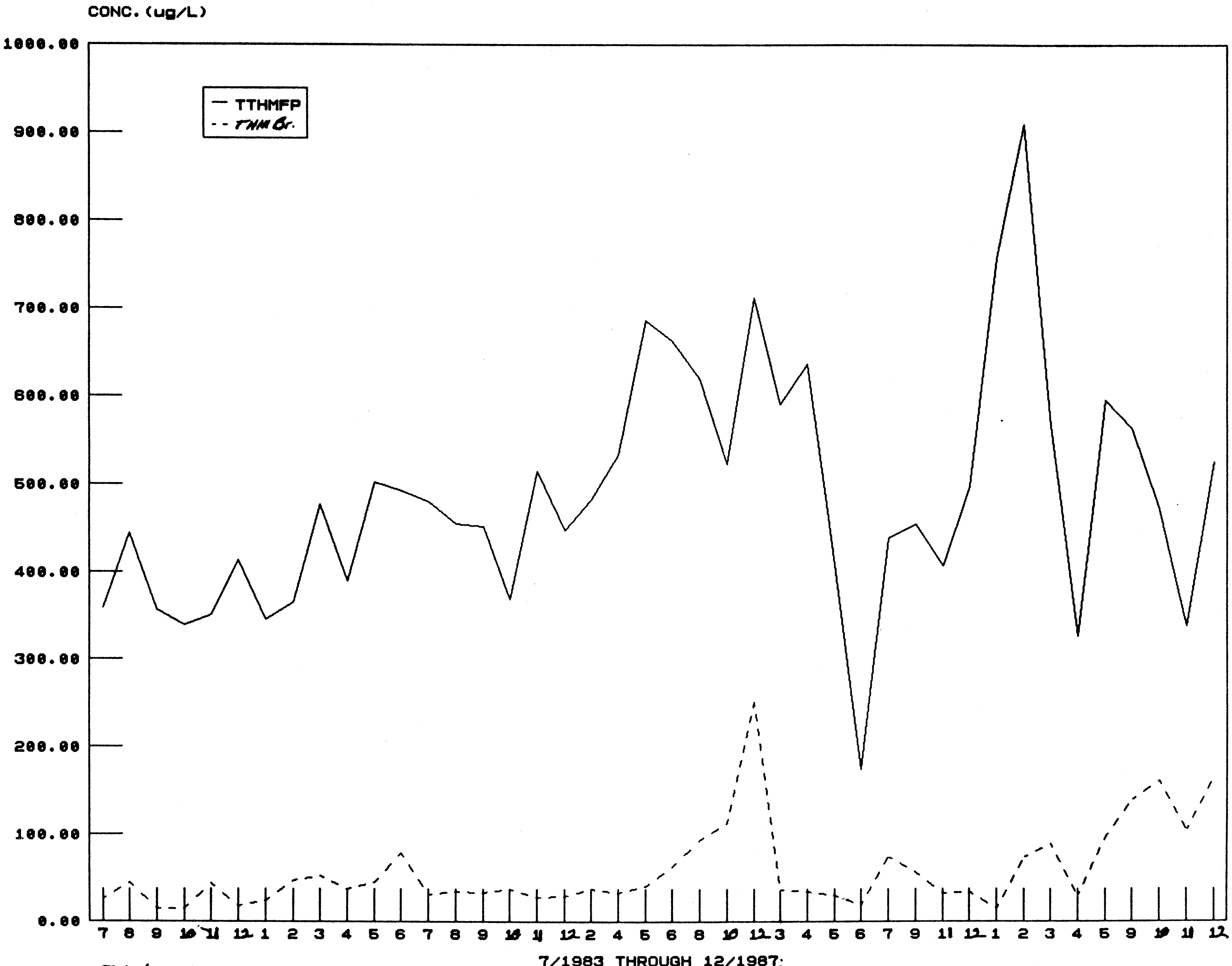
THM-16

OLD RIVER AT ROCK SLOUGH



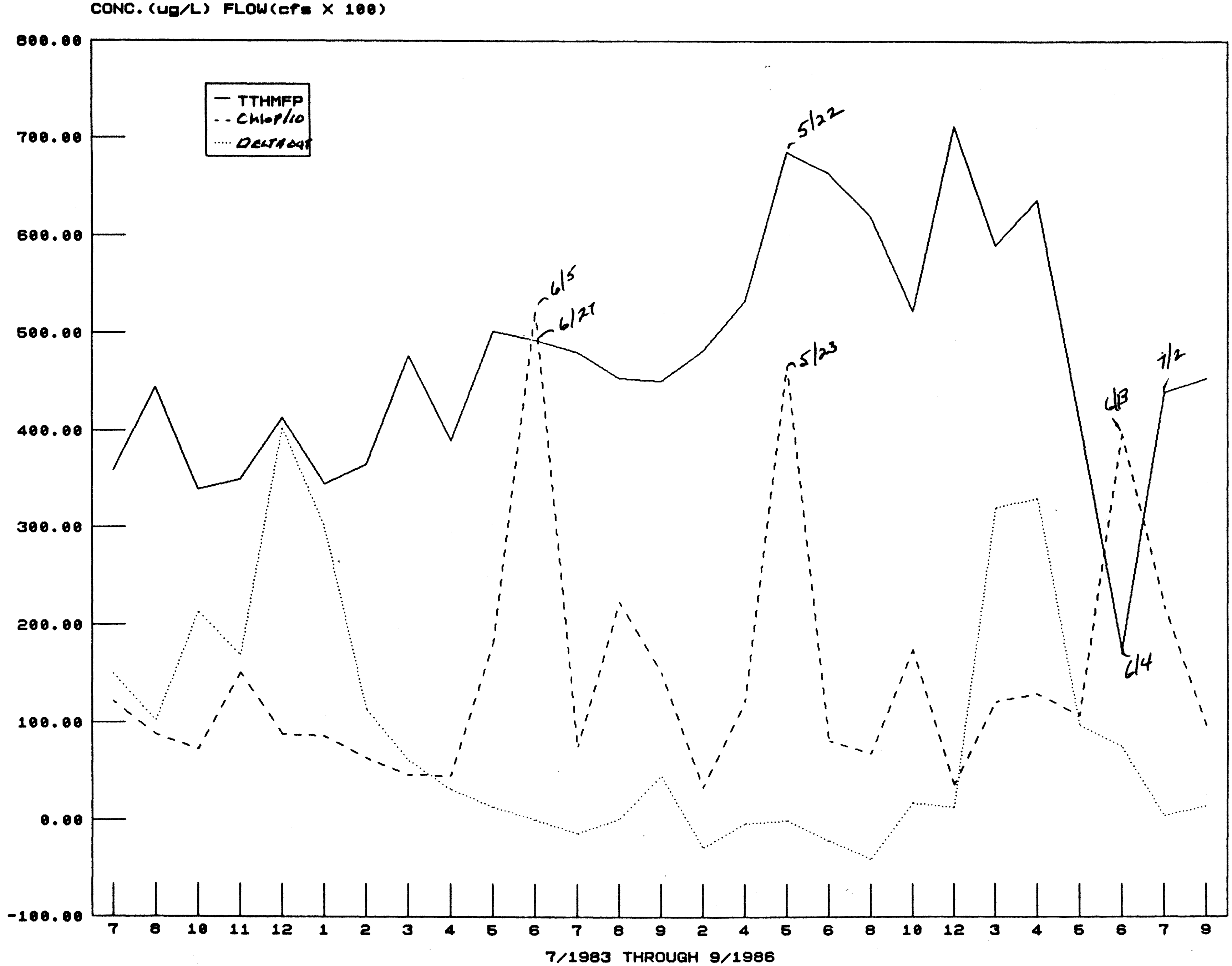
THM-16A

CLIFTON COURT INTAKE



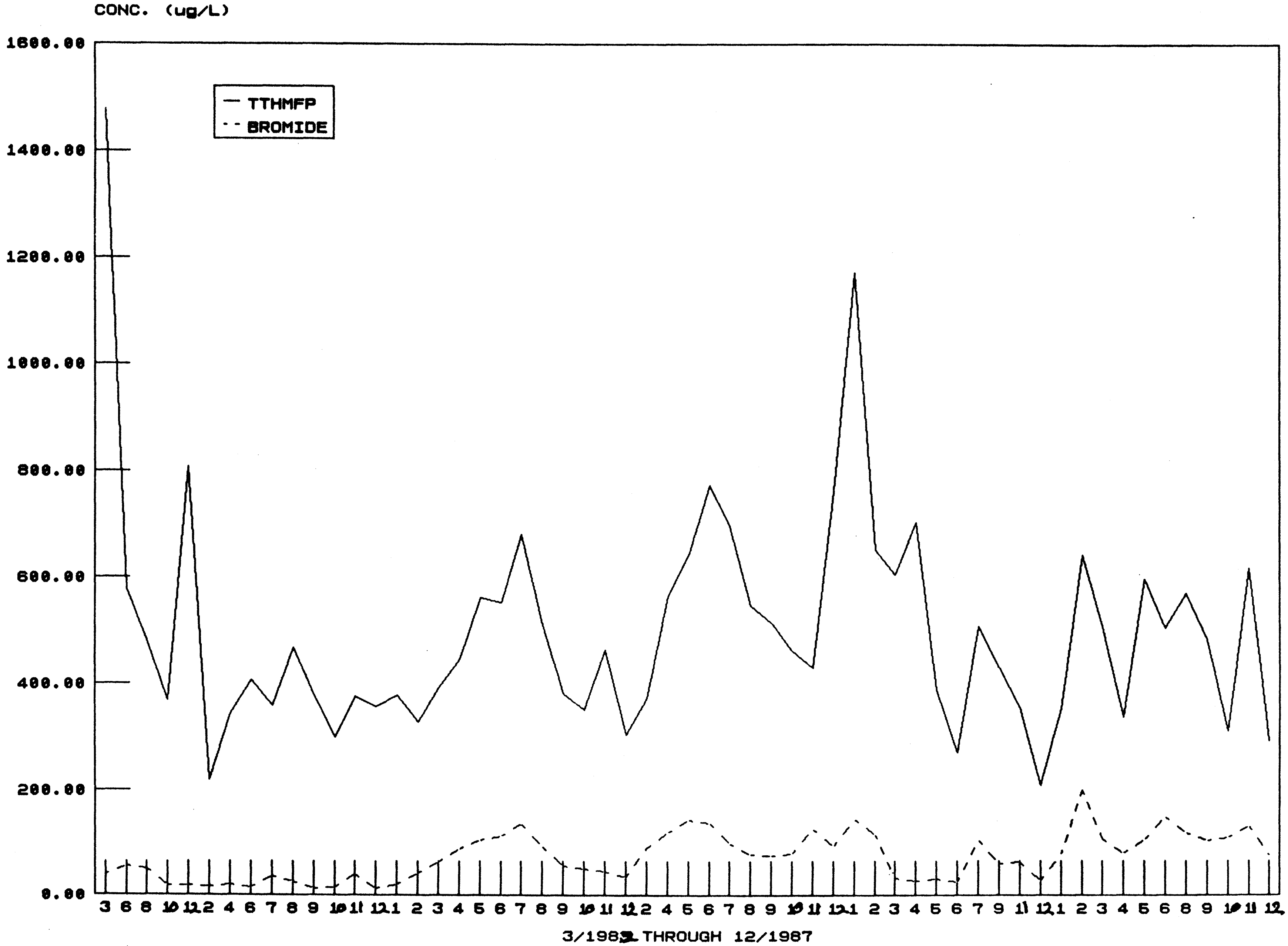
THM-17

CLIFTON COURT INTAKE



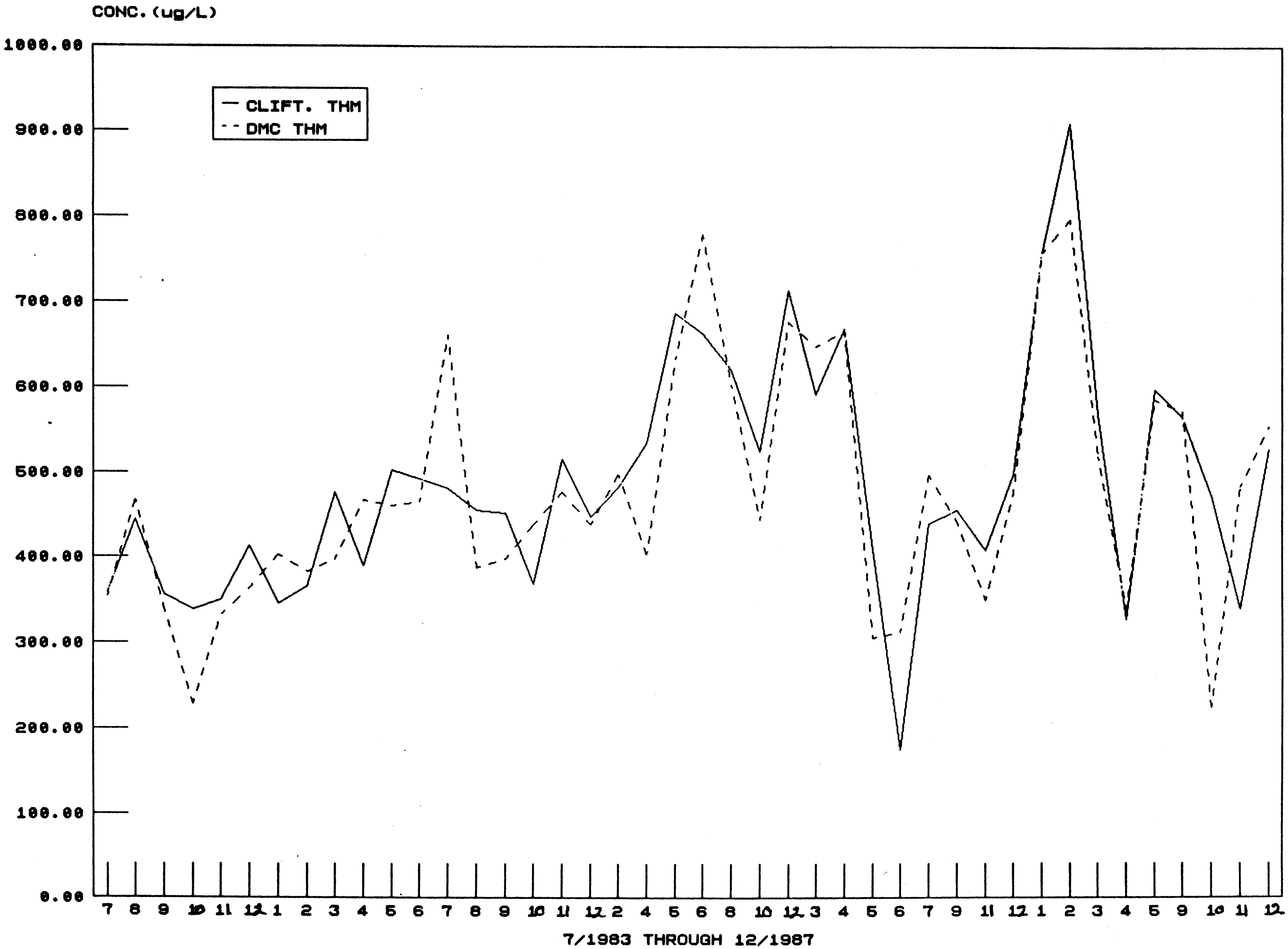
THM-17A

SAN JOAQUIN RIVER AT VERNALIS



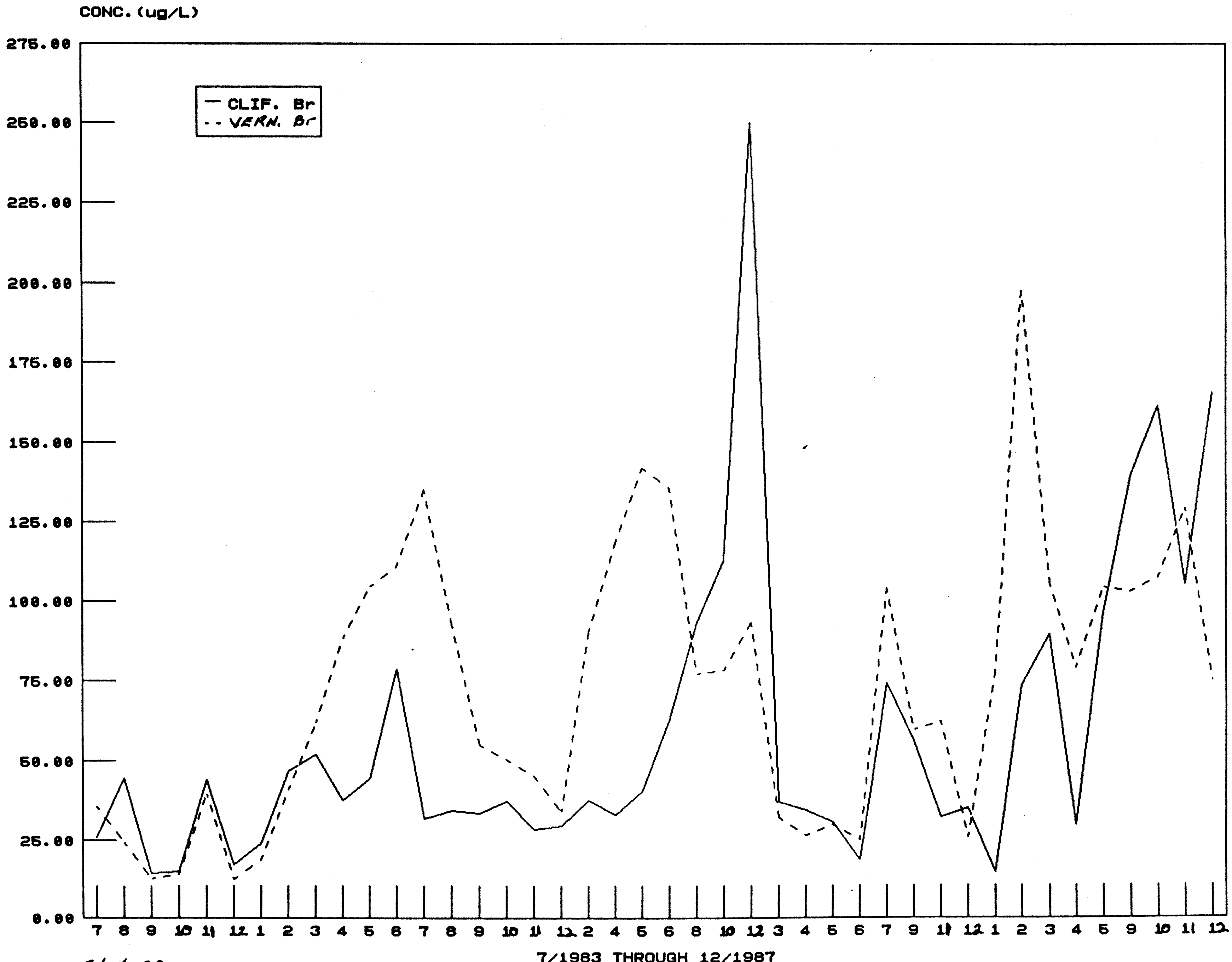
THM-18

CLIFTON COURT INTAKE
DELTA MENDOTA INTAKE



THM-19

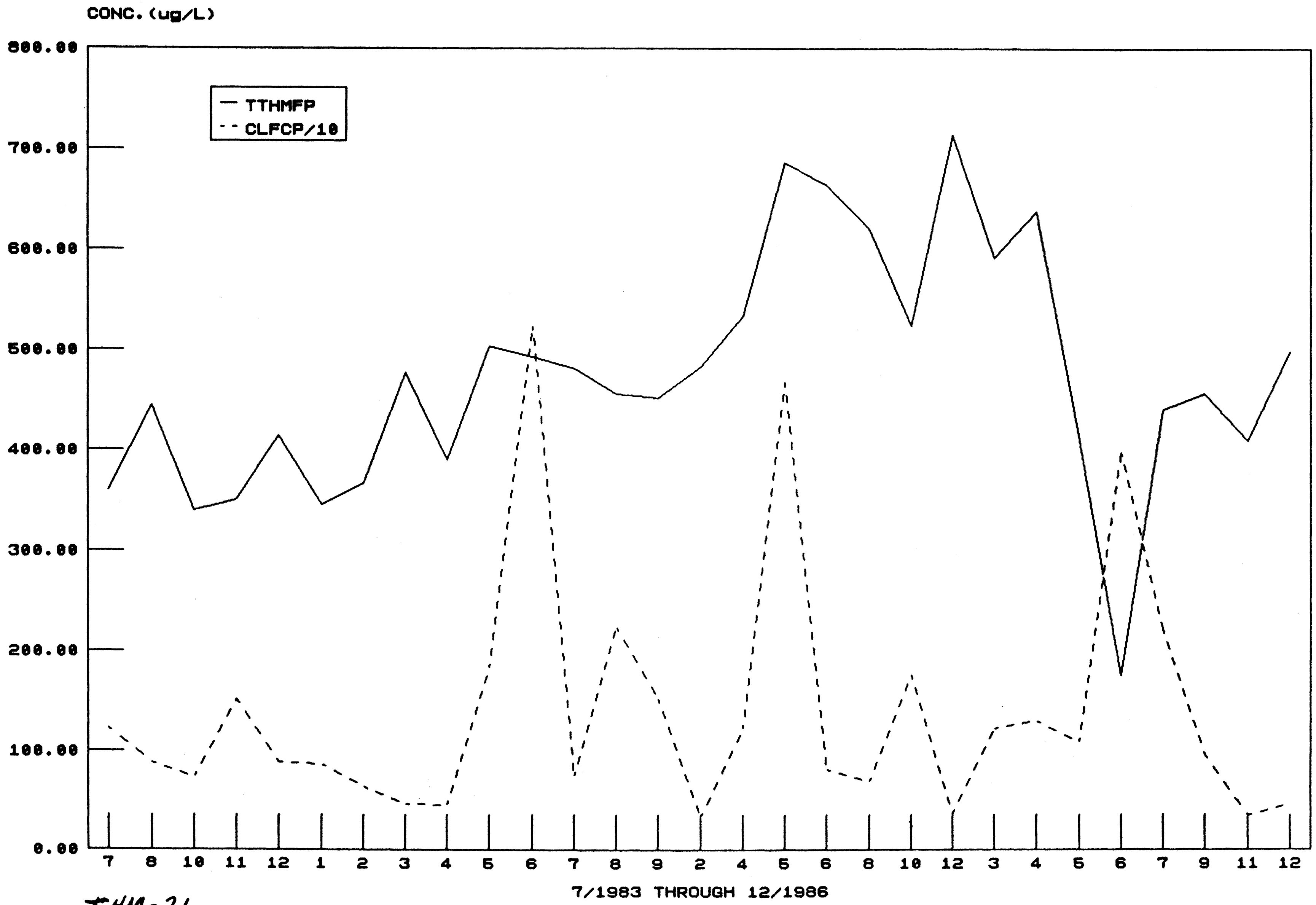
CLIFTON COURT AND VERNALIS



THM-20

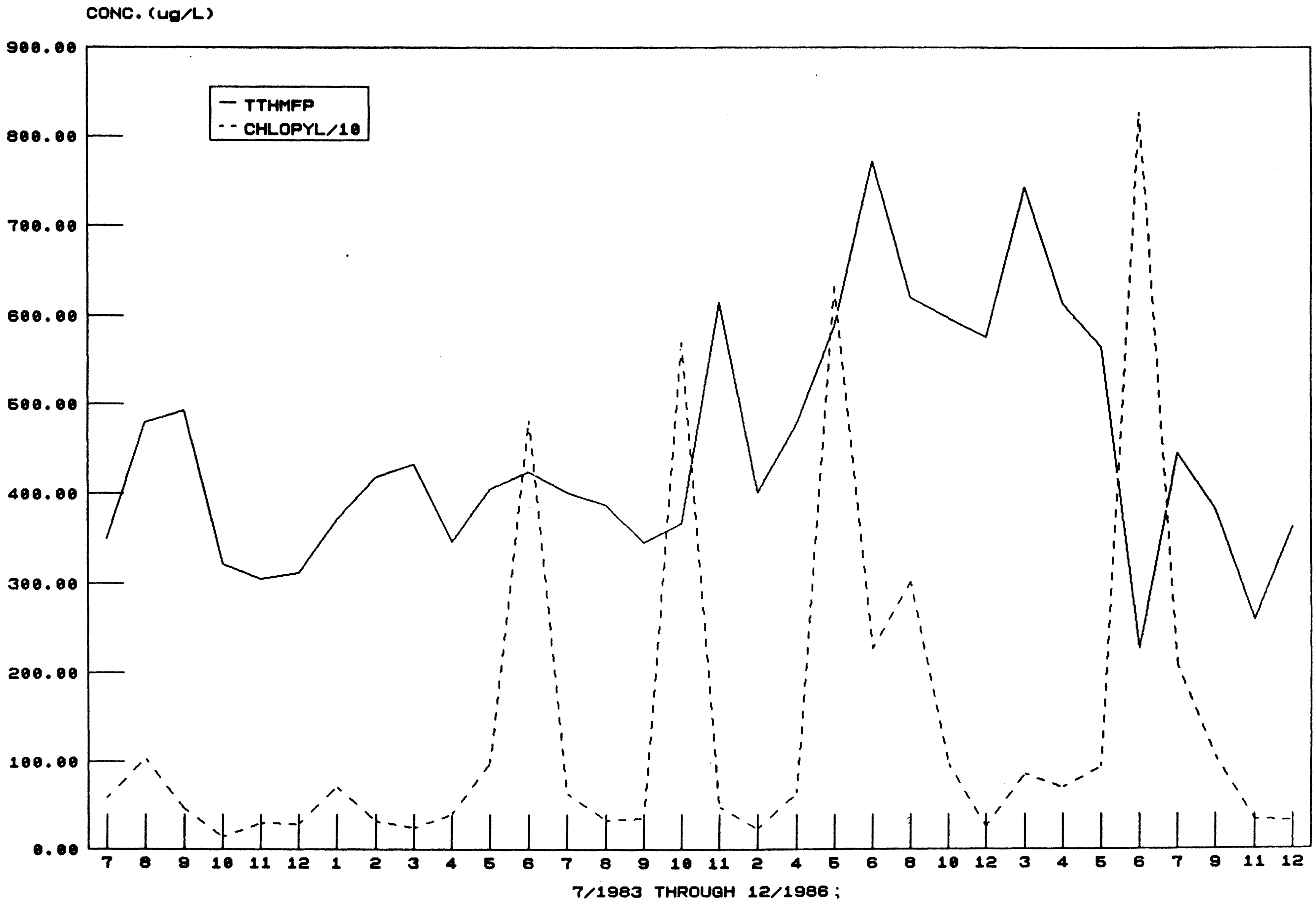
98

OLD RIVER AT CLIFTON COURT



THM-21

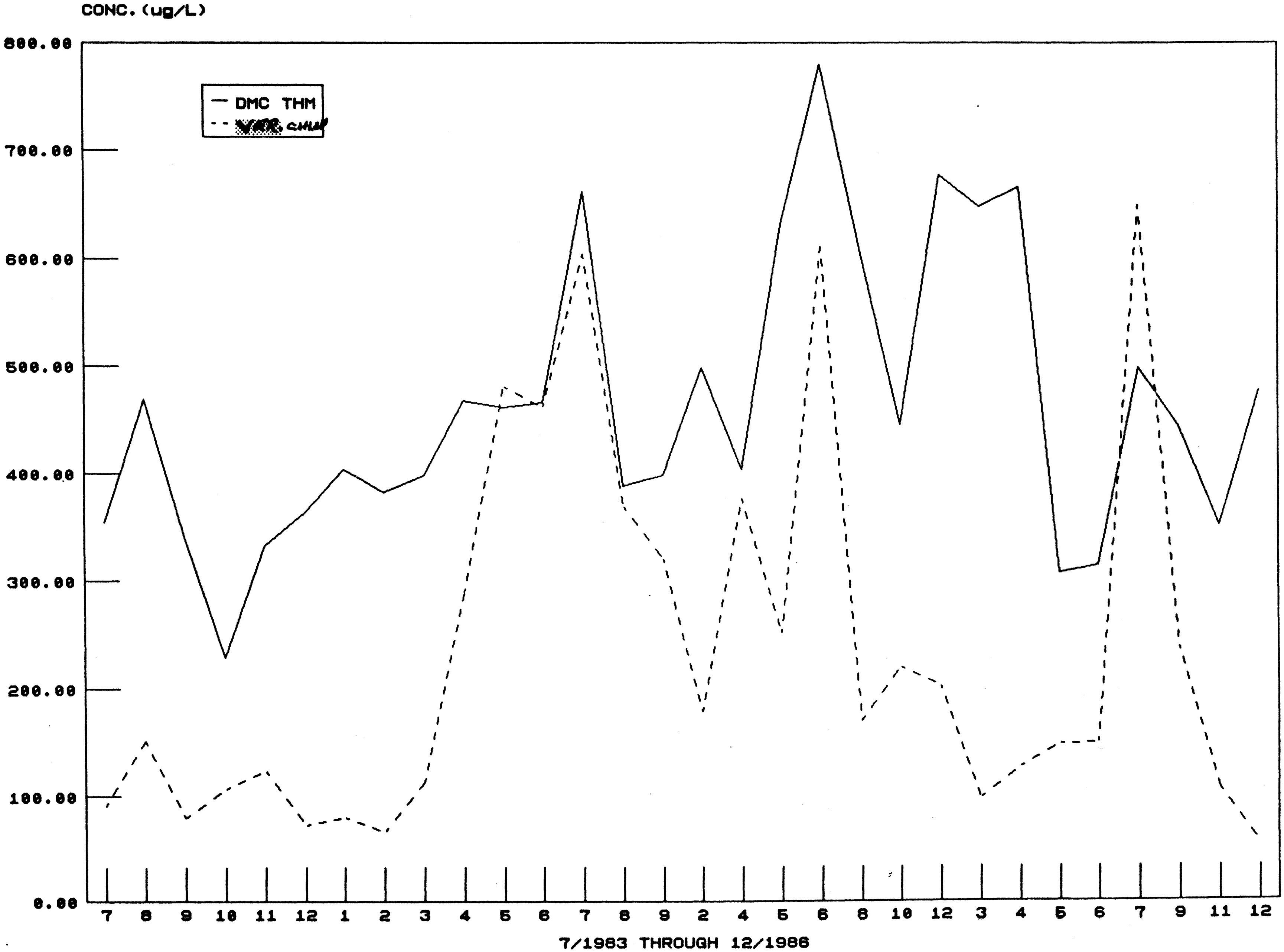
OLD RIVER AT ROCK SLOUGH



THM-22

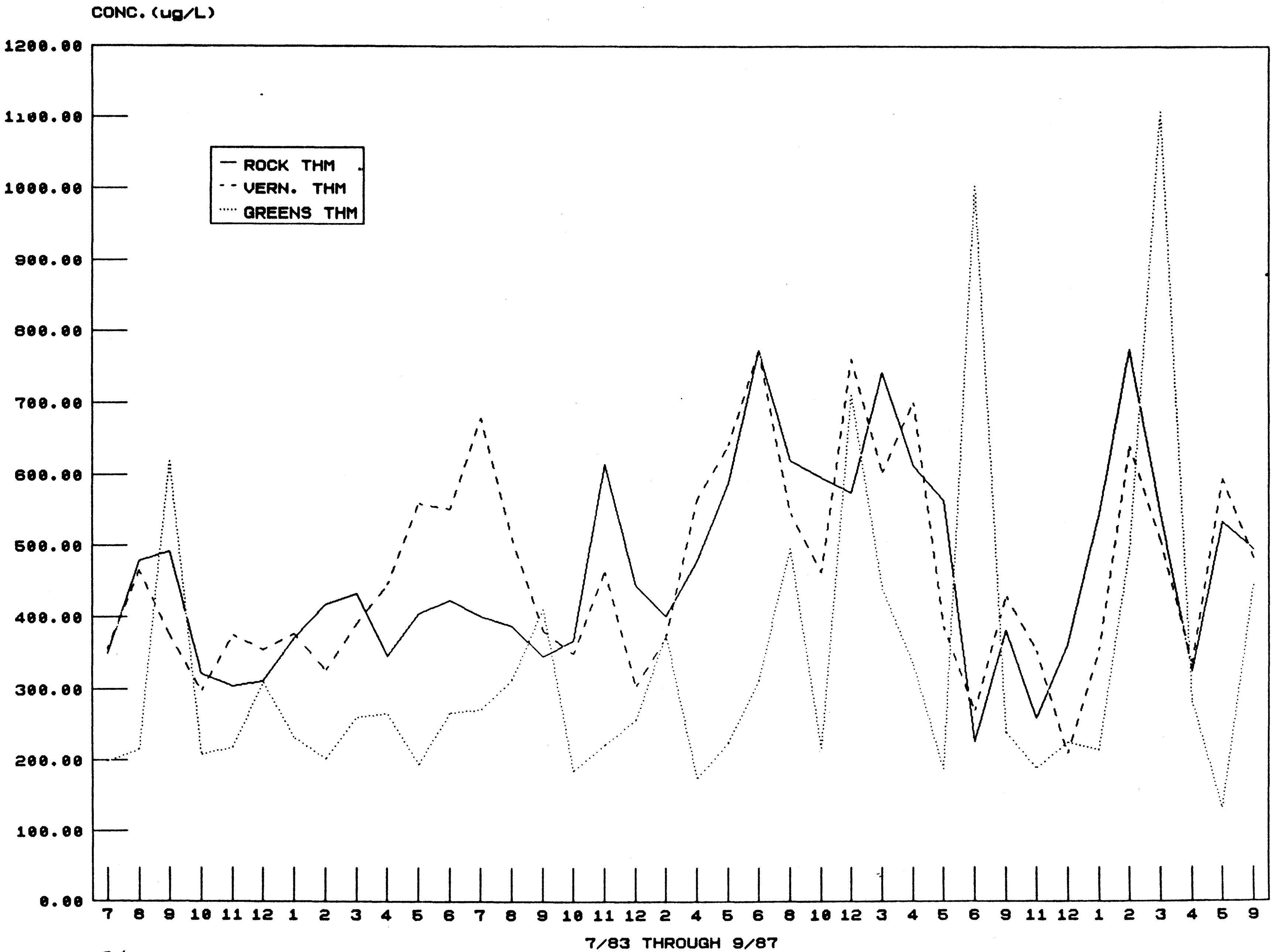
100

DELTA MENDOTA CANAL TTHMFP AND VERNALIS CHLOROPHYL



THM-23

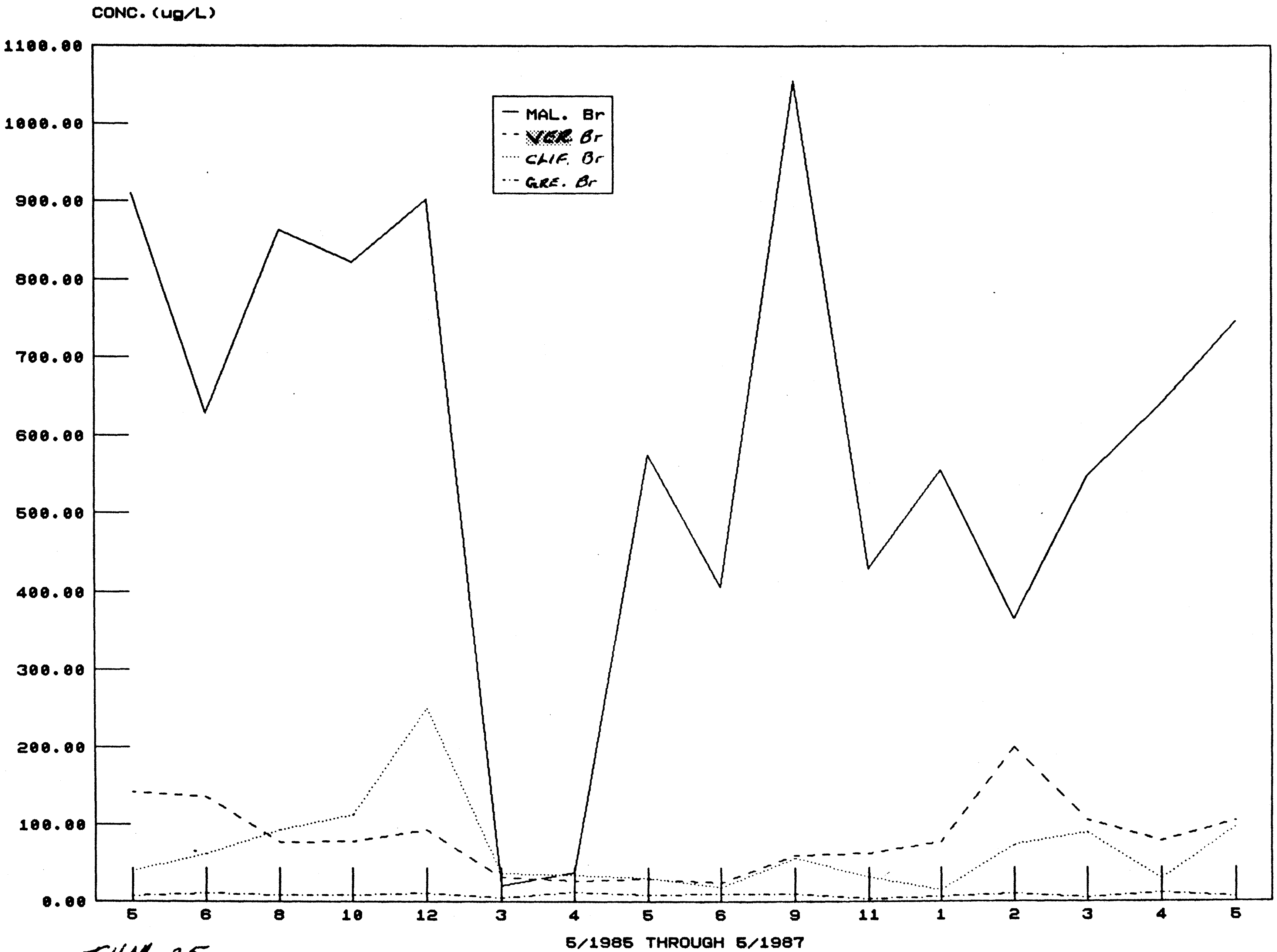
ROCK SLOUGH, VERNALIS AND GREENES LANDING



THM-24

102

MALLARD IS, VERNALIS, CLIFTON COURT AND GREENES LANDING



THM-25

Major Constituents of Seawater

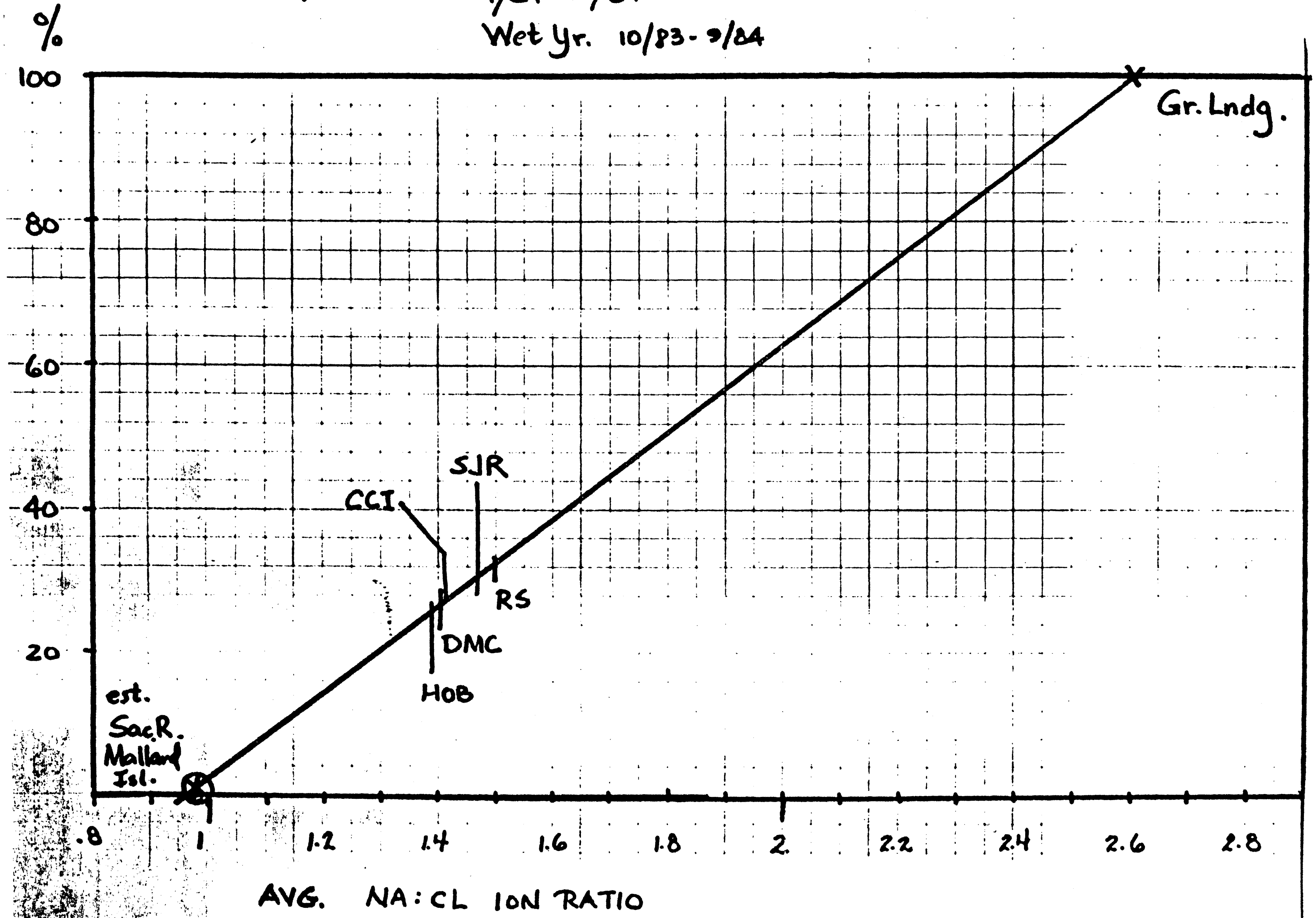
ELEMENT	PPM	MOL. WT.	Moles/l
Boron	4.6	10.811	0.000425
Bromide	65	79.909	0.000813
Calcium	400	40.08	0.009980
Chloride	19000	35.453	0.535920
Potassium	380	39.102	0.009718
Magnesium	1350	24.312	0.055528
Sodium	10500	22.9898	0.456724

Na:Cl molar ratio:0.852224

THEORETICAL MIXING OF DELTA WATERS BASED ON NA:CL ION RATIOS

1/84 - 12/84

Wet Yr. 10/83 - 9/84



CCI = Clifton Ct intake

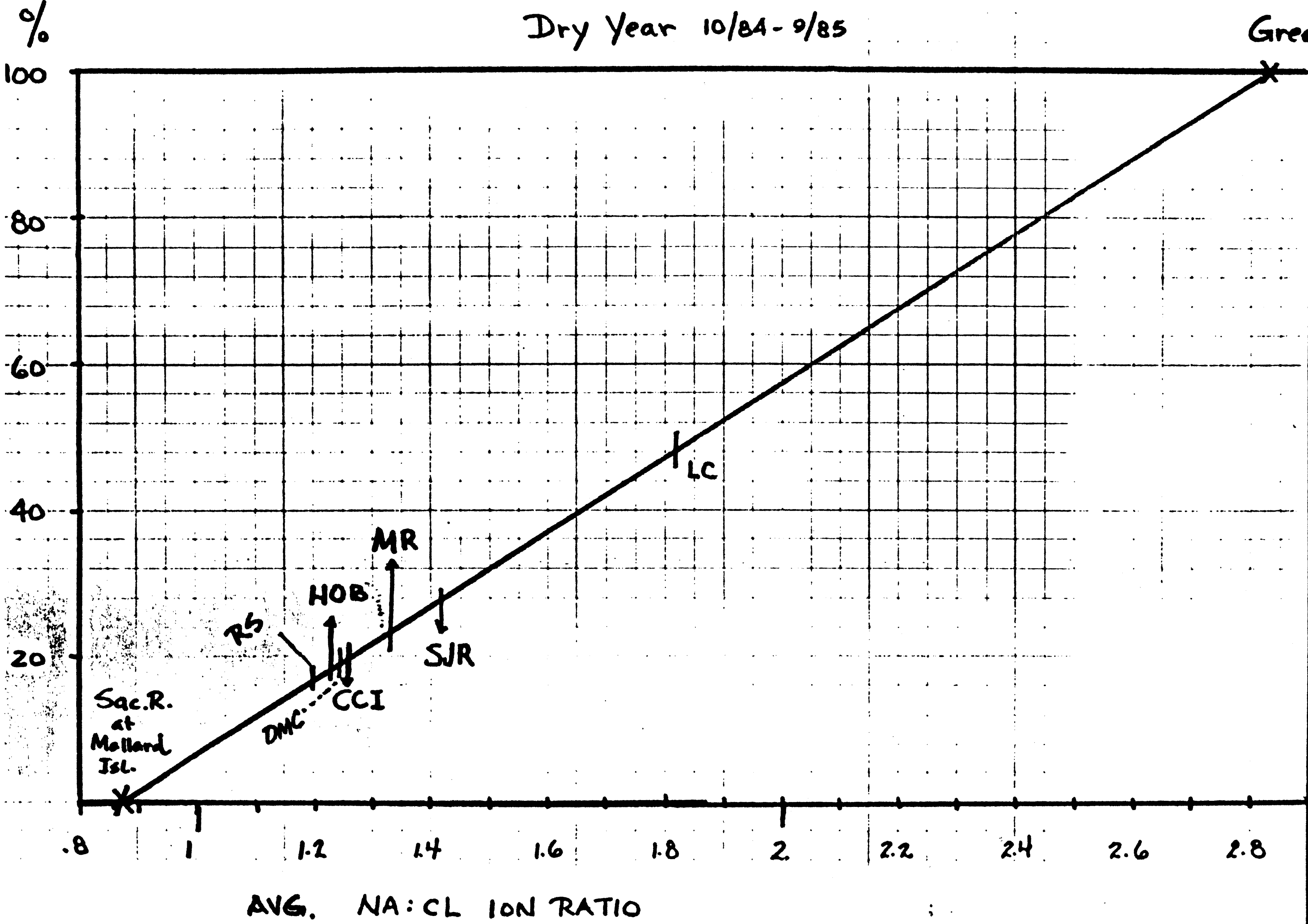
RS = Rock Sl.

HOB = H.O. Banks P.P.

SJR = Vernalis

THEORETICAL MIXING OF DELTA WATERS BASED ON NA:CL ION RATIOS 1/85-12/85

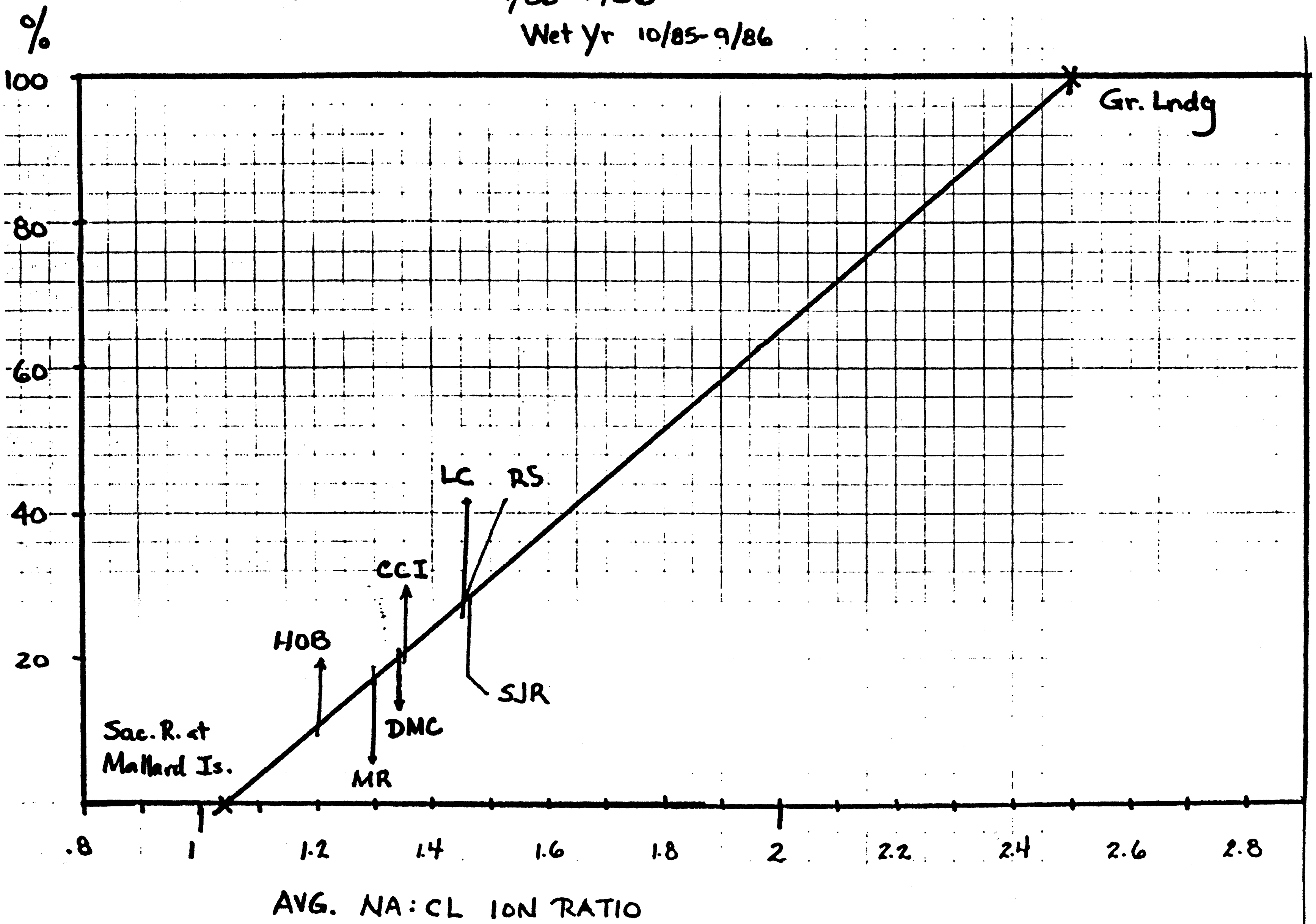
Dry Year 10/84-9/85



LC = Little Connection Slough

MR = Middle River

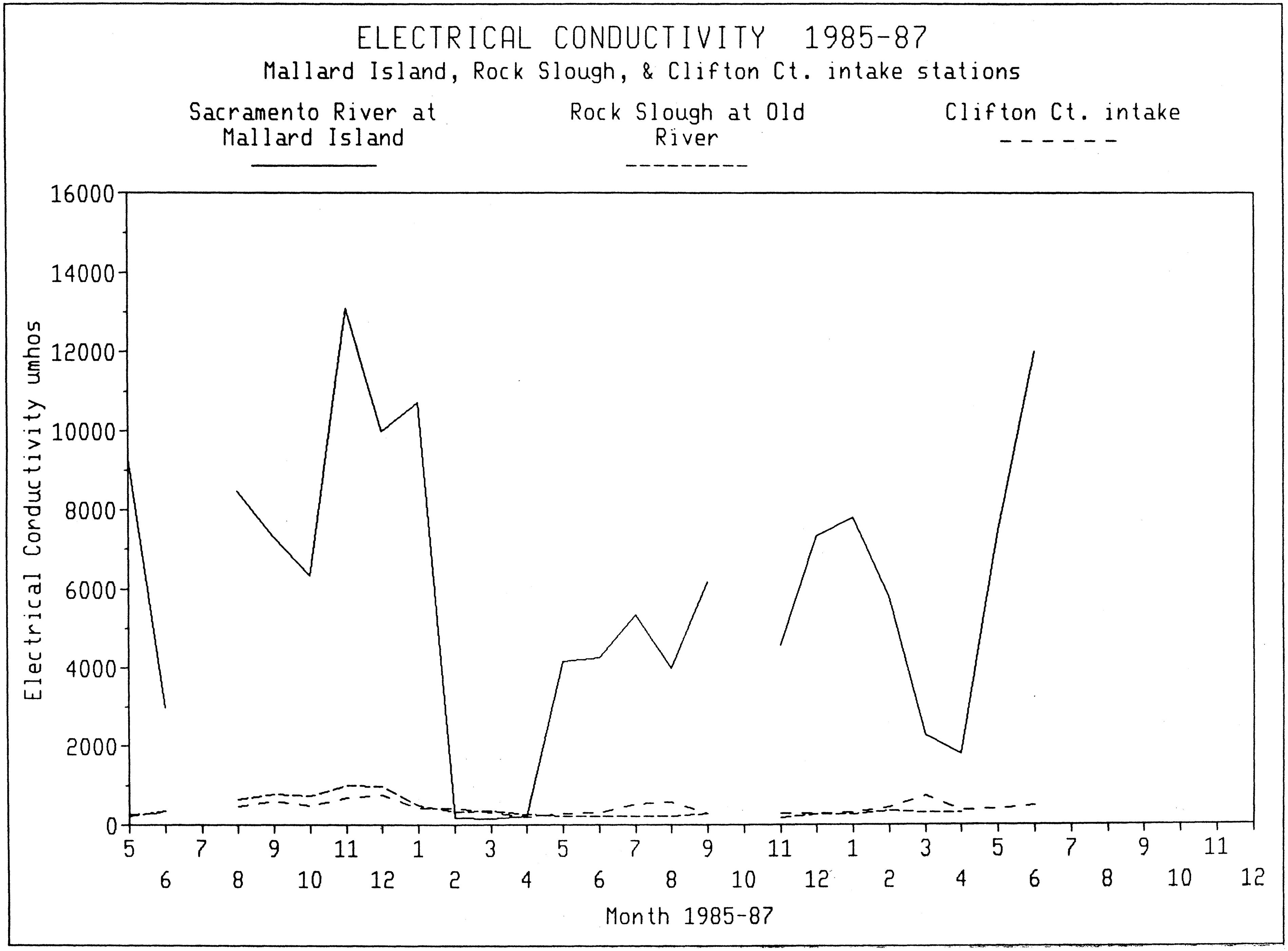
THEORETICAL MIXING OF DELTA WATERS BASED ON NA:CL ION RATIOS 1/86-9/86
Wet Yr 10/85-9/86



SUMMARY OF MOLAR SODIUM TO CHLORIDE ION RATIOS AT ALL DELTA STATIONS

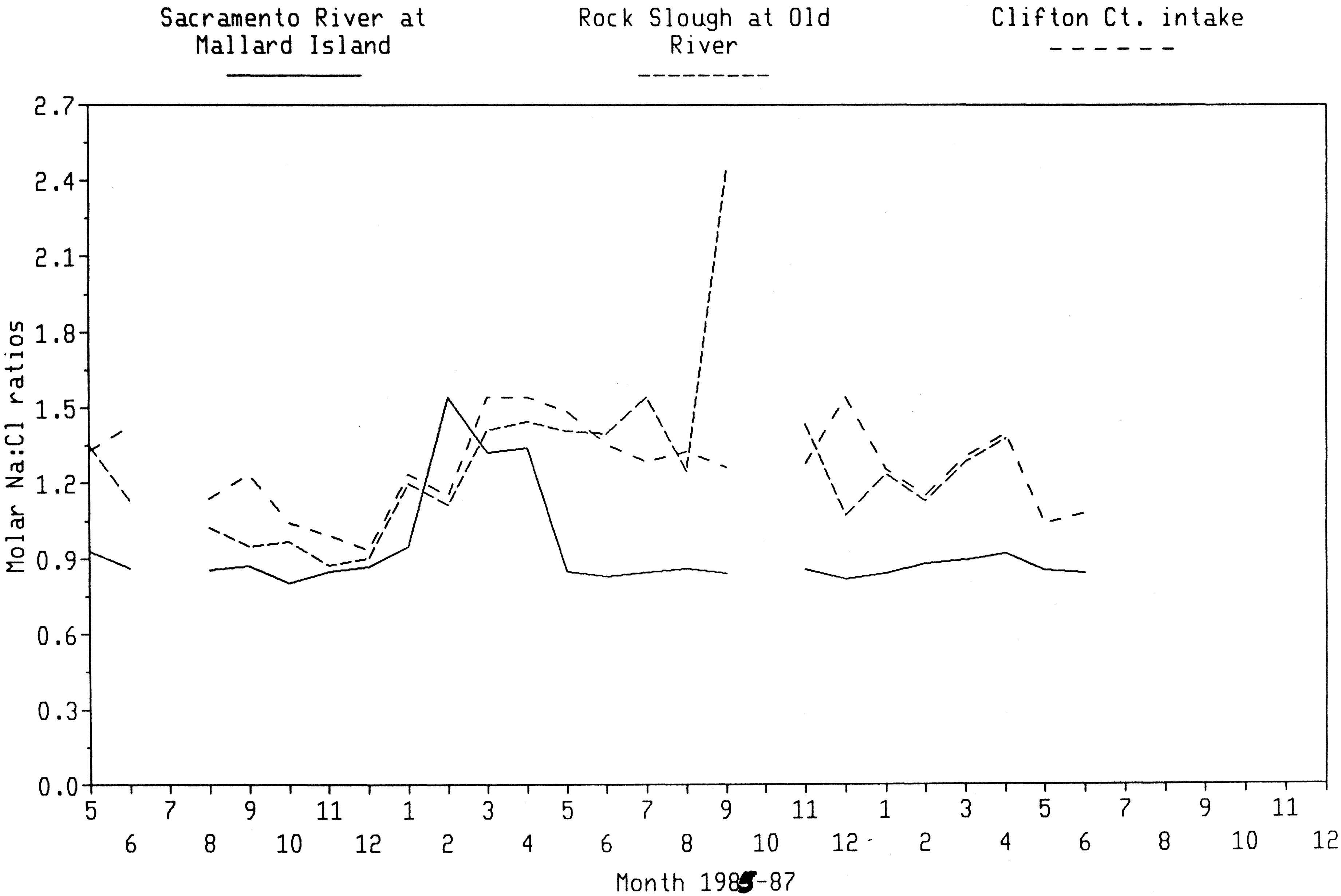
	1984					1985				
STATION	OBS	MIN	MAX	AVG	STD.DEV.	OBS	MIN	MAX	AVG	STD DEV
AMERICAN	12	1.54	3.08	2.57	0.73	8	1.54	2.31	1.83	0.37
BANKS	12	1.09	1.54	1.4	0.11	12	0.93	1.63	1.23	0.22
CACHE	12	1.49	1.7	1.58	0.06	4	1.57	1.79	1.67	0.08
CLIFTON	12	1.32	1.54	1.42	0.07	12	0.93	1.54	1.27	0.19
COSUMNES	12	1.93	6.17	3.05	1.03	0				
DMC	12	1.23	1.49	1.4	0.08	12	0.95	1.61	1.26	0.19
GREENES	13	2.16	3.08	2.6	0.33	13	2.2	3.39	2.84	0.4
HONKER	6	1.23	2.16	1.52	0.32	0				
LCONNECTS	0					10	1.2	2.52	1.82	0.37
LINDSEY	6	1.97	2.35	2.09	0.12	14	1.37	2.25	1.93	0.21
MALLARD	0					3	0.88	0.96	0.93	0.03
MALLARDIS	0					8	0.8	0.95	0.87	0.04
MIDDLER	0					9	1	1.6	1.34	0.21
MOKLELUMN	12	1.54	3.08	2.96	0.43	0				
NOBAY	12	2.31	3.34	2.82	0.27	8	2.31	3.39	2.86	0.28
ROCKSL	12	1.25	1.76	1.54	0.16	13	0.87	1.8	1.22	0.27
VERNALIS	11	1.33	1.7	1.47	0.11	14	1.26	1.68	1.42	0.13

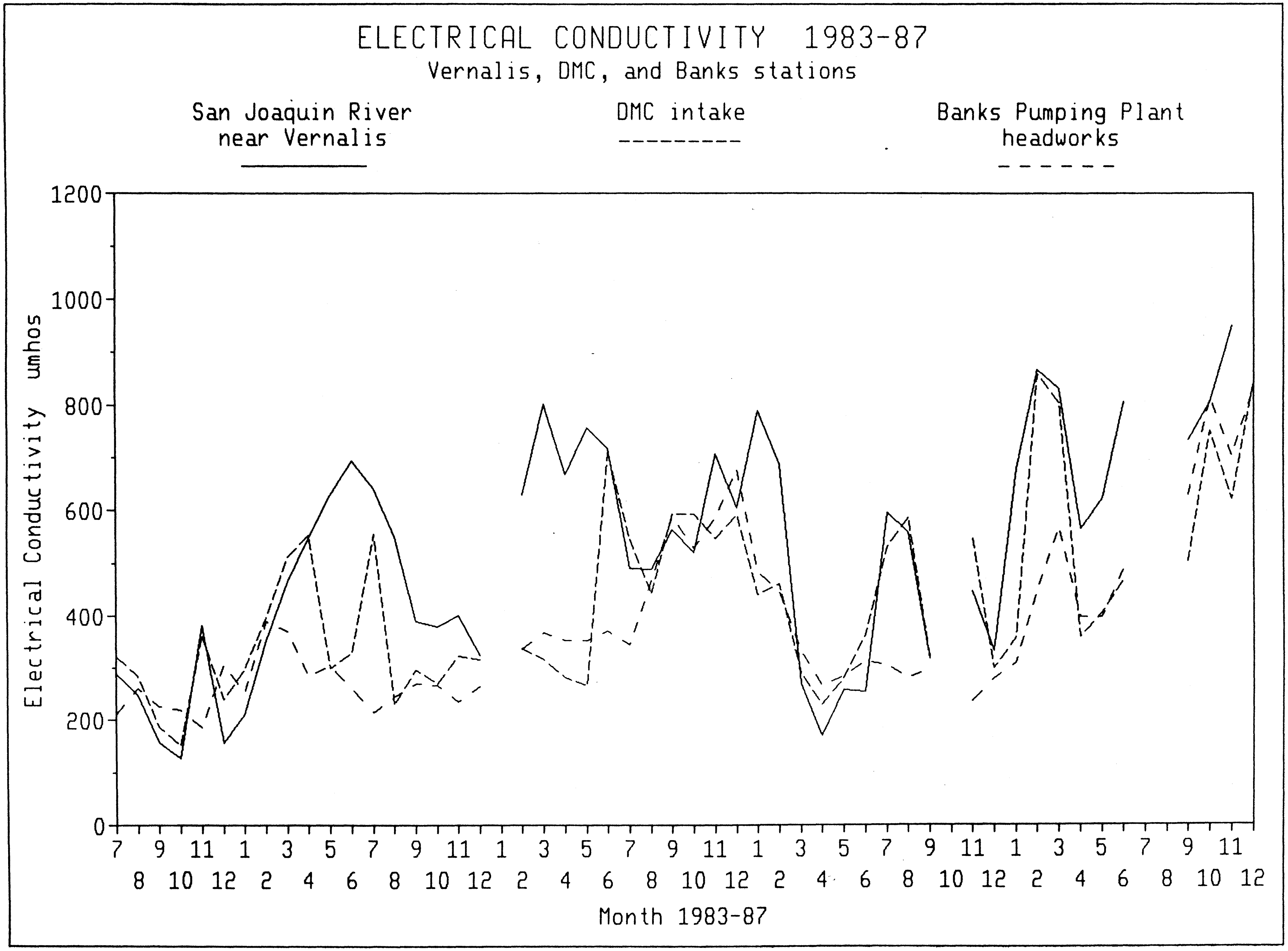
	1986					1987				
STATION	OBS	MIN	MAX	AVG	STD DEV	OBS	MIN	MAX	AVG	STD DEV
AMERICAN	7	1.54	3.08	2.2	0.76	8	1.54	3.08	1.99	0.53
BANKS	9	0.45	1.45	1.21	0.29	11	0.96	1.38	1.11	0.13
CACHE	0					0				
CLIFTON	9	1.15	1.54	1.35	0.13	9	0.89	1.4	1.1	0.17
COSUMNES	0					0				
DMC	9	1.13	1.6	1.34	0.14	10	0.89	1.4	1.13	0.17
GREENES	9	2.06	3.08	2.5	0.34	9	1.96	2.78	2.31	0.26
HONKER	0					0				
LCONNECTS	7	0.97	1.85	1.46	0.28	6	0.99	1.67	1.28	0.23
LINDSEY	9	1.66	2.02	1.77	0.1	10	1.48	1.76	1.6	0.1
MALLARD	0					0				
MALLARDIS	11	0.81	1.54	1	0.25	8	0.82	0.92	0.86	0.03
MIDDLER	7	1.19	1.42	1.31	0.08	8	1	1.28	1.19	0.06
MOKLELUMN	0					0				
NOBAY	7	2.31	3.08	2.73	0.24	10	2.2	3.08	2.67	0.3
ROCKSL	9	1.11	2.44	1.47	0.37	8	0.86	1.38	1.09	0.18
VERNALIS	9	1.34	1.66	1.47	0.09	9	1.2	1.47	1.3	0.07

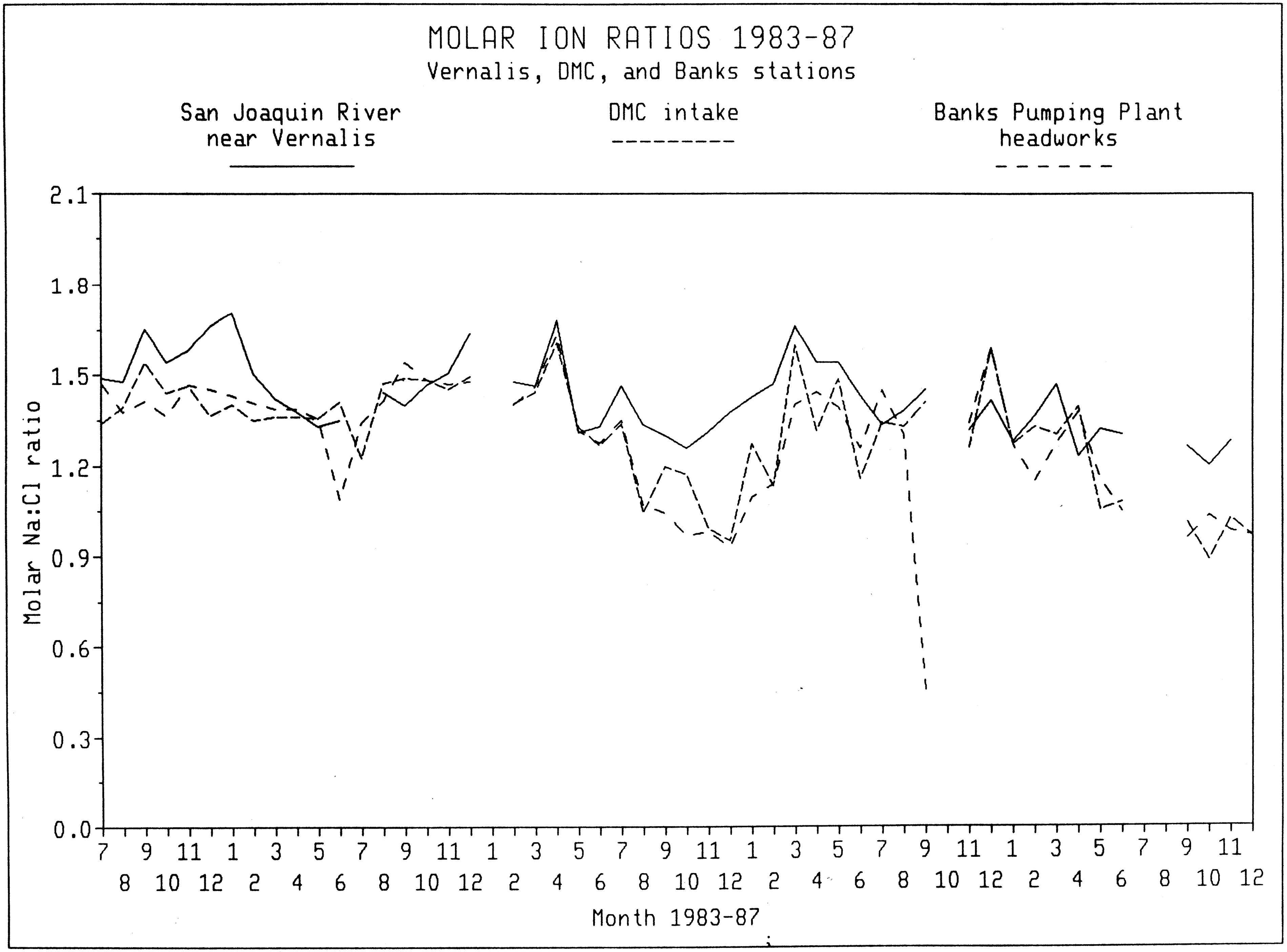

ELECTRICAL CONDUCTIVITY 1985-87
Mallard Island, Rock Slough, & Clifton Ct. intake stations
Sacramento River at Mallard Island
Rock Slough at Old River
Clifton Ct. intake
Electrical Conductivity umhos
16000
14000
12000
10000
8000
6000
4000
2000
0
5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Month 1985-87

MOLAR ION RATIO~~N~~S 1985-87

Mallard Island, Rock Slough, & Clifton Ct. intake stations




ELECTRICAL CONDUCTIVITY 1983-87
Vernalis, DMC, and Banks stations
San Joaquin River near Vernalis
DMC intake
Banks Pumping Plant headworks
Electrical Conductivity umhos
0
200
400
600
800
1000
1200
7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Month 1983-87


MOLAR ION RATIOS 1983-87
Vernalis, DMC, and Banks stations
San Joaquin River near Vernalis
DMC intake
Banks Pumping Plant headworks
Molar Na:Cl ratio
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11 1 3 5 7 9 11
8 10 12 2 4 6 8 10 12 2 4 6 8 10 12 2 4 6 8 10 12 2 4 6 8 10 12
Month 1983-87

CLIFTON COURT INTAKE AND BANKS HEADWORKS PUMPING DATA

Units in Acre-Feet/Day

STATION	MONTH	YEAR	DAYS	LOWEST	HIGHEST	TOTAL	MEAN	STDDEV	EXCHANGE	RESTIME
CLIFTON	9	86	30	11480	14552	377110	12570	739	12.06365	2.486873
BANKS	9	86	30	11393	12647	374808	12494	299	11.99001	2.502001
BANKS	2	83	28	11008	12590	348240	12437	290	11.14011	2.513468
CLIFTON	2	83	28	9904	13686	344774	12313	880	11.02923	2.538780
CLIFTON	1	83	31	10104	14708	379641	12246	941	12.14462	2.552670
BANKS	1	83	31	7079	12583	376737	12153	970	12.05172	2.572204
BANKS	12	85	31	9015	12533	363212	11717	1105	11.61906	2.667918
CLIFTON	12	85	31	8909	13406	361574	11664	1080	11.56666	2.680041
CLIFTON	8	85	31	7518	13879	343355	11076	1839	10.98384	2.822318
BANKS	8	85	31	7739	12573	338299	10913	1796	10.82210	2.864473
CLIFTON	8	86	31	8442	13905	333425	10756	1370	10.66618	2.906284
BANKS	8	86	31	6858	12571	330595	10664	1295	10.57565	2.931357
CLIFTON	8	87	31	7645	12079	312007	10098	1234	9.981030	3.095662
CLIFTON	1	86	31	4028	13289	310129	10004	2779	9.920953	3.124749
BANKS	1	86	31	4263	12499	306504	9887	2836	9.804990	3.161727
CLIFTON	8	84	31	4528	11727	306239	9879	1484	9.796513	3.164287
BANKS	8	87	31	7968	12493	305233	9846	1243	9.764331	3.174893
BANKS	8	84	31	4726	12540	298591	9632	1530	9.551855	3.245431
BANKS	12	87	31	0	12629	298204	9619	4547	9.539475	3.249818
CLIFTON	12	87	31	0	15055	294839	9574	1651	9.431829	3.265093
CLIFTON	7	85	31	6942	10909	291093	9390	867	9.311996	3.329073
CLIFTON	7	84	31	6069	11207	286063	9228	966	9.151087	3.387516
CLIFTON	9	87	30	5936	13272	274578	9153	2114	8.783685	3.415273
BANKS	7	85	31	7733	12565	282768	9122	867	9.045680	3.426880
BANKS	9	87	30	5228	12496	272233	9074	2325	8.708669	3.445007
CLIFTON	3	85	31	3396	14967	280410	9045	3146	8.970249	3.456053
BANKS	7	84	31	5733	12571	279416	9013	1746	8.938451	3.468323
BANKS	3	85	31	3770	12561	277997	8968	2947	8.893057	3.485727
CLIFTON	9	85	30	4363	13030	266857	8895	2423	8.536692	3.514333
BANKS	9	85	30	5522	12549	265599	8853	2464	8.496449	3.531006
CLIFTON	12	84	31	1044	13329	273700	8829	3172	8.755598	3.540604
BANKS	12	84	31	2490	12489	273096	8810	3147	8.736276	3.548240
CLIFTON	7	87	31	3967	11107	269106	8681	1446	8.608636	3.600967

BANKS	7	87	31	5913	11500	265122	8552	1362	8.481189	3.655285
CLIFTON	7	86	31	4959	10552	247103	7971	1591	7.904766	3.921716
BANKS	11	84	30	5539	10342	238220	7941	1434	7.620601	3.936532
CLIFTON	11	84	30	4106	10137	238004	7933	1738	7.613691	3.940501
BANKS	7	86	31	3763	9440	239823	7736	1894	7.671881	4.040847
CLIFTON	4	84	30	3439	11291	218166	7272	1989	6.979078	4.298679
BANKS	4	84	30	4220	12528	214679	7156	2171	6.867530	4.368362
CLIFTON	10	85	31	2492	10710	221591	7148	1672	7.088643	4.373251
BANKS	2	85	28	4248	10217	199502	7125	2007	6.382021	4.387368
BANKS	10	85	31	2535	10747	219658	7086	1620	7.026807	4.411515
CLIFTON	11	85	30	3556	13983	207350	6912	2915	6.633077	4.522569
CLIFTON	2	85	28	3769	10587	193150	6898	1761	6.178822	4.531748
BANKS	11	85	30	2699	12534	206499	6883	2870	6.605854	4.541624
CLIFTON	10	86	31	3148	13246	212169	6844	3435	6.787236	4.567504
CLIFTON	6	85	30	4921	10494	202413	6747	1366	6.475143	4.633170
BANKS	10	86	31	3097	12641	207921	6707	3452	6.651343	4.660802
CLIFTON	4	85	30	3572	9698	199821	6661	1666	6.392226	4.692988
BANKS	4	85	30	3699	9011	196817	6561	1658	6.296129	4.764517
BANKS	6	85	30	4814	10357	195529	6518	1348	6.254926	4.795949
CLIFTON	5	86	31	119	10607	195672	6312	2736	6.259500	4.952471
CLIFTON	12	86	31	120	10817	190724	6152	2163	6.101215	5.081274
CLIFTON	5	85	31	3894	8926	190232	6137	1489	6.085476	5.093693
CLIFTON	3	87	31	1302	11442	189905	6126	2003	6.075016	5.102840
BANKS	3	87	31	1043	12520	189646	6118	2471	6.066730	5.109512
CLIFTON	6	84	30	2564	10986	183147	6105	1660	5.858829	5.120393
BANKS	12	86	31	1462	10311	188133	6069	1994	6.018330	5.150766
BANKS	11	86	30	3324	8107	180820	6027	1519	5.784389	5.186659
CLIFTON	11	86	30	2382	8454	179676	5989	1538	5.747792	5.219569
BANKS	6	86	30	2457	10318	178455	5949	1883	5.708733	5.254664
BANKS	5	86	31	0	10322	184392	5948	2853	5.898656	5.255548
BANKS	6	84	30	3324	12524	178221	5941	2284	5.701247	5.261740
BANKS	5	85	31	2588	8896	184005	5936	1524	5.886276	5.266172
CLIFTON	5	84	31	0	11133	175868	5673	2358	5.625975	5.510312
CLIFTON	8	83	31	2462	10298	174166	5618	1771	5.571528	5.564258
BANKS	8	83	31	1418	10141	167707	5410	1797	5.364907	5.778188
BANKS	2	87	28	0	12570	151234	5401	2801	4.837939	5.787817
CLIFTON	2	87	28	281	10312	150327	5369	2299	4.808925	5.822313
BANKS	5	84	31	898	12550	164799	5316	2225	5.271881	5.880361
CLIFTON	3	84	31	2286	8950	158995	5129	1760	5.086212	6.094755

CLIFTON	4	87	30	1874	8251	153357	5112	1544	4.905854	6.115023
BANKS	4	87	30	2075	7767	153282	5109	1530	4.903454	6.118614
BANKS	3	84	31	1799	9453	157466	5080	1545	5.037300	6.153543
CLIFTON	9	84	30	1286	7391	134332	4478	1250	4.297248	6.980794
BANKS	9	84	30	1092	8239	131247	4375	1456	4.198560	7.145143
CLIFTON	5	87	31	1983	7041	134270	4331	1698	4.295265	7.217732
BANKS	1	87	31	161	8020	132326	4269	1775	4.233077	7.322557
CLIFTON	1	87	31	1177	6738	130759	4218	1490	4.182949	7.411095
CLIFTON	6	87	30	1365	7334	122307	4077	1622	3.912571	7.667402
BANKS	2	86	28	0	10321	112232	4008	2538	3.590275	7.799401
BANKS	4	86	30	0	10330	119661	3989	2864	3.827927	7.836550
BANKS	6	87	30	935	6994	118977	3966	1557	3.806046	7.881997
BANKS	5	87	31	1888	7883	122880	3964	1787	3.930902	7.885973
CLIFTON	6	83	30	0	8664	117479	3916	2038	3.758125	7.982635
BANKS	2	84	29	369	7255	113226	3904	1568	3.622072	8.007172
CLIFTON	1	85	31	1670	6669	116698	3764	1323	3.733141	8.304994
CLIFTON	2	84	29	660	7225	108668	3747	1574	3.476263	8.342674
BANKS	1	85	31	978	7233	115619	3730	1436	3.698624	8.380697
BANKS	10	84	31	13	12344	114926	3707	2805	3.676455	8.432695
CLIFTON	10	84	31	0	12803	114800	3703	2985	3.672424	8.441803
CLIFTON	4	86	30	0	8778	110833	3694	2801	3.545521	8.462370
BANKS	6	83	30	49	10389	108167	3606	2071	3.460236	8.668885
CLIFTON	10	87	31	0	7519	107969	3483	1576	3.453902	8.975021
BANKS	10	87	31	0	9246	104091	3358	1982	3.329846	9.309112
CLIFTON	6	86	30	1981	9558	182136	3071	1716	5.826487	10.17909
CLIFTON	11	87	30	0	5154	81917	2731	1499	2.620505	11.44635
BANKS	11	87	30	0	6696	81555	2719	1709	2.608925	11.49687
CLIFTON	3	83	31	0	15207	83158	2683	4380	2.660204	11.65113
BANKS	3	83	31	0	12568	82716	2668	3922	2.646065	11.71664
CLIFTON	2	86	28	9018	114465	4088	2406		0.130774	12.99251
CLIFTON	7	83	31	0	8003	72201	2329	2002	2.309692	13.42206
BANKS	7	83	31	0	10423	70424	2272	2364	2.252847	13.75880
CLIFTON	9	83	30	0	5532	45485	1516	1479	1.455054	20.62005
BANKS	11	83	30	129	3996	44719	1491	1358	1.430550	20.96579
CLIFTON	11	83	30	0	5012	43585	1453	1530	1.394273	21.51410
BANKS	3	86	31	0	10370	44645	1440	2280	1.428182	21.70833
CLIFTON	3	86	31	0	7492	43402	1400	2199	1.388419	22.32857
BANKS	9	83	30	61	4025	39978	1333	1131	1.278886	23.45086
CLIFTON	12	83	31	0	5334	29753	960	1345	0.951791	32.5625

BANKS	12	83	31	0	2596	25954	837	723	0.830262	37.34767
CLIFTON	5	83	31	0	3644	24817	801	1220	0.793889	39.02621
BANKS	5	83	31	0	3245	23782	767	1079	0.760780	40.75619
CLIFTON	10	83	31	0	2521	21132	682	847	0.676007	45.83577
BANKS	10	83	31	61	2214	20754	669	423	0.663915	46.72645
BANKS	1	84	31	0	1639	20372	657	468	0.651695	47.57991
CLIFTON	1	84	31	0	2932	18551	598	889	0.593442	52.27425
BANKS	4	83	30	0	2219	7270	242	534	0.232565	129.1735
CLIFTON	4	83	30	0	2267	6689	223	619	0.213979	140.1793

TOTAL = total volume for the entire month

Molar Sodium to Chloride Ion Ratios by Month and Year

at the H. O. Banks Pumping Plant Headworks

Year	<1	1- 1.09	1.1- 1.19	1.2- 1.29	1.3- 1.39	1.4- 1.49	1.5- above
1982							3
1983					8,10	7,9,11,12	
1984		6			3,4,5,7	1,2,8	
						10,11,12	9
1985	10,11,12	8,9		6	5,6,7	2,3	4
1986	9	1	2	6	5,8,11	3,4,7	12
1987	9,11,12	2,6,8,10	2,5	1,3	4		

note: data not yet available for 9 and 10/87.

at the Clifton Court Intake

Year	<1	1- 1.09	1.1- 1.19	1.2- 1.29	1.3- 1.39	1.4- 1.49	1.5- above
1982							
1983					8	7,10,11	9,12
1984					3-8	2,10-12	1,9
1985	11,12	10	8	9	1,5,7	2,3,6	4
1986			2	1,7,9,11	6,8	5	3,4,12
1987	9,10,11	5,6	2	1	3,4		10
	12						

note: data not yet available for 9/87.

Total THM Formation Potential Concentrations (mg/l)
by Month and Year

at the H. O. Banks Pumping Plant Headworks

Year	<300	300-399	400-499	500-599	600-699	700-799	>800
1982			8,10	6	12		3
1983	2	6,7,9-11	4,8,12				
1984		1,10	2,5-9, 11,12	3	4		
1985		2	4,9	4,9,10	5,6,8,12	7	
1986		6,11	9,12	5,7	3	4	1,2
1987		4,10	11		3,5,9	1,2,12	2

note: no data available for 6,8,9, and 10/87.

at Clifton Court Intake

Year	<300	300-399	400-499	500-599	600-699	700-799	>800
1982							
1983		7,9-11	8,12				
1984		1,2,4,10	3,6-9,12	5,11			
1985			2	4,10	5,6,8	12	1,3
1986	6		5,7,9, 11,12	3	4		
1987		4,11	10	3,5,9,12		1	2,6,10

note: no data available for 6,9, and 10/87.

Chloroform Percentage by Weight of Total THM Formation Potential by Month and Year

at the H. O. Banks Pumping Plant Headworks

Year	<50%	50-69.9%	70-79.9%	80-89.9%	>90%
1982				6,10	3,8,12
1983				2,4,7-12	6
1984			2	1,3-12	
1985	12	8,9	2,7,9	4-6	
1986			9	1-7,11,12	
1987	10	9,11,12	2-5	1,2	

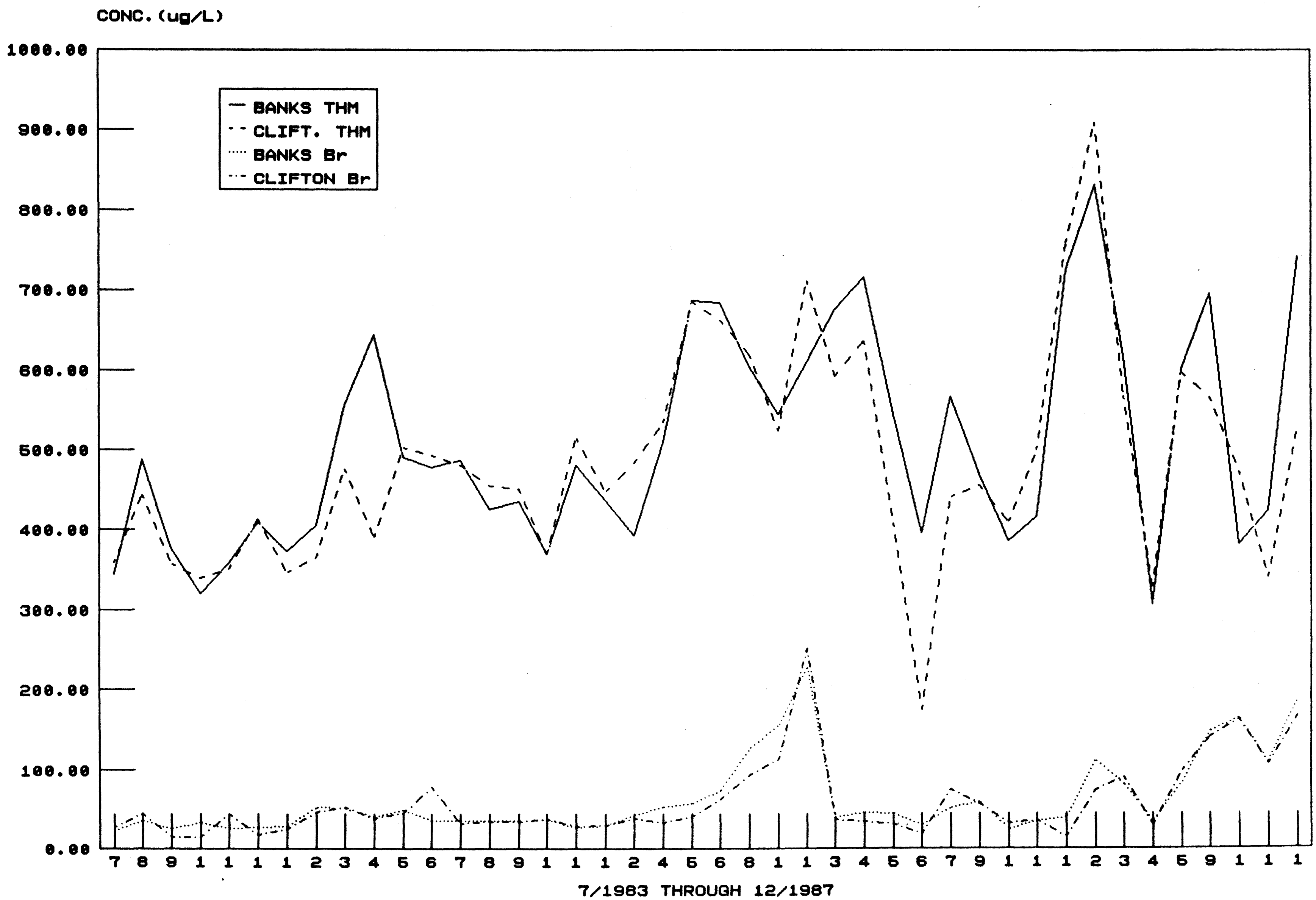
note: no data available for 6,8,9, and 10/87.

at Clifton Court Intake

Year	<50%	50-69.9%	70-79.9%	80-89.9%	>90%
1982					
1983			11	7,8	9,10,12
1984			2,6	1,4,5,7-12	
1985	12	10	8	2,4-6	
1986			6,7,9	3-6,11,12	4
1987	10,12	9,11	3,5	2,4	1

note: no data available for 6,9, and 10/87.

CLIFTON COURT AND BANKS PUMPING PLANT



120

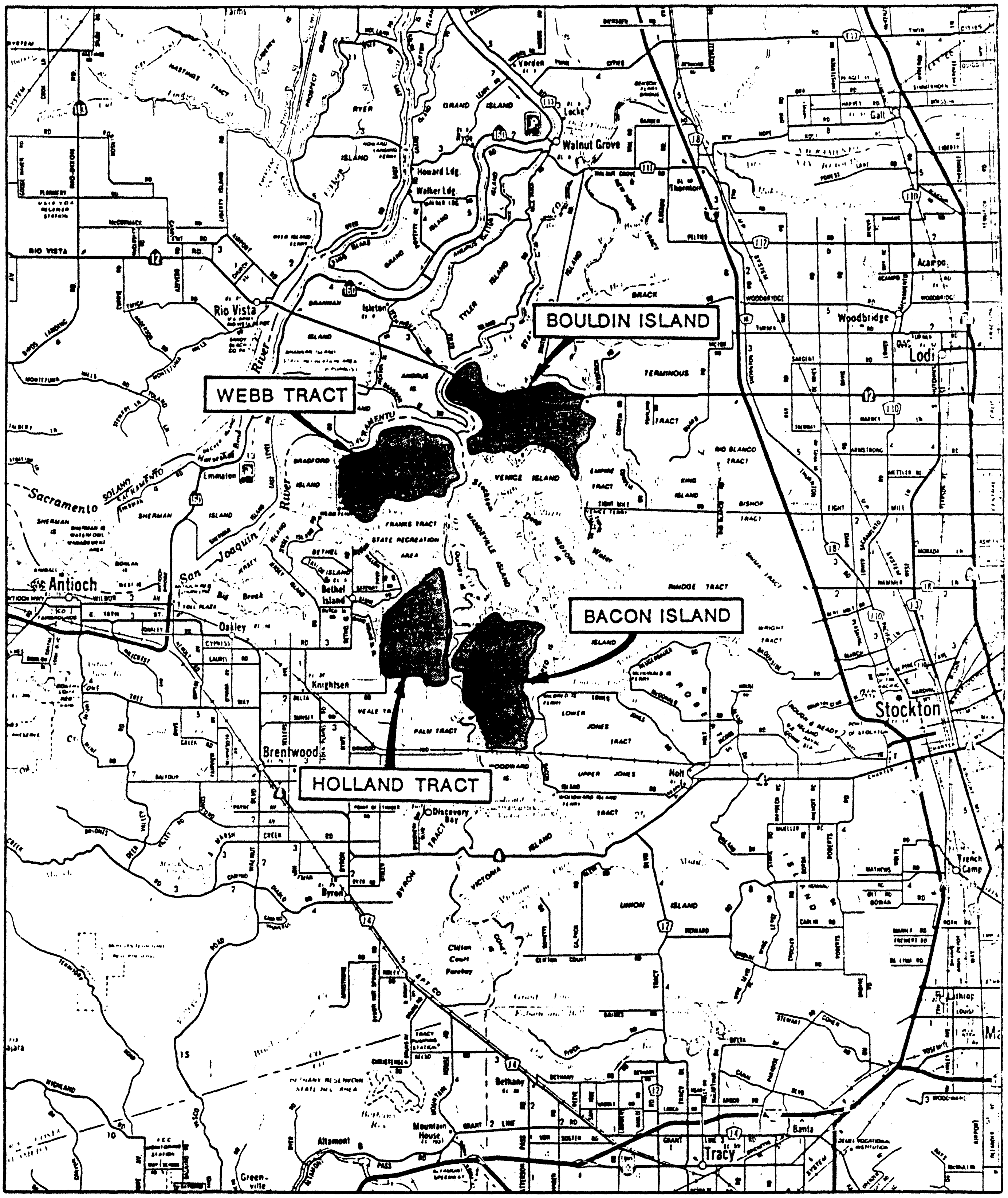


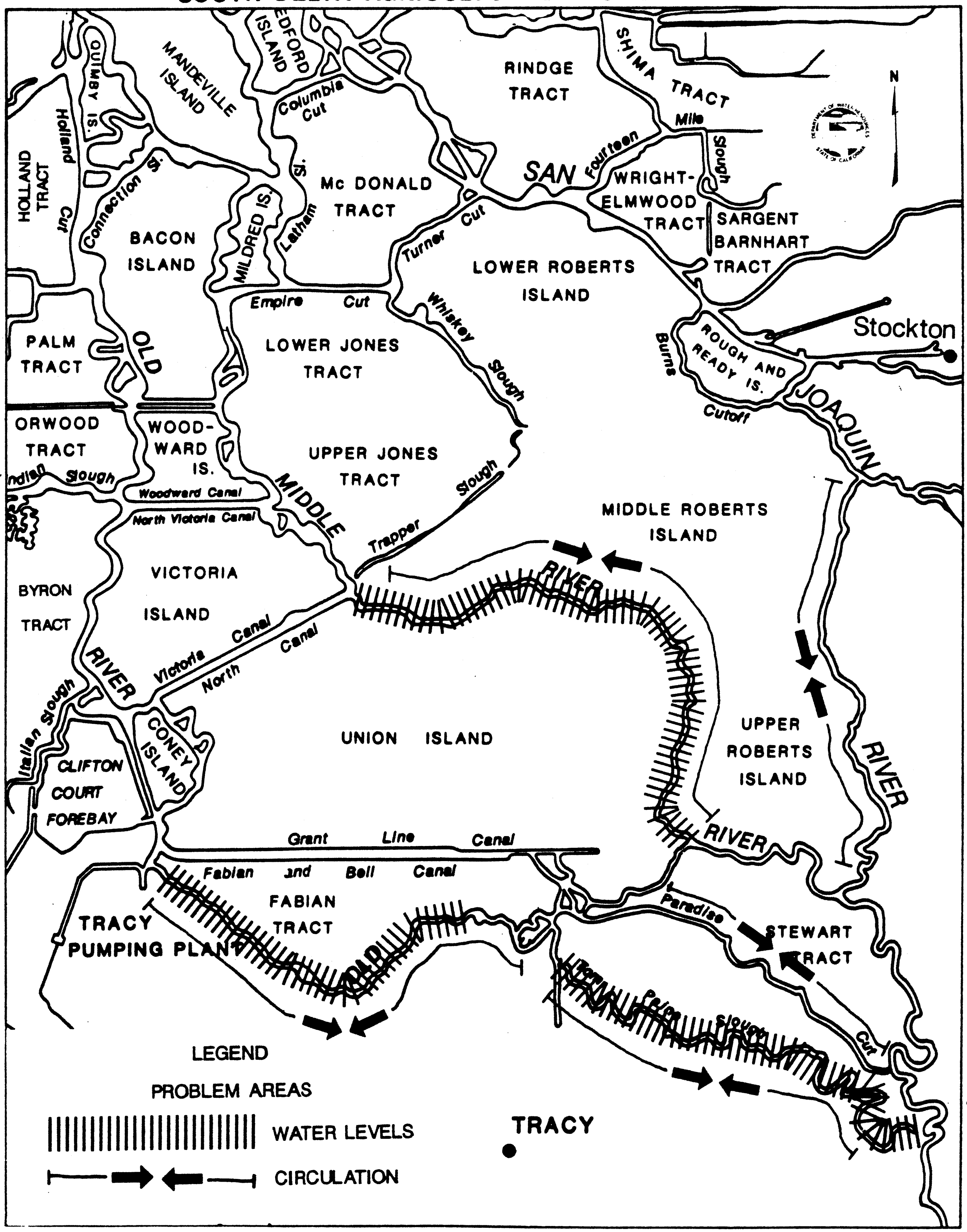
FIGURE 1. PROJECT LOCATION

0 1 2 3
MILES

122

DWR-347

SOUTH DELTA AGRICULTURAL PROBLEM AREAS



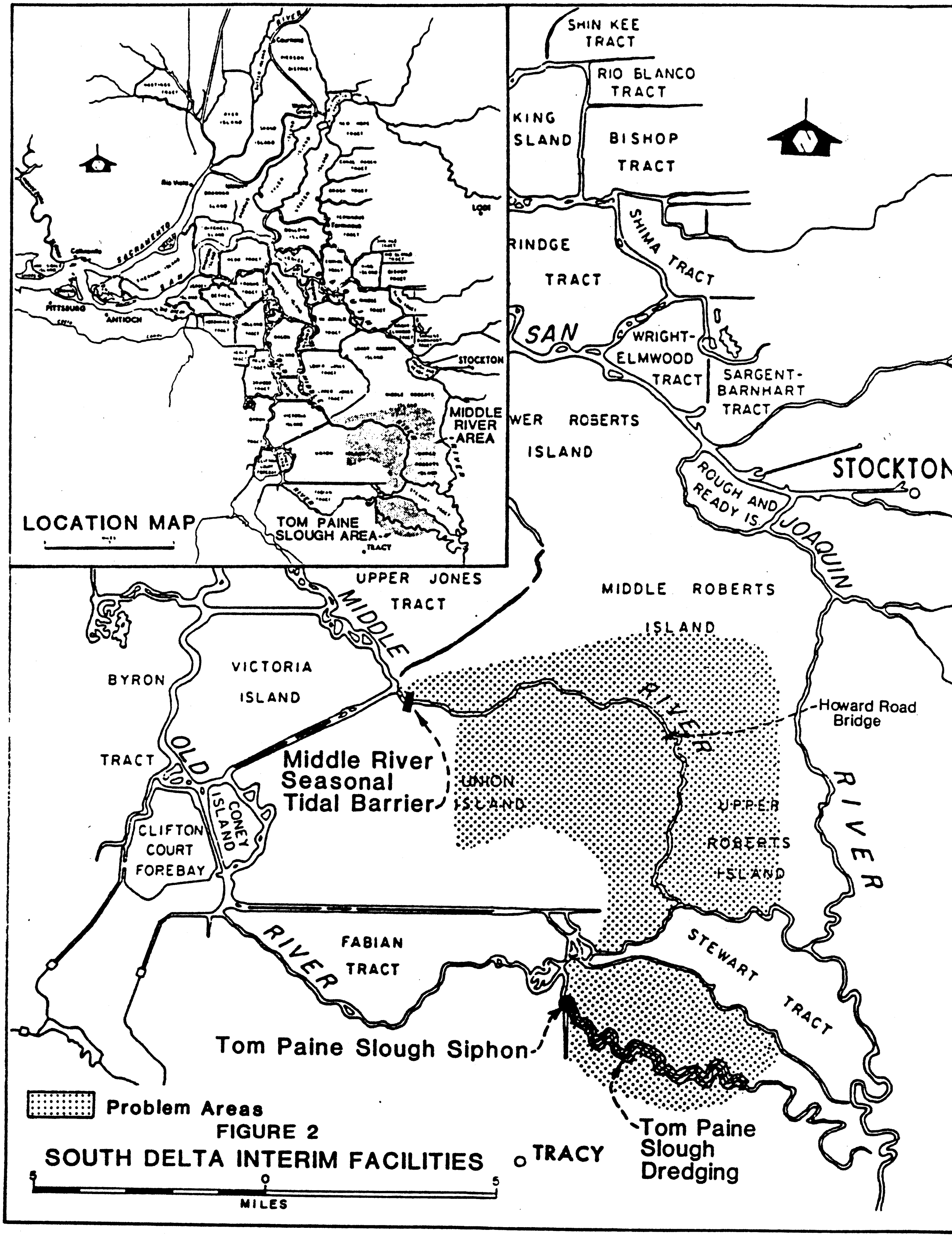


FIGURE 2
SOUTH DELTA INTERIM FACILITIES

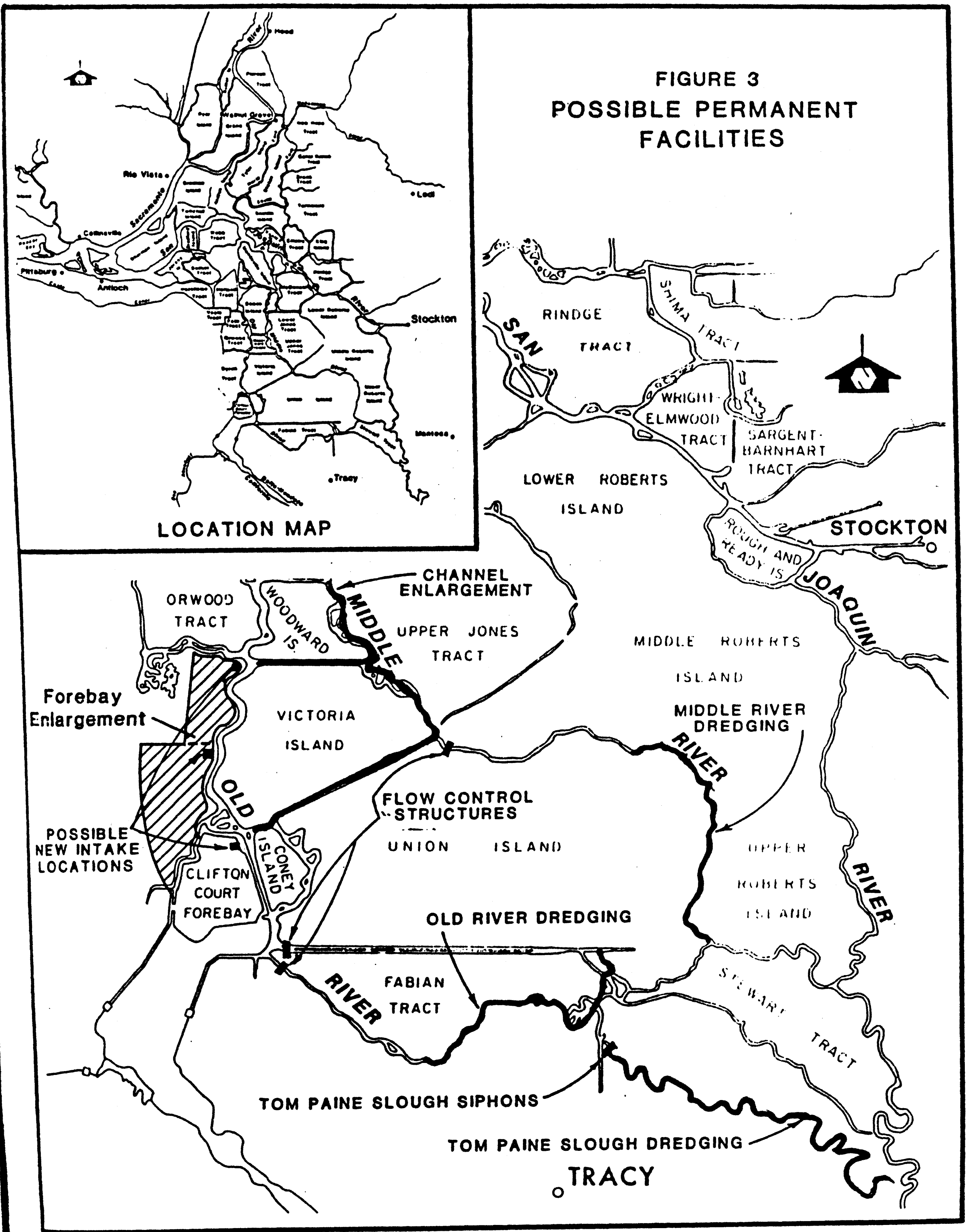


FIGURE 3
POSSIBLE PERMANENT FACILITIES

128

Appendix A

DAYFLOW MODEL DESCRIPTION

Introduction

DAYFLOW* is a computer program developed in 1978 as an accounting tool for determining historical Delta boundary hydrology. DAYFLOW output is used extensively in studies initiated by the Department of Water Resources (DWR), the Department of Fish and Game (DFG), and less frequently by other State and Federal agencies (e.g., U. S. Bureau of Reclamation (USBR)) and private consultants. The output has been put in STORET, The Environmental Protection Agency's data storage and retrieval system, making it available for use nationally.

The DAYFLOW program presently provides the best estimate of historical mean daily flows: (1) through the Delta Cross Channel and Georgiana Slough; (2) past Jersey Point; and (3) past Chipps Island to San Francisco Bay (net Delta outflow). The degree of accuracy of DAYFLOW output is affected by the DAYFLOW computational scheme and the accuracy and limitations of the input data. The input data include the principal Delta stream inflows, Delta precipitation, Delta exports, and Delta gross channel depletions. These data include both monitored and estimated values as described in this DAYFLOW program documentation. Currently, flows are not routed to account for travel time through the Delta. All calculations involving inflows, depletions, transfers, exports, and outflow are performed using data for the same day. All DAYFLOW summary reports distributed through January 1985, providing flow data through August 1984, and data for September 1984 reported herein were generated according to the algorithm described in the Computational Scheme section.

DAYFLOW program documentation is presented as follows:

- Computational Scheme
- Summary Tables of Monthly Data
- Input Data Documentation
- Methodology for DAYFLOW Data Summary Generation
- Summary of Equations

Computational Scheme

The DAYFLOW computational scheme was developed to derive three types of quantities:

- Net Delta Outflow estimates at Chipps Island
- Interior Delta flow estimates at significant locations
- Summary and fish-related parameters and indices

The DAYFLOW FORTRAN program listing is presented in Attachment E.

*This program has also been referred to as the DAYFLO and DAY FLOW model.

FIGURE 2

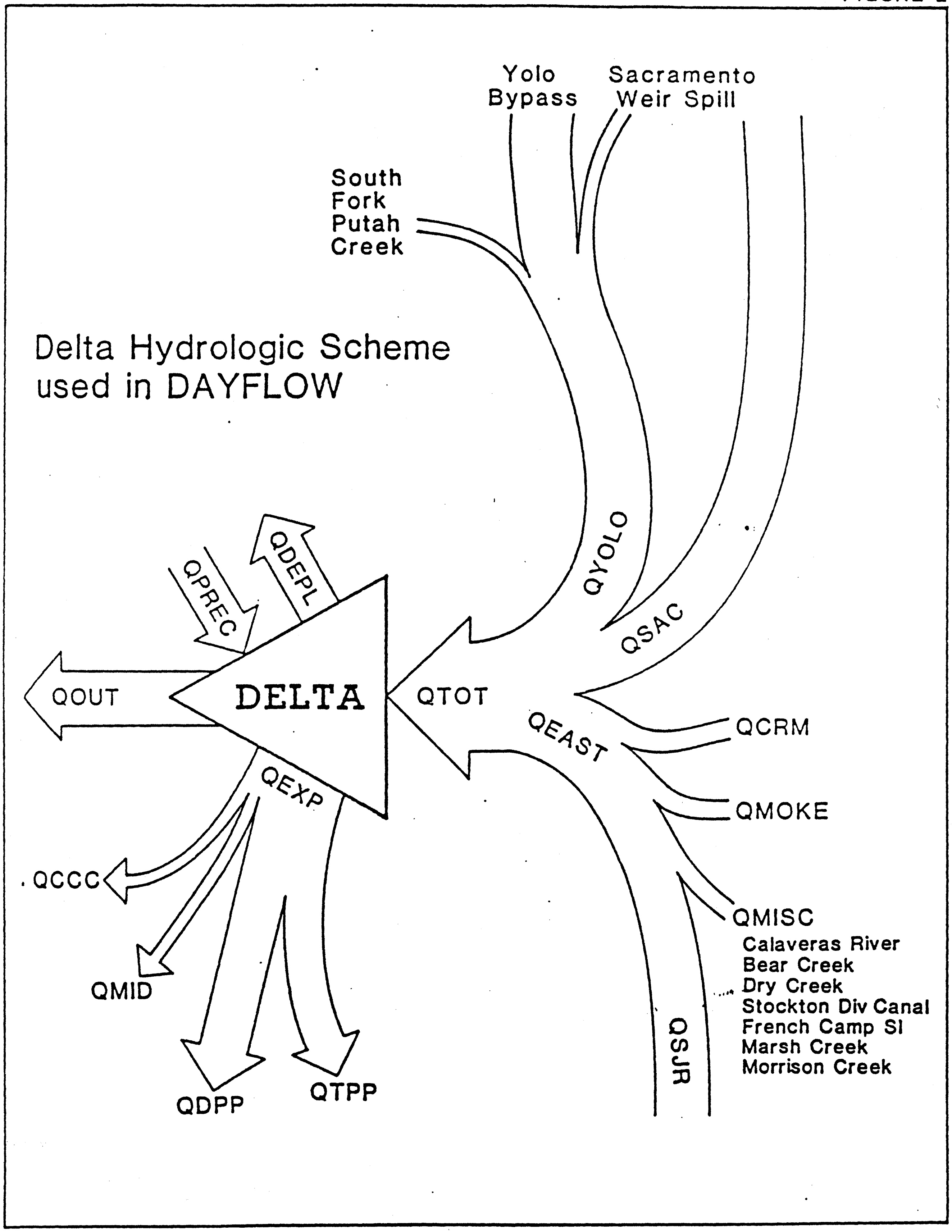

Yolo Bypass
Sacramento Weir Spill
South Fork Putah Creek
Delta Hydrologic Scheme used in DAYFLOW
QDEPL
QPREC
QYOLO
QSAC
QOUT
DELTA
QTOT
QEAST
QCRM
QEXP
QMOKE
QCCC
QMISC
Calaveras River
Bear Creek
Dry Creek
Stockton Div Canal
French Camp Sl
Marsh Creek
Morrison Creek
QMID
QSJR
QDPP
QTPP

Table 1

SUMMARY DAYFLOW PROGRAM DOCUMENTATION

Column No. 1/	DAYFLOW Parameter	Description	Pre - Execution Calculation	DAYFLOW Program Calculation	Comments
(1)	QSJR	San Joaquin River at Vernalis	None	None	Measured
(2)	QCRM	Cosumnes River at Michigan Bar	None	None	Measured
(3)	QMOKE	Mokelumne River at Woodbridge	None	None	Measured
(4)	QMISC	Miscellaneous Stream Flow	Sum of Calaveras River, Bear Creek, Marsh Creek, Dry Creek, Stockton Div. Canal, Morrison Creek and French Camp Slough	None	Sum of measured flows; hand calculated or intermediate program used (e.g., DFDAT84)
(5)	QEAST	East Delta Inflow	None	Sum of flows (1) through (4)	Calculated
(6)	QSAC	Sacramento River at Freeport	None	None	Measured
(7)	QYOLO	Yolo Bypass flow	Sum of Yolo Bypass near Woodland, Sacramento Weir Spill and South Fork Putah Creek	None	Sum of measured flows; hand calculated or intermediate program used (e.g., DFDAT84)
(8)	QTOT	Total inflow	None	Sum of flows (5) through (7)	Calculated
(9)	QDEPL	Gross channel depletion	None	None	Estimated by DWR (1965); repeating annual cycle
(10)	QPREC	Delta precipitation runoff	Depth converted to volume; evenly distributed over 5 days from event	None	Measured precipitation; estimated runoff pattern (5-day)
(11)	QCD	Net channel depletion	None	Depl(9) - flow(10)	Calculated
(12)	QTPP	CVP Tracy export	None	None	Operation records
(13)	QCPP	SWP export	BBID pumping subtracted (from 5/01/71)	None	Op. records; Delta PP through 4/30/71, Clifton Court intake from 5/01/71
(14)	QCCC	Contra Costa Canal export	None	None	Operations records
(15)	QMID	Miscellaneous diversions	Determine intensity and duration of event	None	Estimated diversions/transfers (e.g., island flooding/pumping)
(16)	QEXP	Total exports	None	Sum of exports (12) through (15)	Calculated
(17)	QXGEO	Delta Cross Channel and Georgiana Slough	Gate operation code and partial settings determined	Calculated by empirical formula based on gate settings and Sacramento River flow	Estimated; times determined and operations coded by hand
(18)	QWEST	Flow past Jersey Point	None	Flow(5)+flow(17)-exp(16)-65%depl(11)	Calculated
(19)	QOUT	Delta outflow at Chipps Island	None	Flow(8) - depl(11) - exp(16)	Calculated
(20)	QDIVER	Percent diverted	None	[Exp(16) + depl(11)]/flow(8)	Calculated
(21)	QEFFECT	Effective inflow	None	A. If [exp(16) + 42% depl(11)] >=flow(1), then flow(21) = flow(8) - flow(1) B. If [exp(16) + 42% depl(11)] < flow(1), then flow(21) = Flow(8) - lower [(65% flow(1) + 15% depl(11)) OR (exp(16) + 42% depl(11))]	Calculated
(22)	QEFFDIV	Effective % diverted	None	[Flow(21) - flow(19)]/flow(21)	Calculated

1/ Column numbers refer to DAYFLOW Data Summary report layout.

Net Delta Outflow Estimates At Chipps Island

An estimate of net Delta outflow at Chipps Island is derived by performing a water balance about the boundary of the Sacramento-San Joaquin Delta, taking Chipps Island as the western limit (this quantity should not be confused with the total tidal flow, which is much larger). Figure 1 is a map of the area of interest. A flow schematic is shown in Figure 2. In its most general form, the water balance equation is (using DAYFLOW parameters; see Table 1 for a complete listing of DAYFLOW parameters and their definitions):

$$QOUT = QTOT + QPREC - QDEPL - QEXP \qquad (1)$$

Where:

QOUT = Net Delta outflow at Chipps Island
QTOT = Total Delta inflow
QPREC = Delta precipitation runoff estimate
QDEPL = Deltawide gross channel depletion estimate (consumptive use)
QEXP = Total Delta exports and diversions/transfers

The parameters on the right side of the equation are input data used to calculate net Delta outflow. These input parameters are further defined in the Input Data Documentation Section, including exceptions and changes made to the parameters appearing in the equations presented.

Total Delta Inflow (QTOT). The principal surface water inflows, miscellaneous stream flows, and the Yolo Bypass flow addition near Rio Vista are included in determination of total Delta inflow according to the following equation:

$$QTOT = QSAC + QEAST + QYOLO \qquad (2)$$

Eastern Delta inflow (QEAST) includes inflow to the Delta from the northeast, east, and southeast (Marsh Creek is the exception, flowing to the Delta from the southwest). QEAST is defined as:

$$QEAST = QSJR + QCRM + QMOKE + QMISC \qquad (3)$$

Miscellaneous stream flow (QMISC) is a composite flow defined as:

QMISC = Calaveras River flow
+ Bear Creek flow
+ Dry Creek flow
+ Stockton Diverting Canal flow
+ French Camp Slough flow
+ Marsh Creek flow
+ Morrison Creek flow (4)

The Yolo Bypass flow addition to the Delta water balance is calculated as:

QYOLO = Yolo Bypass flow at Woodland
+ Sacramento Weir Spill
+ South Fork Putah Creek (5)

Appendix B

SWRCB DECISION 1485 STANDARDS

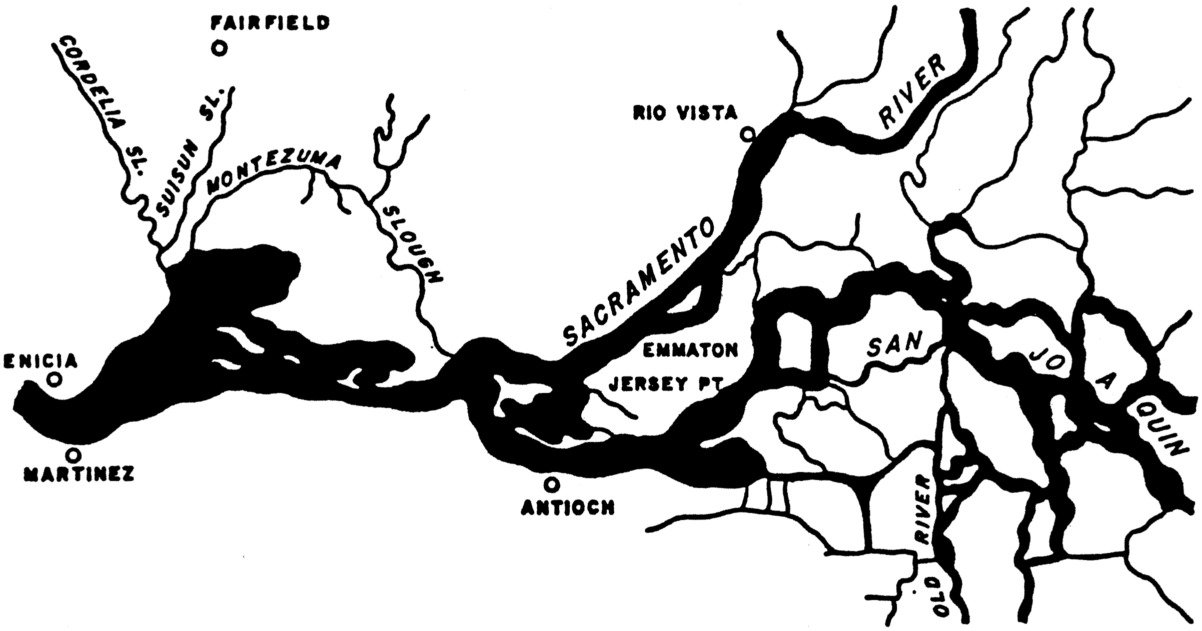
132

Water Right Decision 1485

In the Matter of Permit 12720 (Application 5625) and Other Permits of United States Bureau of Reclamation for the Federal Central Valley Project and of California Department of Water Resources for the State Water Project.

DECISION IN FURTHERANCE OF JURISDICTION RESERVED IN DECISIONS D 893, D 990, D 1020, D 1250, D 1275, D 1291, D 1308, D 1356, and PERMIT ORDER 124

Sacramento-San Joaquin Delta and Suisun Marsh



August 1978

STATE WATER RESOURCES CONTROL BOARD

TABLE I

PERMITS FOR FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT
CONTAINING RESERVED JURISDICTION REGARDING THE SACRAMENTO-SAN JOAQUIN DELTA
OR COORDINATION OF TERMS AND CONDITIONS

Permittee 1/	Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
				Quantity (cfs)	Season	Quantity (AF)	Season	
USBR	5625	12720	Sacramento River	11,000	Jan.1 to Dec. 31	3,190,000	Oct. 1 to June 30	Power
USBR	5626	12721	Sacramento River	8,000	Jan.1 to Dec. 31	3,190,000	Oct. 1 to June 30	Irrigation, domestic, stockwatering navigation and recreation
USBR	5627	11966	Trinity River	1,100	Jan.1 to Dec. 31	1,540,000	Jan. 1 to Dec. 31	Power
USBR	5628	11967	Trinity River	2,500	Jan.1 to Dec. 31	1,540,000	Jan. 1 to Dec. 31	Irrigation, domestic, navigation, salinity control and flood control
DWR	5629	16477	Feather River	7,600	Jan.1 to Dec. 31	380,000	Oct. 1 to July 1	Power, recreation, fish and wildlife enhancement
DWR	5630	16478	Feather River	1,400	Oct.1 to July 1	380,000	Oct. 1 to July 1	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement
USBR	9363	12722	Sacramento River	1,000	Jan.1 to Dec. 31	310,000	Oct. 1 to June 30	Municipal and industrial

TABLE I (Continued)

PERMITS FOR FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT
CONTAINING RESERVED JURISDICTION REGARDING THE SACRAMENTO-SAN JOAQUIN DELTA
OR COORDINATION OF TERMS AND CONDITIONS

Permittee 1/	Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
				Quantity (cfs)	Season	Quantity (AF)	Season	
USBR	9364	12723	Sacramento River	9,000	Jan. 1 to Dec. 31	1,303,000	Oct. 1 to June 30	Irrigation, flood control, domestic, stockwatering, navigation & recreation
USBR	9365	12724	Sacramento River	2,275	Jan. 1 to Dec. 31	1,303,000	Oct. 1 to June 30	Power
USBR	9366	12725	Rock Slough	200	Jan. 1 to Dec. 31	--	--	Irrigation and domestic
USBR	9367	12726	Rock Slough	250	Jan. 1 to Dec. 31	--	--	Municipal and industrial
USBR	9368	12727	Old River	4,000	Jan. 1 to Dec. 31	--	--	Irrigation and domestic
USBR	13370	11315	American River	8,000	Nov. 1 to Aug. 1	1,000,000	Nov. 1 to July 1	Irrigation, salinity control and flood control
USBR	13371	11316	American River	700	Nov. 1 to Aug. 1	300,000	Nov. 1 to July 1	Municipal, industrial, domestic and recreational
USBR	13372	11317	American River	8,000	Jan. 1 to Dec. 31	1,000,000	Oct. 1 to July 1	Power

TABLE I (Continued)

PERMITS FOR FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT CONTAINING RESERVED JURISDICTION REGARDING THE SACRAMENTO-SAN JOAQUIN DELTA OR COORDINATION OF TERMS AND CONDITIONS

Permittee 1/	Application No.	Permit No.	Source	Direct Diversion Quantity (cfs)	Direct Diversion Season	Storage Quantity (AF)	Storage Season	Purpose
DWR	14443	16479	Feather River,	1,360	Jan. 1 to Dec. 31	3,500,000	Sept. 1 to July 31	Irrigation, domestic, municipal, industrial, salinity control, recreational, fish and wildlife enhancement
			Sacramento-San Joaquin Delta Channels	6,185	Jan. 1 to Dec. 31	42,100	Jan. 1 to Dec. 31	
DWR	14444	16480	Feather River	11,000	Jan. 1 to Dec. 31	3,500,000	Oct. 1 to July 1	Power, recreational and fish and wildlife enhancement
DWR	14445A	16481	Italian Slough	2,115	Oct. 1 to July 1	44,000	Oct. 1 to July 1	Irrigation, domestic, municipal, industrial, salinity control, recreational and fish and wildlife enhancement
USBR	14662	11318	American River	--	--	300,000	Oct. 1 to July 1	Power

TABLE I (Continued)

PERMITS FOR FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT CONTAINING RESERVED JURISDICTION REGARDING THE SACRAMENTO-SAN JOAQUIN DELTA OR COORDINATION OF TERMS AND CONDITIONS

Permittee 1/	Application No.	Permit No.	Source	Direct Diversion Quantity (cfs)	Direct Diversion Season	Storage Quantity (AF)	Storage Season	Purpose
USBR	15374	11968	Trinity River	300	Jan. 1 to Dec. 31	200,000	Jan. 1 to Dec. 31	Municipal and industrial
USBR	15375	11969	Trinity River	1,700	Jan. 1 to Dec. 31	1,800,000	Jan. 1 to Dec. 31	Irrigation, domestic, fish & wildlife propagation, navigation, water quality control and recreation
USBR	15376	11970	Trinity River	3,525	Jan. 1 to Dec. 31	1,800,000	Jan. 1 to Dec. 31	Power
USBR	15764	12860	Old River	--	--	1,000,000	Oct. 1 to April 30	Irrigation, domestic, stockwatering municipal, industrial and recreation
USBR	16767	11971	Trinity River	--	--	700,000	Jan. 1 to Dec. 31	Irrigation, domestic and water quality control
USBR	16768	11972	Trinity River	175	Jan. 1 to Dec. 31	700,000	Jan. 1 to Dec. 31	Power

TABLE I (Continued)

PERMITS FOR FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT
CONTAINING RESERVED JURISDICTION REGARDING THE SACRAMENTO-SAN JOAQUIN DELTA
OR COORDINATION OF TERMS AND CONDITIONS

Permit-tee 1/	Application No.	Permit No.	Source	Direct Diversion Quantity (cfs)	Direct Diversion Season	Storage Quantity (AF)	Storage Season	Purpose
USBR	17374	11973	Trinity River	1,500	Jan. 1 to Dec. 31	--	--	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement
DWR	17512	16482	Italian Slough and San Luis Creek	--	--	1,100,000	Oct. 1 to July 1	Irrigation, domestic, municipal, industrial, salinity control, recreation, fish and wildlife enhancement
DWR	17514A	16483	Lindsey Slough	135	Oct. 1 to July 1	--	--	Municipal and industrial
USBR	18721	16209	North Fork American River and Knickerbocker Creek	100	Nov. 1 to Aug. 1	1,700,000	Nov. 1 to July 1	Irrigation, recreation, incidental domestic and water quality control
USBR	18723	16210	North Fork American River and Knickerbocker Creek	6,300	Jan. 1 to Dec. 31	1,700,000	Nov. 1 to July 1	Power, incidental recreation and domestic

TABLE I (Continued)

PERMITS FOR FEDERAL CENTRAL VALLEY PROJECT AND STATE WATER PROJECT CONTAINING RESERVED JURISDICTION REGARDING THE SACRAMENTO-SAN JOAQUIN DELTA OR COORDINATION OF TERMS AND CONDITIONS

Permittee 1/	Application No.	Permit No.	Source	Direct Diversion		Storage		Purpose
				Quantity (cfs)	Season	Quantity (AF)	Season	
USBR	21542	15149	Old River	--	--	1,000,000	Nov. 1 to April 30	Power
USBR	21636	16211	North Fork American River and Knickerbocker Creek	600	Jan. 1 to Dec. 31	800,000	Nov. 1 to July 1	Power
USBR	21637	16212	North Fork American River and Knickerbocker Creek	900	Nov. 1 to July 1	800,000	Nov. 1 to July 1	Irrigation, municipal, industrial, domestic, recreation, fish and wildlife enhancement and water quality control
USBR	22316	15735	Rock Slough	--	--	5,400	Oct. 1 to June 30	Irrigation, domestic, municipal, industrial, water quality control and recreation

1/ USBR = Permit held by U.S. Bureau of Reclamation
DWR = Permit held by Department of Water Resources

Table II
DECISION 1485
WATER QUALITY STANDARDS
FOR THE SACRAMENTO–SAN JOAQUIN DELTA AND SUISUN MARSH[1]

BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE[2]	VALUES	
MUNICIPAL and INDUSTRIAL					
Contra Costa Canal Intake at Pumping Plant No. 1	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
Contra Costa Canal Intake at Pumping Plant No. 1 or Antioch Water Works Intake on San Joaquin River	Chloride	Maximum Mean Daily 150 mg/l Chloride for at least the number of days shown during the Calendar Year. Must be provided in intervals of not less than two weeks duration. (% of Year shown in parenthesis)		Number of Days Each Calendar Year Less than 150 mg/l Chloride	
			Wet	240 (66%)	
			Ab. Normal	190 (52%)	
			Bl. Normal	175 (48%)	
			Dry	165 (45%)	
			Critical	155 (42%)	
City of Vallejo Intake at Cache Slough	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
Clifton Court Forebay Intake at West Canal	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
Delta Mendota Canal at Tracy Pumping Plant	Chloride	Maximum Mean Daily Cl^- in mg/l	All	250	
AGRICULTURE				0.45 EC April 1 to Date Shown	EC from Date Shown[3] to Aug. 15
WESTERN DELTA					
Emmaton on the Sacramento River	Electrical Conductivity	Maximum 14-day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	July 1	0.63
			Bl. Normal	June 20	1.14
			Dry	June 15	1.67
			Critical	--	2.78
Jersey Point on the San Joaquin River	Electrical Conductivity	Maximum 14-day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	Aug. 15	--
			Bl. Normal	June 20	0.74
			Dry	June 15	1.35
			Critical	--	2.20
INTERIOR DELTA					
Terminous on the Mokelumne River	Electrical Conductivity	Maximum 14-day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	Aug. 15	--
			Bl. Normal	Aug. 15	--
			Dry	Aug. 15	--
			Critical	--	0.54
San Andreas Landing on the San Joaquin River	Electrical Conductivity	Maximum 14–day Running Average of Mean Daily EC in mmhos	Wet	Aug. 15	--
			Ab. Normal	Aug. 15	--
			Bl. Normal	Aug. 15	--
			Dry	June 25	0.58
			Critical	--	0.87

Table II
DECISION 1485
WATER QUALITY STANDARDS
FOR THE SACRAMENTO–SAN JOAQUIN DELTA AND SUISUN MARSH[1]

BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE[2]	VALUES
FISH AND WILDLIFE				
• STRIPED BASS SPAWNING				
Prisoners Point on the San Joaquin River	Electrical Conductivity	Average of mean daily EC for the period not to exceed	All	April 1 to May 5 0.550 mmhos
Chipps Island	Delta Outflow Index in cfs	Average of the daily Delta outflow index for the period, not less than	All	April 1 to April 14 6700 cfs
Antioch Waterworks Intake on the San Joaquin River	Electrical Conductivity	Average of mean daily EC for the period, not more than	All	April 15 to May 5 1.5 mmhos
Antioch Waterworks Intake	Electrical Conductivity (Relaxation Provision – replaces the above Antioch and Chipps Island Standard whenever the projects impose deficiencies in firm supplies [5])	Average of mean daily EC for the period, not more than the values corresponding to the deficiencies taken (linear interpolation to be used to determine values between those shown)	All – whenever the projects impose deficiencies in firm supplies [5]	Total Annual Imposed Deficiency MAF / April 1 to May 5 EC in mmhos: 0 / 1.5 0.5 / 1.9 1.0 / 2.5 1.5 / 3.4 2.0 / 4.4 3.0 / 10.3 4.0 or more / 25.2
• STRIPED BASS SURVIVAL				
Chipps Island	Delta Outflow Index in cfs	Average of the daily Delta outflow index for each period shown not less than		May 6–31 / June / July
			Wet	14,000 / 14,000 / 10,000
			Ab. Normal	14,000 / 10,700 / 7,700
			Bl. Normal	11,400 / 9,500 / 6,500
			Subnormal Snowmelt	6,500 / 5,400 / 3,600
			Dry [6]	4,300 / 3,600 / 3,200
			Dry [7] or Critical	3,300 / 3,100 / 2,900
• SALMON MIGRATIONS				
Rio Vista on the Sacramento River	Computed net stream flow in cfs	Minimum 30-day running average of mean daily net flow		Jan. / Feb. 1–Mar. 15 / Mar.16–June 30
			Wet	2,500 / 3,000 / 5,000
			Ab. Normal	2,500 / 2,000 / 3,000
			Bl. Normal	2,500 / 2,000 / 3,000
			Dry or Critical	1,500 / 1,000 / 2,000
				July / Aug. / Sept. 1–Dec. 31
			Wet	3,000 / 1,000 / 5,000
			Ab. Normal	2,000 / 1,000 / 2,500
			Bl. Normal	2,000 / 1,000 / 2,500
			Dry or Critical	1,000 / 1,000 / 1,500
• SUISUN MARSH				Jan.–May / Oct.–Dec.
Chipps Island at O&A Ferry Landing	Electrical Conductivity	Maximum 28-day running average of mean daily EC	Wet	12.5 mmhos / 12.5 mmhos
			Ab. Normal	12.5 mmhos / 12.5 mmhos
			Bl. Normal	12.5 mmhos / 12.5 mmhos
			Dry or Critical	12.5 mmhos / 15.6 mmhos
		(The 15.6 mmhos EC Standard applies only when project water users are taking deficiencies in scheduled water supplies [8] otherwise the 12.5 mmhos EC remains in effect.)		
Chipps Island	Delta Outflow Index in cfs	Average of the daily Delta outflow index for each month, not less than values shown	Wet	February–May 10,000 cfs
			Subnormal Snowmelt	February–April 10,000 cfs
		Minimum daily Delta outflow index for 60 consecutive days in the period	Ab. Norm. and Bl. Norm.	January–April 12,000 cfs

Table II
DECISION 1485
WATER QUALITY STANDARDS
FOR THE SACRAMENTO–SAN JOAQUIN DELTA AND SUISUN MARSH [1/]

BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE [2/]	VALUES
FISH AND WILDLIFE				
• *SUISUN MARSH*				
Chipps Island (continued)	*Delta Outflow Index in cfs*	*Average of the daily Delta outflow index for each month, not less than values shown*	*All (if greater flow not required by above standard)—whenever storage is at or above the minimum level in the flood control reservation envelope at two out of three of the following: Shasta Reservoir, Oroville Reservoir, and CVP storage on the American River*	*Jan.–May* *6,600 cfs*
Collinsville on Sacramento River (C–2) *Miens Landing on Montezuma Slough (S–64)* *Montezuma Slough at Cutoff Slough (S–48)* *Montezuma Slough near mouth* *Suisun Slough near Volanti Slough (S–42)* *Suisun Slough near mouth (S–31)* *Goodyear Slough south of Pierce Harbor (S–35)* *Cordelia Slough above S. P. R.R. (S–32)*	*Electrical Conductivity*	*The monthly average of both daily high tide values not to exceed the values shown (or demonstrate that equivalent or better protection will be provided at the location)*	*All — To become effective Oct. 1, 1984*	*Month* / *EC in mmhos* *Oct.* 19.0 *Nov.* 15.5 *Dec.* 15.5 *Jan.* 12.5 *Feb.* 8.0 *Mar.* 8.0 *Apr.* 11.0 *May* 11.0
• *OPERATIONAL CONSTRAINTS*				
Minimize diversion of young striped bass from the Delta	*Diversions in cfs*	*The mean monthly diversions from the Delta by the State Water Project (Department) not to exceed the values shown.*	*All*	*May* 3,000 / *June* 3,000 / *July* 4,600
		The mean monthly diversions from the Delta by the Central Valley Project (Bureau), not to exceed the values shown	*All*	*May* 3,000 / *June* 3,000
Minimize diversion of young striped bass into Central Delta		*Closure of Delta cross channel gates for up to 20 days but no more than two out of four consecutive days at the discretion of the Department of Fish and Game upon 12 hours notice*	*All — whenever the daily Delta outflow index is greater than 12,000 cfs*	*April 16–May 31*
Minimize cross Delta movement of Salmon		*Closure of Delta Cross Channel gates (whenever the daily Delta outflow index is greater than 12,000 cfs)*	*All*	*Jan. 1–April 15*

Table II
DECISION 1485
WATER QUALITY STANDARDS
FOR THE SACRAMENTO-SAN JOAQUIN DELTA AND SUISUN MARSH 1/

FISH PROTECTIVE FACILITIES

Maintain appropriate records of the numbers, sizes, kinds of fish salvaged and of water export rates and fish facility operations.

STATE FISH PROTECTIVE FACILITY

The facility is to be operated to meet the following standards to the extent that they are compatible with water export rates:

(a) King Salmon — from November through May 14, standards shall be as follows:
- (1) Approach Velocity — 3.0 to 3.5 feet per second
- (2) Bypass Ratio — maintain 1.2:1.0 to 1.6:1.0 ratios in both primary and secondary channels
- (3) Primary Bay — not critical but use Bay B as first choice
- (4) Screened Water System — the velocity of water exiting from the screened water system is not to exceed the secondary channel approach velocity. The system may be turned off at the discretion of the operators.

(b) Striped Bass and White Catfish — from May 15 through October, standards shall be as follows:
- (1) Approach Velocity — in both the primary and secondary channels, maintain a velocity as close to 1.0 feet per second as is possible
- (2) Bypass Ratio
  - (i) When only Bay A (with center wall) is in operation maintain a 1.2:1.0 ratio
  - (ii) When both primary bays are in operation and the approach velocity is less than 2.5 feet per second, the bypass ratio should be 1.5:1.0
  - (iii) When only Bay B is operating the bypass ratio should be 1.2:1.0
  - (iv) Secondary channel bypass ratio should be 1.2:1.0 for all approach velocities.
- (3) Primary Channel — use Bay A (with center wall) in preference to Bay B
- (4) Screened Water Ratio — if the use of screened water is necessary, the velocity of water exiting the screened water system is not to exceed the secondary channel approach velocity
- (5) Clifton Court Forebay Water Level — maintain at the highest practical level.

TRACY FISH PROTECTIVE FACILITY

The secondary system is to be operated to meet the following standards, to the extent that they are compatible with water export rates:

(a) The secondary velocity should be maintained at 3.0 to 3.5 feet per second whenever possible from February through May while salmon are present

(b) To the extent possible, the secondary velocity should not exceed 2.5 feet per second and preferably 1.5 feet per second between June 1 and August 31, to increase the efficiency for striped bass, catfish, shad, and other fish. Secondary velocities should be reduced even at the expense of bypass ratios in the primary, but the ratio should not be reduced below 1:1.0

(c) The screened water discharge should be kept at the lowest possible level consistent with its purpose of minimizing debris in the holding tanks

(d) The bypass ratio in the secondary should be operated to prevent excessive velocities in the holding tanks, but in no case should the bypass velocity be less than the secondary approach velocity.

FOOTNOTES

1/ Except for flow, all values are for surface zone measurements. Except for flow, all mean daily values are based on at least hourly measurements. All dates are inclusive.

2/ Footnote 2 is set forth on next sheet.

3/ When no date is shown in the adjacent column, EC limit in this column begins on April 1.

4/ If contracts to ensure such facilities and water supplies are not executed by January 1, 1980, the Board will take appropriate enforcement actions to prevent encroachment on riparian rights in the southern Delta.

5/ For the purpose of this provision firm supplies of the Bureau shall be any water the Bureau is legally obligated to deliver under any CVP contract of 10 years or more duration, excluding the Friant Division of the CVP, subject only to dry and critical year deficiencies. Firm supplies of the Department shall be any water the Department would have delivered under Table A entitlements of water supply contracts and under prior right settlements had deficiencies not been imposed in that dry or critical year.

6/ Dry year following a wet, above normal or below normal year.

7/ Dry year following a dry or critical year.

8/ Scheduled water supplies shall be firm supplies for USBR and DWR plus additional water ordered from DWR by a contractor the previous September, and which does not exceed the ultimate annual entitlement for said contractor.

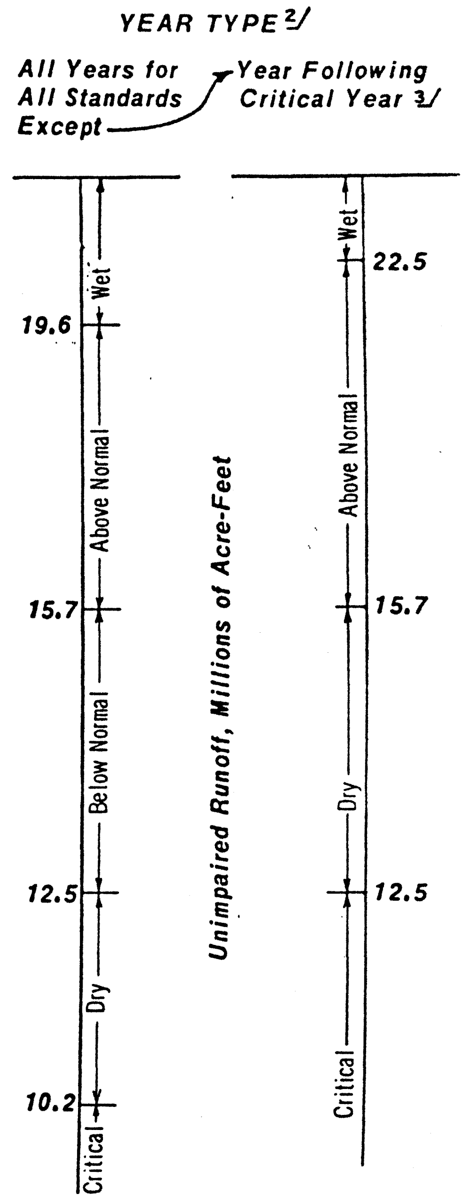
NOTE: EC values are mmhos/cm at 25°C.

FOOTNOTE 2 OF TABLE II

YEAR CLASSIFICATION

Year classification shall be determined by the forecast of Sacramento Valley unimpaired runoff for the current water year *(October 1 of the preceding calendar year through September 30 of the current calendar year)* as published in California Department of Water Resources Bulletin 120 for the sum of the following locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartville; American River, total inflow to Folsom Reservoir. Preliminary determinations of year classification shall be made in February, March and April with final determination in May. These preliminary determinations shall be based on hydrologic conditions to date plus forecasts of future runoff assuming normal precipitation for the remainder of the water year.

YEAR TYPE	***RUNOFF, MILLIONS OF ACRE-FEET***
Wet 1/	equal to or greater than 19.6 (except equal to or greater than 22.5 in a year following a critical year). 3/
Above Normal 1/	greater than 15.7 and less than 19.6 (except greater than 15.7 and less than 22.5 in a year following a critical year). 3/
Below Normal 1/	equal to or less than 15.7 and greater than 12.5 (except in a year following a critical year). 3/
Dry	equal to or less than 12.5 and greater than 10.2 (except equal to or less than 15.7 and greater than 12.5 in a year following a critical year). 3/
Critical	equal to or less than 10.2 (except equal to or less than 12.5 in a year following a critical year). 3/



1/ *Any otherwise wet, above normal, or below normal year may be designated a subnormal snowmelt year whenever the forecast of April through July unimpaired runoff reported in the May issue of Bulletin 120 is less than 5.9 million acre-feet.*

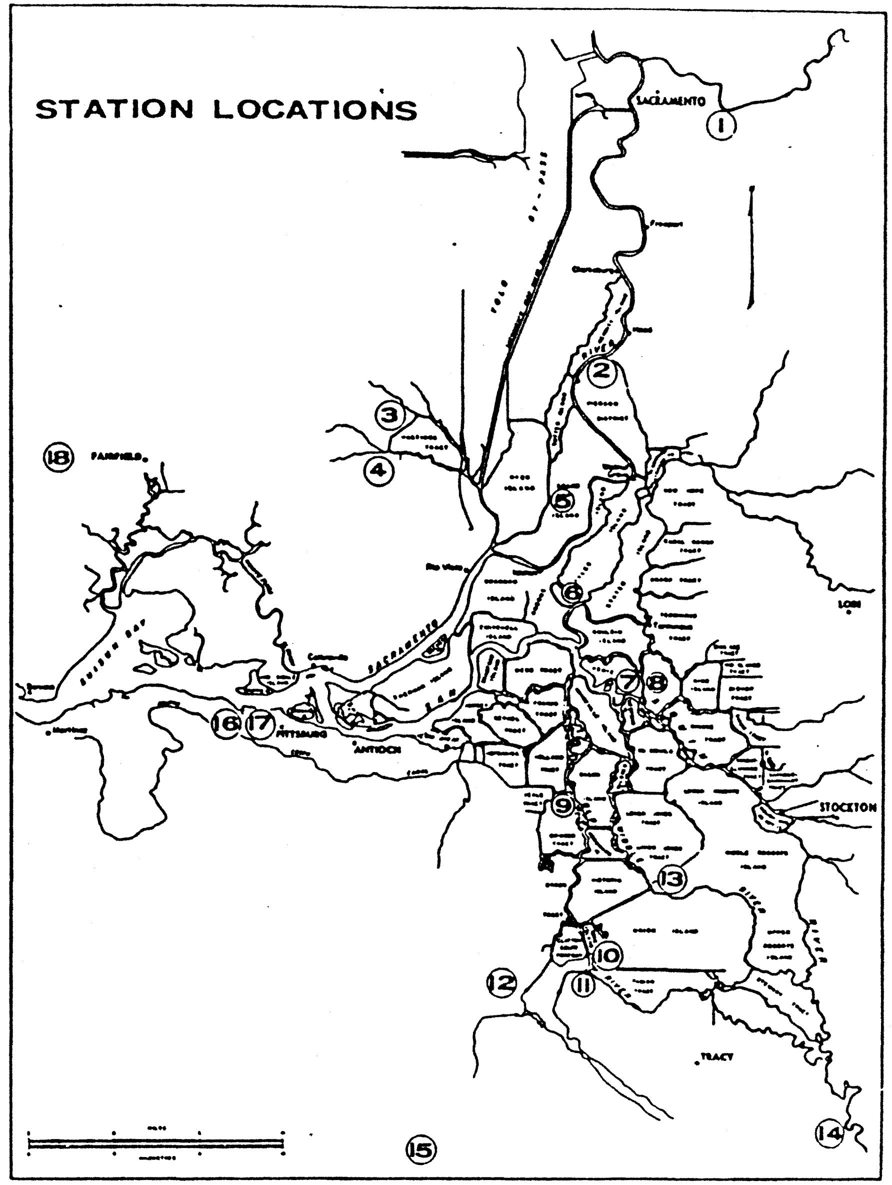
2/ *The year type for the preceding water year will remain in effect until the initial forecast of unimpaired runoff for the current water year is available.*

3/ *"Year following critical year" classification does not apply to Agricultural, Municipal and Industrial standards.*

Appendix C.

MONITORING PROGRAM DATA

Station Location Number	Station Name Station Number
1	American River at Water Treatment Plant A0714010
2	Sacramento River at Greene's Landing B9D82071327
3	Cache Slough at Vallejo Pumping Plant B9D81781448
4	Lindsey Slough at Hastings Cut B9D81581462
5	Agricultural Drain on Grand Island B9V81171369
6	Agricultural Drain on Tyler Island B9V80801348
7	Little Connection Slough at Empire Tract (end of 8-Mile Road) B9D80361299
8	Agricultural Drain on Empire Tract (west end of 8-Mile Road) B9V80361274
9	Rock Slough at Old River B9D75841348
10	Clifton Court Intake KA000000
11	Delta-Mendota Intake at Lindeman Road B9C74901336
12	H. O. Banks Delta Pumping Plant at Headworks KA000331
13	Middle River at Borden Highway (Middle River at Highway 4 Bridge) B9D75351293
14	San Joaquin River near Vernalis B0702000
15	Lake Del Valle Stream Release DV004000
16	Mallard Slough at CCWDPP B8X80221556
17	Sacramento River at Mallard Island E0B80261551
18	North Bay Interim Pumping Plant Intake KE000000



DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
												<---- THM Formation Potential---->							
												<-------------- ug/L ------------>							
7207	ADGEMPIRE	05/27/87	19.5	6.6	5.3	32	53	408	14										D
7406	ADGEMPIRE	09/24/87	19.3	7.3	3.6	274	700	2960	9			1200	780	570	130	2680			D
7478	ADGEMPIRE	10/19/87	16.	7.1	2.							960	560	230	36	1786			D
7450	ADGEMPIRE	10/28/87	19.	7.2	2.1	122	310	1340	16	80		1320	638	183	25	2166			D
7547	ADGEMPIRE	11/24/87	12.5	7.2	8.1					60		1400	41	1	1	1443			D
7607	ADGEMPIRE	12/16/87	8.2	6.5	6.3					250									D
5011	AGDEMPIRE	02/06/85	6.	7.3	9.8	252	685	2610	26	25		1500	920	930	81	3431			D
5027	AGDEMPIRE	03/06/85	10.5	7.3	7.6	226	597	2330	14										D
5044	AGDEMPIRE	04/05/85	21.5	7.3	3.9	224	517	2180	10	75		1800	920	370	31	3121			D
5061	AGDEMPIRE	05/01/85	20.	7.6	6.5	248	566	2280	14	160		1800	900	440	29	3169			D
5077	AGDEMPIRE	06/05/85	20.	7.3	4.	54	95	629	15	75		1800	280	25	0	2105			D
5107	AGDEMPIRE	07/24/85	23.	6.8	4.1	42	69	472	10	40		2100	140	19	0	2259			D
5112	AGDEMPIRE	08/01/85	22.	6.8	5.5	32	44	360	8	100	22.	2100	150	10	0	2260			D
5128	AGDEMPIRE	09/11/85	19.5	6.9	4.5	83	172	886	4	150	19.	3000	460	48	2	3510			D
5138	AGDEMPIRE	10/02/85	18.	7.6	7.6	149	376	1640	10	50	18.	2200	790	330	26	3346			D
5161	AGDEMPIRE	11/13/85	7.	7.3	9.	170	452	1880	4	80	34.	2100	920	390	40	3450			D
5181	AGDEMPIRE	12/03/85	14.	7.	5.4	87	186	1070	8	200	44.	2900	360	44	1	3305			D
6003	AGDEMPIRE	01/16/86	12.	6.8	5.8	112	228	1087	3	160	31.	6900	490	67	1	7458			D
6017	AGDEMPIRE	02/13/86	14.	6.8	6.7	162	396	1880	11	150	40.	2600	650	170	8	3428			D
6028	AGDEMPIRE	03/04/86	19.5	7.3	8.	233	595	2840	7	200	65.	1500	660	210	14	2384			D
6046	AGDEMPIRE	04/17/86	15.	7.4	8.8	148	357	1610	10	160	47.	1900	830	320	13	3063			D
6081	AGDEMPIRE	05/13/86	21.5	7.5	6.6	204	506	2000	15	150	61.	570	330	160	15	1075			D
[illegible]112	AGDEMPIRE	06/11/86	22.	8.1	5.7	296	830	2760	14	80	44.	410	310	230	48	998			D
[illegible]1	AGDEMPIRE	07/09/86	20.5	6.9	5.4	23	30	283	10	100	72.	1400	94	4	0	1498			D
6150	AGDEMPIRE	08/13/86	20.5	7.1	5.1	24	37	281	9	50	19.								D
6198	AGDEMPIRE	09/11/86	20.5	7.3	5.2	192	548	2120	10	80	19.	1400	1000	620	78	3098			D
6283	AGDEMPIRE	11/19/86	16.	6.3	2.3	64	121	808	3	360	56.	5300	120	5	0	5425			D
6300	AGDEMPIRE	12/10/86	12.	6.3	3.	66	128	866	4	280	48.								D
7008	AGDEMPIRE	01/13/87	7.5	6.3	1.7	75	173	996	3	300	60.	3200	190	23	15	3428			D
7046	AGDEMPIRE	02/10/87	11.5	6.6	3.5	132	332	1660	8	200	54.	2900	410	160	6	3476			D
7069	AGDEMPIRE	03/10/87	13.5	6.8	3.	216	542	2390	124	120	33.	1100	72	95	15	1282			D
7172	AGDEMPIRE	04/16/87	21.5	7.5	7.2	222	638	2510	17	125	28.	2900	1300	500	74	4774			D
7172	AGDEMPIRE	04/16/87	21.5	7.5	7.2					125	28.	2900	1300	500	74	4774			D
7196	AGDEMPIRE	05/06/87	23.	7.9	7.5						28.	1200	740	570	200	2710			D
	AGDEMPIRE	05/27/87	19.5	6.6	5.3					200	20.	2900	200	12	0	3112			D
7207	AGDEMPIRE	05/28/87	19.5	6.6	5.3					200	20.	2900	200	12	0	3112			D
7245	AGDEMPIRE	06/11/87	21.	6.9	6.4	36	64	503	19	60	10.	960	130	17	0	1107			D
7308	AGDEMPIRE	08/07/87	21.3	6.6	2.4	54	115	732	4		36.	3500	420	38	4	3962			D
7406	AGDEMPIRE	09/24/87	19.3	7.3	3.6					100	18.								D
	AGDEMPIRE	10/19/87	16.	7.1	2.					60									D
7449	AGDEMPIRE	10/28/87	19.	7.2	2.1						22.								D
5012	AGDGRAND	02/06/85	11.5	7.1	7.5	43	35	576	34	25		2100	32	4	0	2136			D
5028	AGDGRAND	03/06/85	12.5	6.9	5.3	35	29	468	21										D
5046	AGDGRAND	04/05/85	18.5	7.3	5.	53	39	625	30	80		2000	100	4	0	2104			D
562	AGDGRAND	05/01/85	18.5	6.9	5.7	23	13	310	26	50		1000	41	0	0	1041			D
5078	AGDGRAND	06/05/85	21.	7.3	6.6	20	12	265	22	35		840	37	0	0	877			D
5108	AGDGRAND	07/24/85	22.5	7.2	5.5	22	16	267	70	80		1800	60	2	0	1862			D
5113	AGDGRAND	08/01/85	21.5	7.1	6.5	22	13	273	30	50	17.	1300	49	1	0	1350			D
[illegible]6	AGDGRAND	09/11/85	19.5	7.2	6.1	31	33	451	28	30	14.	1100	94	8	0	1202			D
5139	AGDGRAND	10/02/85	19.	7.2	6.	27	19	327	25	30	4.5	820	56	3	0	879			D
5164	AGDGRAND	11/13/85	12.5	7.3	4.5	29	22	368	16	35	9.	890	69	3	0	962			D
5183	AGDGRAND	12/03/85	13.	7.	3.8	55	49	735	31	100	39.	2800	160	5	0	2965			D
6005	AGDGRAND	01/16/86	13.5	7.3	7.3	64	51	716	26	80	20.	3500	130	6	0	3636			D

147

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	<---- THM Formation Potential----> CHCL3	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
												<--------------		ug/L	------------>				
6020	AGDGRAND	02/27/86	17.5	7.	4.4	35	27	602	24	100	28.	1700	83	2	0	1785			D
6036	AGDGRAND	03/13/86	14.5	6.6	5.8	64	57	1060	22	160	56.	3200	180	5	0	3385			D
6051	AGDGRAND	04/23/86	18.5	7.3	7.6	32	29	513	54	50	23.	1700	82	2	0	1784			D
6086	AGDGRAND	05/28/86	22.5	7.3	7.4	21	16	323	36	50	38.	640	29	3	1	673			D
6118	AGDGRAND	06/25/86	24.5	7.2	6.8	20	15	290	35	40	9.2	450	30	2	1	483			D
6138	AGDGRAND	07/23/86	22.5	7.1	6.	15	10	210	24	40	18.								D
6159	AGDGRAND	08/27/86	23.5	7.2	7.6	17	11	250	24	50	29.	1400	35	0	0	1435			D
6206	AGDGRAND	09/09/86	18.5	7.1	3.	37	22	378	18	15	12.	240	30	3	0	273			D
6286	AGDGRAND	11/19/86	14.5	7.3	5.8	18	12	237	14	5	1.7	320	16	2	0	338			D
6300	AGDGRAND	12/10/86	10.	7.1	8.1	33	18	366	30	50	11.	1400	30	0	0	1430			D
7013	AGDGRAND	01/13/87	7.	7.1	7.9	34	23	458	21	80	14.	1900	56	2	2	1960			D
7041	AGDGRAND	02/10/87	14.5	7.2	7.4	42	32	559	38	75	20.	2400	77	0	0	2477			D
7079	AGDGRAND	03/10/87	13.	7.1	6.6	45	50	853	66	120	28.	1400	67	2	3	1472			QD
7076	AGDGRAND	03/10/87	13.	7.1	6.6	54	49	852	76	120	28.	1300	74	2	3	1379			D
7076	AGDGRAND	03/10/87	13.	7.1	6.6	54	49	852	76	120	28.	1300	74	2	3	1379			QD
7179	AGDGRAND	04/16/87	17.	7.	6.2	21	17	358	28	30	7.8	1400	79	5	0	1484			D
7179	AGDGRAND	04/16/87	17.	7.	6.2					30	7.8	1400	79	5	0	1484			D
7213	AGDGRAND	05/20/87	17.	7.3	8.2	18	12	251	38	30	5.4	800	30	0	0	830			D
7252	AGDGRAND	06/11/87	20.	7.3	6.3	33	27	398	29	30	5.5	920	62	5	0	987			D
7390	AGDGRAND	09/03/87	23.1	7.3	5.					35	7.8	1200	58	7	0	1265			D
7390	AGDGRAND	09/03/87	23.1	7.3	5.	44	41	499	22										D
7431	AGDGRAND	10/08/87	16.5	7.3	7.2					40									QD
[illegible]35	AGDGRAND	10/08/87	16.5	7.3	7.2					40									QD
[illegible]1	AGDGRAND	10/08/87	16.5	7.3	7.2					40									D
7437	AGDGRAND	10/08/87	17.2	7.1	7.5	20	15	340	30			980	45	1					QD
7535	AGDGRAND	11/03/87	13.5	7.2	7.	31	20	441	29	60		890	61	1					D
7557	AGDGRAND	12/01/87	10.6	7.3	9.1					60		1600	49	3					D
8006	AGDGRAND	01/06/88	9.2	7.1	8.1					160									D
5038	AGDTYLER	03/27/85	11.5	6.8	7.8	46	84	743	29										D
5053	AGDTYLER	04/24/85	19.5	7.3	5.8	56	100	743	28	100		2100	260	27	0	2387			D
5074	AGDTYLER	05/22/85	21.5	7.2	4.7	23	31	320	17	70		1800	91	4	0	1895			D
5090	AGDTYLER	06/26/85	24.	6.8	5.5	15	10	188	18	50		1400	45	3	0	1448			D
5105	AGDTYLER	07/10/85	25.5	7.	4.5	14	8	189	17	100		1600	51	1	0	1652			D
5124	AGDTYLER	08/28/85	23.5	7.3	6.7	21	20	299	9	100	38.	2100	78	3	0	2181			D
5135	AGDTYLER	09/11/85	19.5	7.2	6.1	24	31	354	10	50	27.	2200		6	0				D
5150	AGDTYLER	10/02/85	17.5	6.9	3.2	26	18	289	14	100	15.	1200	70	2	0	1272			D
5163	AGDTYLER	11/13/85	6.	6.8	8.1	28	35	376	11	160	19.	2000	120	2	0	2122			D
5182	AGDTYLER	12/03/85	12.5	7.	3.7	36	58	587	12	100	64.	2100	85	2	0	2187			D
6004	AGDTYLER	01/16/86	11.	6.9	4.6	38	48	476	9	120	35.	3500	83	8	0	3591			D
6127	AGDTYLER	06/11/86	19.5	7.3	7.9	10	9	158	768	240	46.	1300	66	4	1	1371			D
6133	AGDTYLER	07/09/86	23.5	7.3	0.5	75	114	966	18	400	170.	1400	160	13	0	1573			D
6154	AGDTYLER	08/13/86	21.5	6.8	2.6	21	22	279		150	40.								D
6200	AGDTYLER	09/11/86	20.5	7.3	5.5	24	33	369	38	100	12.	2200	100	3	0	2303			D
6284	AGDTYLER	11/19/86	14.	7.1	4.4	55	103	804	21	150	26.	4100	180	13	0	4293			D
6304	AGDTYLER	12/10/86	9.	7.3	10.4	58	117	829	26	60	23.	3700	310	23	0	4033			D
7010	AGDTYLER	01/13/87	6.	7.1	7.6	56	109	746	29	120	20.	2100	100	5	0	2205			D
7043	AGDTYLER	02/10/87	12.5	6.9	5.5	42	73	647	25	100	24.	2200	97	0	0	2297			D
7072	AGDTYLER	03/10/87	12.5	6.8	6.4	71	129	1100	60	100	36.	1300	80	2	8	1390			D
[illegible]5	AGDTYLER	04/16/87	17.	7.2	6.8	16	18	310	72	35	7.5	1300	95	2	0	1397			D
[illegible]	AGDTYLER	05/20/87	16.5	7.4	7.2	18	14	249	18	105	12.	1600	51	0	0	1651			D
7248	AGDTYLER	06/11/87	21.	7.3	6.4	12	9	198	27	30	4.2	800	20	0	0	820			D
7293	AGDTYLER	06/24/87	22.5	6.8	5.6						6.4	1000	59	5	0	1064			D
3044	AMERICAN	07/21/83	17.	7.3	10.	2	1	35	1	2	1.2	230	3	0	0	233	5E3		F

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	<---- THM Formation Potential----> CHCL3	CHBRCL2	CHBR2CL ug/L	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
3080	AMERICAN	08/18/83	19.	7.3	10.1	2	1	36	1	2	1.2	210	16	2	0	228	5E3		F
3098	AMERICAN	09/13/83	19.5	7.2	9.2	2	1	39	2	0	1.	220	4	0	0	224	4E3		F
3123	AMERICAN	10/04/83	20.	7.1	9.1	2	1	42	1	5	1.8	160	11	0	0	171	4E3		F
3149	AMERICAN	11/01/83	17.	7.1	9.	2	1	40	2	5	1.2	150	4	0	0	154	3E3		F
3165	AMERICAN	12/06/83	11.	7.2	11.8	2	1	46	9	12	2.3	270	4	0	0	274	9E3		F
4004	AMERICAN	01/10/84	9.	7.	11.9	2	1	50	10	10	1.1	200	4	0	0	204	8E3		F
4016	AMERICAN	02/01/84	9.5	7.1	11.9	2	2	53	4	5	1.	200	4	0	0	204	3E3		F
4029	AMERICAN	03/07/84	9.5	7.3	11.6	2	1	57	3	2	1.3	260	17	0	0	277	4E3		F
4041	AMERICAN	04/04/84	11.	7.1	11.4	2	1	55	2	2	1.2	200	5	0	0	205	4E3		F
4071	AMERICAN	05/02/84	12.5	7.1	11.7	2	1	54	1	2	1.3	160	4	0	0	164	2E3		F
4086	AMERICAN	06/06/84	15.	7.3	10.3	2	2	52	3	2	1.	270	10	1	0	281	4E3		F
4100	AMERICAN	07/10/84	18.	7.3	9.4	2	1	48	1	0	1.2	290	4	0	0	294	5E3		F
4112	AMERICAN	08/01/84	19.5	7.2	9.1	2	1	46	1	2	1.2	310	4	0	0	314	5E3		F
4158	AMERICAN	09/05/84	22.	7.2	8.6	2	1	51	1	2	1.3	320	5	0	0	325	1E3		F
4177	AMERICAN	10/04/84	19.5	7.1	9.1	2	1	42	2	2	1.2	160	5	0	0	165	2E3		F
4193	AMERICAN	11/08/84	16.	7.	9.3	2	2	51	11	15	3.2	280	5	0	0	285	2E3		F
4213	AMERICAN	12/05/84	11.	7.3	11.2	2	2	59	6	5	1.5	180	4	0	0	184	5E3		F
5017	AMERICAN	02/13/85	10.	7.3	11.9	2	2	63	2	15		230	6	0	0	236	2E3		F
5033	AMERICAN	03/13/85	12.	7.3	11.2	2	2	63	5								1E3		F
5057	AMERICAN	04/10/85	14.5	7.3	10.5	3	2	67	2	0		180	6	0	0	186	1E3		F
5067	AMERICAN	05/08/85	14.	7.3	10.7	3	2	62	1	5		240	3	0	0	243	4E3		F
5084	AMERICAN	06/12/85	18.5	7.3	9.9	2	2	60	2	0		290	5	1	0	296	3E3		F
[illegible]18	AMERICAN	08/14/85	20.	7.2	9.1	2	2	56	1	2	1.5	210	8	0	0	218	3E3		F
[illegible]4	AMERICAN	10/09/85	16.5	7.2	9.2	2	2	52	1	0	1.4	180	5	0	0	185	1E3		F
5188	AMERICAN	12/03/85	12.5	7.2	10.5	3	2	64	6	5	2.	260	6	0	0	266	1E3		F
6031	AMERICAN	03/11/86	12.	7.1	12.	2	1	56	76	25	3.3	370	5	0	0	375	3E4		F
6047	AMERICAN	04/17/86	14.5	7.3	11.2	2	1	55	6	15	1.4	300	5	0	0	305	6E3		F
6082	AMERICAN	05/13/86	16.5	7.3	10.	2	2	53	3	25	1.4	190	6	1	0	197	3E3		F
6113	AMERICAN	06/11/86	16.5	7.3	10.	2	2	46	3	15	1.9	150	9	4	2	165	3E3		F
6132	AMERICAN	07/09/86	17.5	7.1	9.7	2	2	46	2	5	1.7	210	4	0	0	214	5E3		F
6153	AMERICAN	08/13/86	20.5	7.2	9.3	2	1	50		5	2.1						5E3		F
6202	AMERICAN	09/11/86	22.	7.3	8.5	2	2	52	2	5	2.1	160	4	0	0	164	500.		F
6271	AMERICAN	11/05/86	16.	6.9	10.2	2	1	46	1	5	1.8	240	4	0	0	244	2E3		F
6292	AMERICAN	12/03/86	12.5	7.3	9.2	2	2	51	1	0	1.2						2E3		F
7004	AMERICAN	01/08/87	9.	7.1	12.	2	1	64	3	0	1.	230	6	0	0	236	1E3		F
7026	AMERICAN	02/05/87	10.	6.9	11.2	2	2	70	2	0	1.1	190	4	0	0	194	933.		F
7064	AMERICAN	03/03/87	11.	7.5	11.3	2	2	69	1	0	1.7	250	19	0	0	269	958.		F
7162	AMERICAN	04/09/87	16.	7.2	9.2	3	2	69	2	5	1.2	240	9	0	0	249	1E3		F
7201	AMERICAN	05/13/87	19.5	7.2	8.5	2	2	80	2	5	1.8	240	10	1	0	251			F
7237	AMERICAN	06/04/87	18.	7.3	9.4	3	2	85	3	5	1.2	170	6	0	0	176			F
7409	AMERICAN	09/24/87	17.	6.8	8.3					5	1.6								F
7409	AMERICAN	09/24/87	17.	6.8	8.3	2	2	78	2			370	12	4	1	387			F
7452	AMERICAN	10/28/87	20.	7.1	8.2						2.3								F
7452	AMERICAN	10/28/87	20.	7.1	8.2	4	3	73	2	0		193	5						F
7549	AMERICAN	11/24/87	10.5	8.	9.5					0		140	4						F
7608	AMERICAN	12/16/87	11.	7.1	9.3														F
2059	BANKS	03/30/82	12.5	7.3	9.7	38	35	315	9			930	66	7	0	1003	6E3		F
2116	BANKS	06/29/82	20.	8.	8.3		41	322	11			490	83	14	0	587	240.		F
[illegible]4	BANKS	08/26/82	21.	7.9	8.3		19	213	19			430	34	4	0	468	4E3		F
2139	BANKS	10/21/82	18.5	7.2	8.		23	212	6			370	45	7	0	422	3E3		F
2142	BANKS	12/29/82	10.	7.1	9.7		23	225	9			630	49	4	0	683	645.		F
3006	BANKS	02/24/83	14.	7.4	9.3		30	288	10			190	26	4	0	220	6E3		F
3009	BANKS	04/27/83		7.3	8.4		42	367	6			360	69	10	6	445	125.		F

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	<---- THM Formation Potential----> CHCL3 (ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
3035	BANKS	06/22/83	20.5	7.2	8.4		14	143	11			350	28	4	0	382	2E3		F
3048	BANKS	07/26/83	23.	7.3	8.3	21	22	211	17	8	2.8	300	38	6	0	344	1E3		F
3082	BANKS	08/23/83	22.5	7.3	8.	25	28	261	17	8	3.5	420	58	9	0	487	2E3		F
3100	BANKS	09/14/83	22.	7.3	7.	22	24	226	8	20	2.9	330	38	8	0	376	61.		F
3132	BANKS	10/12/83	20.5	7.3	7.6	23	26	219	6	20	3.1	260	47	8	4	319	306.		F
3152	BANKS	11/08/83	16.5	7.2	8.6	19	20	186	7	25	2.8	310	40	7	0	357	1E3		F
3168	BANKS	12/13/83	12.	7.3	10.2	32	34	305	13	40	3.3	360	42	7	0	409	326.		F
4006	BANKS	01/24/84	9.5	7.3	11.2	26	28	252	5	20	2.9	320	44	8	0	372	267.		F
4022	BANKS	02/28/84	12.	7.5	10.	42	46	388	5	20	3.2	310	75	20	0	405	3E3		F
4034	BANKS	03/27/84	16.5	7.3	9.8	36	40	370	20	30	4.2	460	80	16	0	556	104.		F
4047	BANKS	04/25/84	15.	7.3	9.3	27	30	283	37	25	3.9	570	62	12	0	644	4E3		F
4076	BANKS	05/30/84	23.	7.5	7.1	29	33	304	16	12	4.7	400	72	18	0	490	2E3		F
4092	BANKS	06/27/84	24.5	7.3	6.6	24	34	258	29	40	4.9	410	59	8	0	477	3E3		F
4105	BANKS	07/25/84	23.	7.4	8.1	20	23	214	16	20	4.7	420	57	9	0	486	4E3		F
4125	BANKS	08/29/84	23.	7.3	7.4	22	24	244	7	18	3.1	360	55	10	0	425	3E3		F
4164	BANKS	09/27/84	22.5	7.3	8.6	25	25	268	7	15	3.3	370	55	10	0	435	2E3		F
4183	BANKS	10/25/84	16.5	7.7	9.3	25	26	266	8	20	2.9	300	59	9	0	368	903.		F
4198	BANKS	11/29/84	11.5	7.5	10.5	20	21	233	11	30	3.3	430	44	6	0	480	3E3		F
4219	BANKS	12/12/84	11.5	7.3	10.	23	24	263	10	25	4.3	380	50	6	0	436	4E3		F
5019	BANKS	02/27/85	13.5	7.5	9.5	30	33	335	8	35		310	71	10	0	391	4E3		F
5035	BANKS	03/27/85	12.5	7.4	10.1	36	38	367	11								3E3		F
5049	BANKS	04/24/85	17.5	7.6	8.7	36	34	351	11	5		410	81	17	0	508	5E3		F
[illegible]70	BANKS	05/22/85	19.5	8.1	8.6	35	41	351	26	5		580	90	17	0	687	2E3		F
[illegible]8	BANKS	06/07/85	23.5	7.5	7.4	32	37	322	30								3E3		F
5086	BANKS	06/26/85	23.5	7.7	7.5	38	46	370	32	20		550	110	24	1	685	5E3		F
5101	BANKS	07/10/85	24.5	7.5	7.5	42	48	343	16	15		590	160	35	2	787	5E3		F
5120	BANKS	08/28/85	22.5	7.4	7.8	54	78	466	10	10	6.4	390	140	69	5	604	5E3		F
5131	BANKS	09/25/85	22.5	7.5	7.9	69	102	588	6	10	2.7	340	89	40	10	479			QD
5131	BANKS	09/25/85	22.5	7.5	7.9	69	102	588	6	10	2.7	340	89	40	10	479	3E3		F
5160	BANKS	09/25/85	22.5	7.5	7.9	70	102	584	6	5	6.5	290	170	63	13	536			QD
5146	BANKS	10/23/85	17.	7.6	8.9	59	94	527	7	5	4.	290	150	90	13	543	3E3		F
5173	BANKS	11/15/85	12.	7.4	9.5	71	112	586	6	10	2.9	260	160	100			2E3		F
5167	BANKS	12/03/85	11.5	7.4	10.1	85	141	676	10	10	3.6	240	210	150	10	610	6E3		F
6008	BANKS	01/23/86	12.	7.3	9.2	56	79	482	12	25	7.2	1700	170	47	2	1919	5E3		F
6013	BANKS	02/13/86	11.5	7.7	10.5	45	61	444	17	25	8.6	780	140	28	1	949	3E3		F
6024	BANKS	03/04/86	16.5	7.3	8.2	30	33	332	14	30	5.8	600	70	6	0	676	2E3		F
6039	BANKS	04/09/86	17.5	7.5	9.4	29	31	265	13	20	5.	630	76	10	0	716	750.		F
6074	BANKS	05/07/86	15.5	7.3	8.9	28	31	284	11	15	5.	460	74	10	0	544	3E3		F
6105	BANKS	06/04/86	19.5	7.5	8.6	31	38	312	32	20	5.9	340	45	9	0	394	3E3		F
6123	BANKS	07/02/86	24.	7.3	6.4	31	33	305	25	15	4.7	470	78	17	0	565	4E3		F
6142	BANKS	08/14/86	24.	7.3	7.7	27	32	280	22	15	18.						5E3		F
6172	BANKS	09/24/86	19.5	7.5	8.6	10	34	297	22	10	7.1	360	89	19	0	468	6E3		F
6277	BANKS	11/12/86	14.	7.4	9.7	20	23	236	13	15	1.9	340	35	9	0	384	3E3		F
6308	BANKS	12/17/86	10.	7.3	10.1	32	31	278	9	15	1.6	350	58	7	0	415	3E3		F
7017	BANKS	01/22/87	6.5	7.3	12.	28	34	309	14	20	3.8	650	68	7	0	725			F
7055	BANKS	02/24/87	11.5	7.3	10.7	41	55	446	9	20	4.3	630	160	41	0	831			QD
7055	BANKS	02/24/87	11.5	7.3	10.7	41	55	446	9	20	4.3	630	160	41	0	831			F
7052	BANKS	02/24/87	11.5	7.3	10.7	39	55	443	9	20	4.3	630	98	43	0	771			QD
[illegible]7	BANKS	03/24/87	13.	7.5	9.7	57	69	568	8	25	5.	470	120	18	8	616			F
7184	BANKS	04/30/87	18.5	8.4	10.	34	38	396	10	15	3.2	240	57	8	0	305			F
7219	BANKS	05/28/87	18.	7.4	11.	39	52	397	28	15	2.5	450	120	30	0	600			F
7281	BANKS	06/23/87	22.5	7.6	8.3	51	75	487	19	15									F
7371	BANKS	08/17/87	21.9	7.4	7.6	85	130	639	13										F

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (THM Formation Potential, ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7399	BANKS	09/09/87	21.5	7.2	7.4					5	4.								F
7399	BANKS	09/09/87	22.	7.2	8.	77	124	628	12			450	160	74	12	696			F
7442	BANKS	10/22/87	19.5	7.4	7.9	116	173	814	5	0		130	120	100	29	379			F
7442	BANKS	10/22/87	19.5	7.4	7.9						3.9								F
7540	BANKS	11/05/87	17.5	7.4	8.7	91	143	703	6	5		250	100	50	21	421			F
7567	BANKS	12/08/87	12.6	7.4	9.8	113	180	835	4	15		440	180	96	25	741			F
7395	BARKER	09/03/87									6.7	1100	48	1	0	1149			F
7395	BARKER	09/03/87	20.5	7.3	5.5	33	23	734	65										F
7438	BARKER	10/08/87	19.8	7.4	7.6					25									F
7438	BARKER	10/08/87	19.8	7.4	7.6	39	28	561	36			750	32	1					F
7537	BARKER	11/03/87	14.5	7.3	7.1	49	35	561	19	10		670	42	1					QD
7561	BARKER	12/01/87	11.3	7.5	10.2	54	46	599	16	15		590	39	3	2	634			F
8002	BARKER	01/06/88	12.	8.2	11.8					5									F
7082	BETHEL TR PP	03/17/87										3000	490	48	0	3538			D
7111	BOULDIN1	03/26/87	13.5	7.2	8.3	46	43	591	17		32.	2100	120	16	0	2236			D
7299	BOULDIN1	08/06/87	23.6	7.3	7.2	21	28	262	12		7.9	1300	56	5	0	1361		P	D
	BOULDIN1	10/16/87	18.	6.9	2.4					500									D
7470	BOULDIN1	10/16/87	18.	6.9	2.4	72	40	688	7			1800	210	25					D
7572	BOULDIN1	12/11/87	11.5	6.7	3.6					200									D
7112	BOULDIN2	03/26/87	13.5	7.	6.2	46	42	504	13		55.	2800	210	26	0	3036		P	D
7300	BOULDIN2	08/06/87	25.5	7.1	7.1	13	8	182	18		5.4	830	74	0	0	904			D
7471	BOULDIN2	10/16/87	17.4	6.8	5.4	24	16	342	7			1700	75	1					D
	BOULDIN2	10/16/87	17.4	6.8	5.4					250									D
/3	BOULDIN2	12/11/87	12.5	6.9	5.3					400									D
7087	BRANNANPP01	03/16/87										2300	180	16	0	2496			D
7301	BRANNANPP01	08/06/87	22.1	6.9	5.5	29	36	294	13		5.5	1200	60	8	0	1268			D
	BRANNANPP01	10/16/87	15.7	6.9	4.9					50									D
7472	BRANNANPP01	10/16/87	15.7	6.9	4.9	36	52	361	15			900	92	6					D
7574	BRANNANPP01	12/11/87	11.5	6.7	6.1					120									D
7302	BRANNANPP02	08/06/87	22.6	6.9	3.	44	80	505	25		11.	1700	180	21	0	1901			D
7473	BRANNANPP02	10/16/87	15.9	6.7	0.6	43	95	597	35			310	48	9					D
	BRANNANPP02	10/16/87	15.9	6.7	0.6					35									D
7575	BRANNANPP02	12/11/87	13.	6.4	1.7					80									D
7303	BRANNANPP03	08/06/87	22.	7.3	7.2	50	102	671	32		8.2	1400	170	26	0	1596		P	D
	BRANNANPP03	10/16/87	15.8	6.5	1.2					15									D
7474	BRANNANPP03	10/16/87	15.8	6.5	1.2	74	221	1330	84			78	50	24	9	161			D
7304	BRANNANPP04	08/06/87	22.4	7.1	6.3	32	37	328	14		5.	860	79	14	0	953		P	D
	BRANNANPP04	10/16/87	16.4	6.9	3.3					60									D
7475	BRANNANPP04	10/16/87	16.4	6.9	3.3							1500	180	20					D
4012	CACHE	01/31/84	11.5	8.3	12.4	85	88	976	13	8	5.5	300	85	31	2	418			F
4020	CACHE	02/22/84	12.5	8.1	10.4	82	82	896	76	15	6.4	360	87	26	1	474			F
4031	CACHE	03/14/84	16.5	8.1	8.4	79	80	897	14	15	7.6	270	82	27	0	379			F
4045	CACHE	04/11/84	15.5	8.6	10.1	59	57	720	20	10	8.	500	81	18	0	599			F
4073	CACHE	05/23/84	21.	8.3	9.	36	34	488	34	30	6.7	570	63	8	0	641			F
4089	CACHE	06/13/84	19.	8.2	8.5	42	42	595	52	30	7.	760	83	8	0	851			F
4102	CACHE	07/11/84	24.5	8.3	8.5	36	34	541	46	25	8.4	800	64	4	0	868			F
4122	CACHE	08/22/84	21.5	8.1	7.5	32	29	495	90	50	7.1	600	51	4	0	655			F
4160	CACHE	09/12/84	23.	8.1	8.9	39	38	577	20	30	8.4	630	64	5	0	699			F
0	CACHE	10/11/84	19.5	8.2	7.8	44	42	594	29	25	6.	850	69	6	0	925			F
4195	CACHE	11/15/84	12.5	7.4	7.7	38	38	460	95	30	9.	730	47	4	0	781			F
4216	CACHE	12/06/84	10.5	7.[illegible]	8.8	64	64	744	50	50	8.5	720	87	10	0	817			F
5058	CACHE	04/10/85	16.	8.3	9.5	63	62	713	24	10		640	88	16	0	744			F
5068	CACHE	05/08/85	16.5	8.4	9.4	44	38	560	28	25		760	77	6	0	843			F

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	<---- THM Formation Potential----> CHCL3	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
												<--------------		ug/L		------------>			
5094	CACHE	05/29/85	17.5	8.4	9.5	36	33	512	22										F
5082	CACHE	06/12/85	24.	8.1	7.1	35	33	499	50	20		870	43	5	0	918			F
7259	CAL BLANK	06/08/87										180	90	44	0	314			QB
7241	CAL BLANK	06/08/87										230	100	43	0	373			QB
7260	CAL BLANK	06/08/87										240	110	56	0	406			QB
7286	CAL BLANK	06/22/87										240	100	53	4	397			QB
7286	CAL BLANK	06/22/87										230	100	60	5	395			QB
7286	CAL BLANK	06/22/87										240	110	65	5	420			QB
3049	CLIFTON	07/26/83	21.	7.3	7.9	20	22	208	22	8	3.2	310	42	7	0	359	1E3		F
3084	CLIFTON	08/23/83	21.5	7.3	7.7	27	31	283	20	8	3.1	360	72	12	0	444	2E3		F
3102	CLIFTON	09/14/83	22.5	7.3	7.8	17	17	180	11	10	3.3	330	23	4	0	357	0.		F
3129	CLIFTON	10/12/83	20.	7.1	8.3	12	13	137	12	12	2.8	310	27	2	0	339	0.		F
3154	CLIFTON	11/08/83	16.	7.3	8.5	33	36	324	10	20	3.3	270	63	17	0	350	652.		F
3170	CLIFTON	12/13/83	12.	7.1	9.6	16	16	171	13	25	2.9	380	30	3	0	413	0.		F
4008	CLIFTON	01/24/84	10.	7.3	10.8	22	22	226	12	25	3.1	300	39	6	0	345	0.		F
4024	CLIFTON	02/28/84	13.	7.5	10.2	39	42	389	7	18	3.1	280	67	18	0	365	2E3		F
4036	CLIFTON	03/27/84	16.5	7.4	9.4	35	40	362	10	25	3.8	380	79	17	0	476	2E3		F
4049	CLIFTON	04/25/84	16.5	7.3	9.3	27	30	288	12	15	3.8	320	56	13	0	389	4E3		F
4078	CLIFTON	05/30/84	24.	7.1	7.4	29	33	307	19	20	4.9	420	67	15	0	502	3E3		F
4094	CLIFTON	06/27/84	25.5	7.2	6.3	50	56	472	28	30	5.4	350	110	31	1	492	3E3		F
4107	CLIFTON	07/25/84	24.	7.5	8.6	18	21	212	18	25	4.4	420	52	8	0	480	5E3		F
4127	CLIFTON	08/29/84	24.5	7.3	7.6	20	23	222	11	15	3.2	390	54	10	0	454	4E3		F
[illegible]66	CLIFTON	09/27/84	22.	7.5	8.3	24	24	261	6	15	3.2	390	49	12	0	451	2E3		F
[illegible]35	CLIFTON	10/25/84	17.	7.5	10.	27	29	284	7	18	3.4	300	54	14	0	368	0.		F
4200	CLIFTON	11/29/84	12.	7.3	10.2	20	21	233	11	30	3.7	460	48	6	0	514	2E3		F
4221	CLIFTON	12/12/84	11.5	7.3	10.	21	22	252	16	35	4.7	390	52	5	0	447	5E3		F
5003	CLIFTON	01/30/85	7.	7.1	10.5	32	37	348	8								3E3		F
5021	CLIFTON	02/27/85	13.	7.3	9.8	26	28	303	14	40		410	64	8	0	482	4E3		F
5037	CLIFTON	03/27/85	12.5	7.4	9.6	33	34	334	8								4E3		F
5051	CLIFTON	04/24/85	18.	7.6	9.6	24	24	277	8	8		470	56	7	0	533	4E3		F
5072	CLIFTON	05/22/85	21.5	8.1	9.2	25	29	264	21	15		610	65	11	0	686	2E3		F
5088	CLIFTON	06/26/85	24.5	7.5	7.7	37	40	314	17	15		550	88	24	1	663	5E3		F
5103	CLIFTON	07/10/85	25.5	7.5	6.5	43	50	386	15								5E3		F
5122	CLIFTON	08/28/85	23.5	7.4	7.7	51	69	458	10	10	4.	460	110	47	3	620	6E3		F
5133	CLIFTON	09/25/85	22.5	7.4	6.6	64	80	602	12								3E3		F
5148	CLIFTON	10/23/85	17.5	7.5	8.9	52	77	484	9	10	2.3	330	130	59	4	523	3E3		F
5175	CLIFTON	11/15/85	12.	7.4	10.2	92	143	679	12								2E3		F
5169	CLIFTON	12/03/85	12.	7.4	10.1	98	162	744	10	8	3.7	310	220	170	13	713	6E3		F
6010	CLIFTON	01/23/86	11.5	7.3	9.	48	60	410	8								6E3		F
6015	CLIFTON	02/13/86	11.5	7.3	10.4	41	55	423	17								3E3		F
6026	CLIFTON	03/04/86	16.5	7.3	7.8	29	29	306	21	20	8.	520	64	7	0	591	1E3		F
6041	CLIFTON	04/09/86	16.5	7.2	8.8	20	20	197	14	20	3.9	570	62	5	0	637	2E3		F
6041	CLIFTON	04/09/86	16.5	7.2	8.8	20	20	197	14	20	3.9	570	62	5	0	637			QD
6053	CLIFTON	04/09/86	16.5	7.2	8.8	20	20	195	14	30	3.9	610	53	5	0	668			QD
6076	CLIFTON	05/07/86	15.5	7.3	8.8	27	28	280	13	20	6.3	350	51	7	0	408	3E3		F
6107	CLIFTON	06/04/86	20.5	7.3	8.2	29	33	303	26		3.6	140	28	6	0	174	3E3		F
6125	CLIFTON	07/02/86	24.5	7.3	6.5	55	66	534	11	10	3.5	310	91	36	2	439	5E3		F
6144	CLIFTON	08/14/86	24.5	7.4	7.4	61	71	571	15	5	5.3						5E3		F
[illegible]4	CLIFTON	09/24/86	19.5	7.3	8.3	27	33	292	19	15	7.2	350	86	18	0	454	7E3		F
6279	CLIFTON	11/12/86	14.	7.3	9.7	24	29	276	13	10	2.2	350	43	14	0	407	3E3		F
6310	CLIFTON	12/17/86	10.	7.3	10.	32	32	285	11	5	2.1	430	60	7	0	497	3E3		F
7019	CLIFTON	01/22/87	6.5	7.3	11.5	26	32	300	19	15	4.1	730	26	2	0	758			F
7053	CLIFTON	02/24/87	11.5	7.3	10.1	38	51	435	11	20	4.7	780	96	34	0	910	3E3		F

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	<---- THM Formation Potential ----> CHCL3	CHBRCL2	CHBR2CL ug/L	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7109	CLIFTON	03/24/87	13.5	7.3	9.6	77	91	730	10	10	4.2	400	140	27	0	567	6E3		F
7186	CLIFTON	04/30/87	20.	8.3	11.1	29	32	365	12	10	3.2	270	49	7	0	326			F
7221	CLIFTON	05/28/87	19.5	7.4	9.	39	58	401	20	10	2.4	420	140	36	0	596			F
7283	CLIFTON	06/23/87	23.	8.3	7.4	49	70	483	22	15									F
7401	CLIFTON	09/09/87	22.4	7.4	8.1					5	2.8								F
7401	CLIFTON	09/09/87	22.4	7.4	8.1	79	133	646	17			340	130	73	21	564			F
7444	CLIFTON	10/22/87	19.5	7.4	7.3	95	165	777	6	0		210	140	120	1	471			F
7444	CLIFTON	10/22/87	19.5	7.4	7.3						3.1								F
7544	CLIFTON	11/05/87	18.	7.3	7.6	113	190	821	6	0		180	67	78	13	338			QD
7569	CLIFTON	12/08/87	11.3	7.4	10.2	108	182	847	7	20		260	150	93	22	525			F
	CLIFTONPP02	04/30/87																	D
	CLIFTONPP02											5	26	340	2900	3271			D
	CLIFTONPP03	04/30/87																	D
7256	CLYT BLANK	06/08/87										240	130	57	0	427			QB
7255	CLYT BLANK	06/08/87										240	130	60	0	430			QB
7239	CLYT BLANK	06/08/87										240	130	57	0	427			QB
7285	CLYT BLANK	06/22/87										200	100	48	0	348			QB
7285	CLYT BLANK	06/22/87										210	110	51	0	371			QB
7285	CLYT BLANK	06/22/87										190	98	48	0	336			QB
	COLUSA	10/21/87	17.5	7.3	7.6					5									D
7097	CONEY ISL PP	03/17/87										1500	290	35	0	1825			D
3043	COSUMNES	07/21/83	22.5	7.3	8.5	3	2	67	1	2	1.	200	6	0	0	206	257.		F
[illegible]79	COSUMNES	08/18/83	28.	7.7	8.3	4	2	85	1	5	1.2	190	9	0	0	199	102.		F
[illegible]7	COSUMNES	09/13/83	25.	7.3	7.8	4	2	90	1	2	1.2	210	8	0	0	218	76.		F
3122	COSUMNES	10/04/83	21.5	7.3	8.9	4	2	80	2	5	1.2	150	6	0	0	156	102.		F
3148	COSUMNES	11/01/83	18.	7.3	9.3	4	2	82	9	8	1.6	170	5	0	0	175	378.		F
3164	COSUMNES	12/06/83	8.5	7.2	12.	7	2	81	7	18	2.4	830	7	0	0	837	1E3		F
4003	COSUMNES	01/10/84	8.	7.2	11.8	3	2	78	4	8	1.	160	4	0	0	164	1E3		F
4015	COSUMNES	02/01/84	9.5	7.	11.5	4	2	93	2	5	0.9	140	5	0	0	145	561.		F
4028	COSUMNES	03/07/84	11.5	7.3	11.4	4	2	86	1	5	1.3	190	11	0	0	201	766.		F
4040	COSUMNES	04/04/84	14.	7.1	10.7	3	2	80	1	5	1.6	200	9	0	0	209	794.		F
4070	COSUMNES	05/02/84	14.	7.3	10.6	4	1	76	1	2	1.	130	5	0	0	135	597.		F
4085	COSUMNES	06/06/84	19.	7.3	9.1	3	2	74	2	5	1.2	230	11	1	0	242	294.		F
4099	COSUMNES	07/10/84	27.5	7.7	7.6	4	2	86	2	2	1.6	240	9	0	0	249	74.		F
4111	COSUMNES	08/01/84	27.	7.6	8.1	4	2	93	1	10	2.1	320	9	0	0	329	48.		F
4157	COSUMNES	09/05/84	25.5	7.3	7.1	4	2	96	1	5	2.	300	11	0	0	311			F
4176	COSUMNES	10/04/84	21.	7.4	9.	4	2	90	2	2	1.5	160	7	0	0	167			F
4192	COSUMNES	11/08/84	13.5	7.2	10.2	4	2	82	12	25	2.5	280	6	0	0	286			F
4212	COSUMNES	12/05/84	10.5	7.3	11.3	5	4	129	2	8	2.2	280	9	0	0	289			F
7257	DHS BLANK	06/08/87										217	99	62	5	383			QB
7240	DHS BLANK	06/08/87										210	102	61	5	378			QB
7258	DHS BLANK	06/08/87										212	103	60	5	380			QB
7287	DHS BLANK	06/22/87										202	103	56	7	368			QB
7287	DHS BLANK	06/22/87										203	104	58	5	370			QB
7287	DHS BLANK	06/22/87										207	102	59	5	373			QB
3047	DMC	07/26/83	23.	7.3	7.5	33	38	322	31	5	3.6	290	54	10	0	354	5E3		F
3083	DMC	08/23/83	21.5	7.3	7.7	28	31	283	22	5	3.2	400	59	9	0	468	4E3		F
3101	DMC	09/14/83	21.	7.3	7.8	18	18	188	19	12	2.4	310	26	4	0	340	3E3		F
[illegible]3	DMC	10/12/83	18.5	7.3	8.5	14	15	151	18	12	3.2	200	26	2	0	228	2E3		F
3153	DMC	11/08/83	16.5	7.2	8.2	37	39	361	11	20	3.4	270	48	14	0	332	153.		F
3169	DMC	12/13/83	12.	7.2	9.5	23	26	238	18	35	3.5	320	37	6	0	363	4E3		F
4007	DMC	01/24/84	10.5	7.3	10.7	30	33	297	16	35	3.2	340	52	11	0	403	1E3		F
4023	DMC	02/28/84	12.5	7.5	10.	42	48	397	11	18	3.1	280	76	25	1	382	4E3		F

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 ug/L	CHBRCL2 ug/L	CHBR2CL ug/L	CHBR3 ug/L	TTHMFP ug/L	FLOW cfs	PUMP	TYPE
												<---- THM Formation Potential---->							
4035	DMC	03/27/84	16.	7.3	9.5	53	60	511	24	15	3.8	270	90	35	2	397	4E3		F
4048	DMC	04/25/84	15.5	7.5	9.3	60	68	552	18	10	4.7	300	120	45	2	467	4E3		F
4077	DMC	05/30/84	23.5	7.4	7.6	29	33	298	24	20	4.7	380	66	14	0	460	2E3		F
4093	DMC	06/27/84	25.5	7.3	6.	32	35	328	30	35	5.	380	70	15	0	465	3E3		F
4106	DMC	07/25/84	24.	7.7	7.4	58	73	554	28	15	4.4	450	150	57	4	661	5E3		F
4126	DMC	08/29/84	24.5	7.3	7.3	21	22	229	16	18	3.7	330	48	9	0	387	3E3		F
4165	DMC	09/27/84	22.	7.4	8.2	28	29	296	13	15	3.8	330	55	12	0	397	3E3		F
4184	DMC	10/25/84	16.	7.8	9.8	25	26	268	8	20	3.3	360	66	12	0	438	4E3		F
4199	DMC	11/29/84	11.	7.4	10.2	32	34	321	9	25	4.1	400	64	12	0	476	4E3		F
4220	DMC	12/12/84	11.5	7.2	9.3	31	32	315	18	25	4.9	370	60	8	0	438	4E3		F
5002	DMC	01/30/85	7.5	7.3	10.6	38	44	398	7								4E3		F
5020	DMC	02/27/85	13.	7.5	9.9	31	34	336	11	35		410	75	12	0	497	4E3		F
5036	DMC	03/27/85	12.	7.4	9.8	29	31	315	8								3E3		F
5050	DMC	04/24/85	17.5	7.5	9.5	25	24	280	9	5		340	57	5	0	402	4E3		F
5071	DMC	05/22/85	20.5	8.3	9.1	25	29	265	22	20		550	71	10	0	631	3E3		F
5087	DMC	06/26/85	24.5	7.6	7.1	78	95	710	23	10		580	180	9	10	779	3E3		F
5102	DMC	07/10/85	24.5	7.4	6.7	59	68	544	24								5E3		F
5121	DMC	08/28/85	23.	7.4	7.7	50	74	441	17	20	9.7	410	120	70	3	603	4E3		F
5132	DMC	09/25/85	22.5	7.5	6.8	66	85	593	15								4E3		F
5147	DMC	10/23/85	16.5	7.4	7.2	60	79	592	13	5	3.6	270	110	58	5	443	4E3		F
5174	DMC	11/15/85	12.	7.4	10.5	68	106	545	11								4E3		F
5168	DMC	12/03/85	12.	7.4	10.1	72	117	591	10	15	6.3	360	190	120	6	676	4E3		F
[illegible]009	DMC	01/23/86	11.5	7.3	8.8	52	63	439	8								3E3		F
[illegible]4	DMC	02/13/86	11.5	7.5	10.2	44	60	460	16								4E3		F
6025	DMC	03/04/86	16.5	7.3	7.9	29	28	288	25	25	7.8	580	61	6	0	647	3E3		F
6040	DMC	04/09/86	16.	7.3	9.	23	27	229	22	25	4.2	600	58	7	0	665	2E3		F
6075	DMC	05/07/86	16.	7.2	8.3	27	28	278	15	10	6.2	260	40	5	0	305	3E3		F
6106	DMC	06/04/86	21.5	7.3	7.7	36	48	362	31		3.	250	54	8	0	312	3E3		F
6124	DMC	07/02/86	24.5	7.3	7.	54	62	530	13	10	4.8	340	120	34	2	496	5E3		F
6143	DMC	08/14/86	24.5	7.3	6.6	63	73	586	27	5	2.4						5E3		F
6173	DMC	09/24/86	18.5	7.3	8.1	32	35	320	18	10	4.8	340	81	20	0	441	4E3		F
6278	DMC	11/12/86	13.5	7.4	9.4	58	71	545	13	5	1.9	230	64	53	2	349			F
6309	DMC	12/17/86	10.	7.2	9.6	35	34	299	11	5	2.1	400	66	9	0	475			F
7018	DMC	01/22/87	6.5	7.3	11.5	33	40	356	18	20	4.1	670	79	9	0	758			F
7054	DMC	02/24/87	10.5	7.3	9.7	88	102	860	11	10	3.6	480	190	120	7	797			F
7108	DMC	03/24/87	13.	7.5	9.6	88	104	804	13	15	3.9	340	140	33	6	519			F
7184	DMC	04/30/87	20.	8.3	10.3	29	32	359	18	10	3.1	280	51	8	0	339			F
7223	DMC	05/28/87	18.5	7.5	8.6	40	57	408	18	10	2.4	370	120	33	0	523			QD
7220	DMC	05/28/87	18.5	7.5	8.6	39	57	405	17	10	2.5	420	130	34	0	584			F
7220	DMC	05/28/87	18.5	7.5	8.6	39	57	405	17	10	2.5	420	130	34	0	584			QD
7282	DMC	06/23/87	23.	7.5	7.5	49	70	466	22	10									F
7400	DMC	09/09/87	22.	7.4	7.7					5	3.5								F
7400	DMC	09/09/87	22.	7.4	7.7	59	90	503	21			410	110	43	8	571			F
7443	DMC	10/22/87	19.	7.4	7.2						3.3								F
7443	DMC	10/22/87	19.	7.4	7.2	89	155	751	7	0		87	68	34	33	222			F
7541	DMC	11/05/87	18.	7.3	8.5	77	116	620	8	5		280	110	77	14	481			F
7568	DMC	12/08/87	11.3	7.3	10.2	113	181	847	8	20		240	160	120	33	553			F
8012	DMC	01/07/88	7.6	7.1	12.					35									F
[illegible]0	DVGH	08/10/83	12.5	7.8	3.9	14	11	395	3	2	2.9	360	26	2	0	388			F
3089	DVGH	08/10/83	23.5	8.5	8.4	19	16	466	1	5	3.2	310	32	4	0	346			F
3107	DVSR	09/20/83	14.5	7.3	5.3	15	12	414	2	8	2.9	450	16	2	0	468			F
3137	DVSR	10/18/83	18.	8.	7.	17	13	430	1	8	2.9								F
3159	DVSR	11/21/83	15.5	7.9	8.4	18	15	469	4	15	3.6	230	29	4	0	263			F

/5-

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (<---- THM Formation Potential----> ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
6032	DVSR	03/11/86	13.	8.1	11.3	14	12	322	90	30	6.6	660	33	1	0	694			F
6078	DVSR	05/13/86	16.	8.2	6.4	15	11	356	4	20	4.8	510	24	2	0	536			F
	EBMUD BLNK	06/22/87										210	100	59	4	373			QB
	EBMUD BLNK	06/22/87										200	100	54	3	357			QB
	EBMUD BLNK	06/22/87										210	100	60	4	374			QB
7113	EGBERTPP01	03/30/87	13.5	7.3	5.9	67	44	1100	105		33.	2200	250	11	0	2461			D
7306	EGBERTPP01	08/13/87	19.3	7.	6.5						7.1	1300	23	0	0	1323		P	D
7306	EGBERTPP01	08/13/87	19.3	7.	6.5	19	12	305	120										D
7476	EGBERTPP01	10/20/87	15.	7.4	6.6	41	26	667	172			1600	89						D
	EGBERTPP01	10/20/87	15.	7.4	6.6					40									D
7114	EGBERTPP02	03/30/87	14.	7.8	11.7	91	76	1760	60		37.	2800	200	19	0	3019			D
	EGBERTPP02	10/20/87	16.	7.6	5.7					100									D
7477	EGBERTPP02	10/20/87	16.	7.6	5.7							3500	77	2					D
	FABIAN04 **	11/26/86										340	120	53	8	521			D
	FABIAN06	11/26/86										340	170	99	32	641			D
	FABIAN08	11/26/86										330	120	75	20	545			D
7088	GRAND IS 02	03/16/87										660	91	9	0	760			D
7089	GRAND IS 03	03/16/87										1400	110	6	0	1516			D
3041	GREENES	07/21/83	19.5	7.3	8.7	7	4	115	9	2	1.6	190	8	1	0	199	3E4		F
3076	GREENES	08/18/83	21.	7.5	8.2	7	4	124	8	8	1.6	200	14	1	0	215	2E4		F
3095	GREENES	09/13/83	20.5	7.3	8.3	10	6	154	12	8	1.8	600	18	2	0	620	2E4		F
3120	GREENES	10/04/83	18.	7.3	9.	7	5	124	10	5	1.6	200	9	0	0	209	2E4		F
[illegible]146	GREENES	11/01/83	17.	7.3	9.1	8	5	128	6	5	1.7	210	8	0	0	218	2E4		F
[illegible]62	GREENES	12/06/83	10.5	7.4	10.6	4	4	122	30	30	4.1	300	9	0	0	309	7E4		F
4001	GREENES	01/10/84	9.	7.3	10.7	7	4	129	19	20	1.7	220	10	1	0	231	7E4		F
4013	GREENES	02/01/84	10.	7.1	10.8	7	5	140	14	12	1.5	190	11	1	0	202	3E4		F
4026	GREENES	03/07/84	12.	7.5	10.8	10	7	164	8	8	1.6	230	28	1	0	259	3E4		F
4038	GREENES	04/04/84	13.5	7.5	10.4	9	6	148	8	5	1.6	250	14	1	0	265	3E4		F
4068	GREENES	05/02/84	16.	7.3	9.4	10	6	154	8	8	2.	180	13	1	0	194	1E4		F
4083	GREENES	06/06/84	18.	7.5	8.7	10	7	146	9	8	2.	250	15	1	0	266	1E4		F
4097	GREENES	07/10/84	22.5	7.4	8.2	7	4	121	11	5	1.6	260	10	0	0	270	2E4		F
4109	GREENES	08/01/84	21.5	7.4	7.9	8	4	133	11	5	1.6	300	10	1	0	311	2E4		F
4171	GREENES	08/21/84	23.	7.3	8.2	11	6	164	12	10	1.8	250	16	1	0	267	2E4		F
4155	GREENES	09/05/84	22.	7.4	7.7	12	6	185	11	8	2.4	390	20	1	0	411	2E4		F
4174	GREENES	10/04/84	17.5	7.4	9.	8	4	132	7	5	1.6	170	13	1	0	184	1E4		F
4190	GREENES	11/08/84	14.	7.3	9.7	10	6	154	11	8	2.1	210	11	0	0	221	1E4		F
4210	GREENES	12/05/84	10.5	7.4	10.9	9	6	160	24	15	2.6	240	14	1	0	255	4E4		F
5005	GREENES	01/30/85	9.	7.4	11.9	12	7	186	3								1E4		F
5013	GREENES	02/06/85	8.	7.5	12.1	11	6	174	8	10		360	14	1	0	375	1E4		F
5029	GREENES	03/06/85	11.	7.4	10.5	11	7	180	5								1E4		F
5047	GREENES	04/05/85	19.	7.4	9.3	13	6	176	7	2		160	13	0	0	173	1E4		F
5063	GREENES	05/01/85	19.	7.3	8.8	11	7	167	11	10		210	12	1	0	223	1E4		F
5091	GREENES	05/29/85	18.	7.4	9.5	13	7	178	10								2E4		F
5079	GREENES	06/05/85	21.	7.4	8.5	13	6	173	9	10		290	19	1	0	310	2E4		F
5109	GREENES	07/24/85	22.5	7.3	8.	11	5	163	8								2E4		F
5114	GREENES	08/01/85	22.5	7.5	7.9	11	5	163	10	10	3.9	480	14	2	0	496	2E4		F
5154	GREENES	09/04/85	22.	7.3	7.8	15	8	207	8	5	3.5	220	22	2	0	244	1E4		F
5140	GREENES	10/02/85	21.5	7.5	8.2	14	8	168	7	5	1.6	200	14	1	0	215	1E4		F
165	GREENES	11/13/85	12.	7.3	9.7	11	7	163	6	5	2.8	290	20	1	0	311	1E4		F
5184	GREENES	12/03/85	11.5	7.3	9.3	10	7	149	28	35	16.	690	21	1	0	712	2E4		F
6006	GREENES	01/16/86	10.	7.3	10.6	18	10	218	9	15	2.3	660	22	1	0	683	1E4		F
6022	GREENES	02/27/86	12.5	7.1	10.5	4	2	84	63	10	2.9	320	8	0	0	328			QD
6021	GREENES	02/27/86	12.5	7.1	10.5	4	2	84	64	20	4.2	340	7	0	0	347			QD

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	<---- THM Formation Potential----> CHCL3	CHBRCL2	CHBR2CL	CHBR3	TTHMFP ug/L	FLOW cfs	PUMP	TYPE
6021	GREENES	02/27/86	12.5	7.1	10.5	4	2	84	64	20	4.2	340	7	0	0	347	5E4		F
6037	GREENES	03/13/86	11.5	7.3	11.	3	2	70	58	10	2.4	430	8	0	0	438	9E4		F
6052	GREENES	04/23/86	18.5	7.3	8.5	10	7	179	14	10	1.9	310	22	1	0	333	2E4		F
6087	GREENES	05/28/86	23.5	7.3	7.5	12	9	188	14	10	2.9	170	12	2	1	185	1E4		F
6119	GREENES	06/25/86	24.5	7.3	7.8	11	8	161	13	15	3.3	990	10	3	2	1005	1E4		F
6139	GREENES	07/23/86	22.5	7.3	7.8	8	5	128	13	5	5.5	0					2E4		F
6161	GREENES	08/27/86	24.5	7.6	7.3	12	7	179	10	10	5.4	220	17	1	0	238	1E4		F
6208	GREENES	09/09/86	22.5	7.3	7.7	13	7	182	12	5	4.7	220	17	1	0	238	2E4		F
6285	GREENES	11/19/86	14.5	7.3	10.	8	6	146	7	10	1.5	180	7	0	0	187	1E4		F
6306	GREENES	12/10/86	11.	7.3	10.7	11	6	152	8	0	1.5	210	13	0	0	223	2E4		F
7015	GREENES	01/13/87	7.5	7.3	11.	11	7	178	8	5	1.8	220	15	0	0	235			QD
7012	GREENES	01/13/87	7.5	7.3	11.	11	7	178	8	5	1.7	200	12	0	0	212			F
7012	GREENES	01/13/87	7.5	7.3	11.	11	7	178	8	5	1.7	200	12	0	0	212			QD
7040	GREENES	02/10/87	12.	7.3	9.4	14	10	193	15	10	2.3	470	19	0	0	489	1E4		F
7075	GREENES	03/10/87	13.5	7.1	8.4	7	5	128	72	25	3.4	1100	10	0	0	1110	2E4		F
7177	GREENES	04/16/87	16.5	7.2	5.6	10	7	178	8	5	1.4	260	18	2	0	280	1E4		F
7212	GREENES	05/20/87	20.	7.4	7.7	12	7	172	11										F
7212	GREENES	05/20/87	20.	7.4	7.7					10	1.5	120	11	0	0	131			F
7250	GREENES	06/11/87	21.	7.3	7.6	11	7	176	6	5	1.4	180	11	0	0	191			F
	GREENES	08/25/87										250	13	13	0	276			F
	GREENES	08/26/87										220	10	0	0	230			F
7393	GREENES	09/03/87	23.7	7.1	9.	14	11	204	11										F
‾393	GREENES	09/03/87	23.7	7.1	9.					5	4.9	430	17	0	0	447			F
+34	GREENES	10/08/87	20.	7.2	8.7	9	5	159	7			240	11						F
7434	GREENES	10/08/87	20.	7.2	8.7					5									F
7529	GREENES	11/03/87	16.5	7.1	8.1	12	9	180	4	0		300	15						F
8001	GREENES	01/06/88	8.6	7.3	10.5					35									F
7093	HOLLAND TR01	03/17/87										2200	320	30	0	2550			D
7094	HOLLAND TR02	03/17/87										3000	260	14	0	3274			D
7095	HOLLAND TR03	03/17/87										3000	270	24	0	3294			D
3003	HONKER	02/23/83	13.	7.3	8.9		27	233	13			210	33	6	0	249			F
3010	HONKER	04/27/83		7.3	8.8		33	303	9			300	72	10	5	387			F
3036	HONKER	06/22/83	23.5	7.3	7.6		20	184	11			370	43	7	0	420			F
3077	HONKER	08/17/83	24.5	7.3	7.1	8	8	126	6	8	2.5	310	25	5	0	340			F
3124	HONKER	10/04/83	20.5	7.3	8.	7	7	114	6	12	2.1	290	14	1	0	305			F
3166	HONKER	12/06/83	10.	7.2	10.	17	26	232	18	60	6.4	520	47	7	0	574			F
4017	HONKER	02/01/84	10.	7.1	9.7	27	32	302	11	25	5.8	450	68	10	0	528			F
4042	HONKER	04/04/84	15.	7.3	9.6	12	14	171	9	12	3.	310	32	4	0	346			F
4087	HONKER	06/06/84	19.	7.5	7.6	13	12	178	10	10	3.8	340	40	7	0	387			F
4113	HONKER	08/01/84	23.	7.3	7.2	11	12	166	8	15	2.8	460	34	4	0	498			F
4178	HONKER	10/04/84	18.5	7.3	8.8	7	5	120	5	5	1.8	240	14	1	0	255			F
4214	HONKER	12/05/84	10.5	7.2	9.8	12	15	184	13	35	5.	480	37	4	0	521			F
2060	HOOD	03/30/82	11.	7.3	10.7		4	131	20	5		310	9	0	0	319	4E4		F
2115	HOOD	06/29/82	20.	7.9	8.5		5	128	6			230	12	0	0	242	2E4		F
2132	HOOD	08/26/82	22.	7.5	8.1		5	149	10			280	13	0	0	293	2E4		F
2137	HOOD	10/21/82	18.	7.5	8.7		4	122	4			260	10	0	0	270	2E4		F
2140	HOOD	12/29/82	9.5	7.2	10.9		4	130	33			480	16	1	0	497	7E4		F
3004	HOOD	02/24/83	12.	7.5	10.6		2	113	30			120	4	0	0	124	7E4		F
)07	HOOD	04/27/83		7.3	10.		3	112	26			166	6	4	4	180	5E4		F
3033	HOOD	06/22/83	19.5	7.3	9.1		3	101	17			200	8	0	0	208	4E4		F
7115	KINGISPP01	03/26/87	12.5	6.	1.	53	66	757	26		16.	620	120	21	5	7(5			D
7309	KINGISPP01	08/0'/87	19.8	7.1	3.2	39	37	555	4		15.	2100	270	26	0	2396			D
7480	KINGISPP01	10/19/87	15.8	7.1	4.2							670	130	24					D

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP	PH	DO	NA	CL	EC	TURB	COL	TOC	CHCL3	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW	PUMP	TYPE
												<---- THM Formation Potential---->							
			oC		mg/L	mg/L	mg/L	uS/cm	T.U.	C.U.	mg/L	<--------------		ug/L		------------>	cfs		
	KINGISPP01	10/19/87	15.8	7.1	4.2					15									D
7116	KINGISPP02	03/26/87	14.5	7.3	5.8	123	291	1510	7		11.	480	230	160	36	906			D
7310	KINGISPP02	08/07/87	20.4	6.7	2.1	38	33	503	20		4.7	2000	130	23	0	2153			D
	KINGISPP02	10/19/87	15.	6.9	2.					35									D
7481	KINGISPP02	10/19/87	15.	6.9	2.							740	55	6					D
7117	KINGISPP03	03/26/87	17.5	7.1	3.5	26	20	443	4		11.	780	100	8	0	888			D
7311	KINGISPP03	08/07/87	20.1	7.1	3.1	62	151	945	12		14.	2000	450	160	0	2610			D
7482	KINGISPP03	10/19/87	16.	7.1	3.9							1100	200	53					D
	KINGISPP03	10/19/87	16.	7.1	3.9					30									D
7581	KINGISPP03	12/10/87	13.	7.2	7.9					200									D
7405	LCONNECT	09/24/87	20.5	7.4	7.9	17	13	270	6			240	25	3					F
7448	LCONNECT	10/28/87	20.5	7.3	7.	21	28	242	4	5		199	49	15					F
7605	LCONNECT	12/11/87	8.2	7.3	11.3					40									F
5010	LCONNECTSL	02/06/85	7.	7.4	11.2	20	22	252	5	15		660	46	6	0	712			F
5026	LCONNECTSL	03/06/85	11.	7.4	10.	14	18	218	7										F
5044	LCONNECTSL	04/05/85	17.5	7.3	9.5	13	11	188	6	5		230	26	2	0	258			F
5060	LCONNECTSL	05/01/85	19.	7.4	9.1	13	11	175	5	5		280	27	2	0	309			F
5076	LCONNECTSL	06/05/85	20.5	7.5	8.7	13	10	180	7	5		300	26	2	0	328			F
5096	LCONNECTSL	06/07/85	23.	7.7	8.7	13	9	178	7										F
5111	LCONNECTSL	08/01/85	22.5	7.4	8.	13	10	186	5	10	3.8	360	32	2	0	394			F
5137	LCONNECTSL	10/02/85	20.	7.5	7.8	18	11	209	4	5	3.1	240	26	3	0	269			F
5161	LCONNECTSL	11/13/85	11.5	7.3	9.	12	11	183	3	25	3.4	340	34	2	0	376			F
[illegible]180	LCONNECTSL	12/03/85	11.5	7.3	10.2	15	15	204	5	15	6.8	380	36	3	0	419			F
[illegible]30	LCONNECTSL	03/11/86	14.5	7.3	9.	12	19	192	22	25	17.	650	51	3	0	704			F
6045	LCONNECTSL	04/17/86	15.5	7.2	8.5	17	20	195	11	20	4.2	440	51	7	0	498			F
6080	LCONNECTSL	05/13/86	19.5	7.3	8.4	12	15	162	14	25	4.2	150	16	2	0	168			F
6111	LCONNECTSL	06/11/86	21.5	7.3	7.9	9	8	136	12	25	3.9	310	15	2	0	327			F
6130	LCONNECTSL	07/09/86	23.	7.3	7.7	10	10	154	9	10	5.	280	30	1	0	311			F
6150	LCONNECTSL	08/13/86	21.5	7.3	7.8	10	10	153	9	10	3.7								F
6197	LCONNECTSL	09/11/86	21.5	7.4	7.6	12	10	181	12	10	3.8	280	24	3	0	307			F
6282	LCONNECTSL	11/19/86	13.5	7.2	9.1	9	9	156	5	20	3.1	600	19	1	0	620			F
6299	LCONNECTSL	12/10/86	11.	7.3	10.	12	9	168	5	10	2.8								F
7007	LCONNECTSL	01/13/87	7.5	7.1	10.1	13	18	209	6	30	4.8	700	49	2	0	751			F
7045	LCONNECTSL	02/10/87	11.5	7.2	9.6	16	21	235	10	15	4.8	630	41	0	0	671			F
7068	LCONNECTSL	03/10/87	13.5	7.1	9.1	16	25	261	14	35	4.7	1400	38	2	0	1440			F
7170	LCONNECTSL	04/16/87	19.5	7.2	6.8	13	16	228	6	5	2.3	290	35	5	0	330			F
7205	LCONNECTSL	05/20/87	21.5	7.4	8.5	13	12	194	9	5	1.7	280	28	3	0	311			F
7243	LCONNECTSL	06/11/87	22.5	7.8	8.	17	18	241	6	10	2.1	250	32	5	0	287			F
7405	LCONNECTSL	09/24/87	20.5	7.4	7.9					10	2.3								F
7448	LCONNECTSL	10/28/87	20.	7.2	7.4						2.8								QD
	LCONNECTSL	10/28/87	20.	7.2	7.4						2.9								QD
7448	LCONNECTSL	10/28/87	20.	7.2	7.4						2.8								F
7456	LCONNECTSL	10/28/87	20.	7.2	7.4						2.9								QD
	LCONNECTSL	10/28/87	20.	7.2	7.4						2.9								QD
4103	LINDSEY	07/11/84	24.5	8.4	6.7	37	29	426	36	35	6.3	770	57	6	0	833			F
4123	LINDSEY	08/22/84	21.5	8.	7.6	35	26	411	65	50	7.1	950	65	4	0	1019			F
4173	LINDSEY	09/12/84	22.5	7.6	7.	34	25	424	27	50	7.5	930	59	3	0	992			F
4181	LINDSEY	10/11/84	19.5	7.8	8.	32	21	383	28	50	5.6	840	59	4	0	903			F
196	LINDSEY	11/15/84	12.5	7.5	8.6	31	23	353	28	25	4.7	570	45	2	0	617			F
4217	LINDSEY	12/06/84	11.	7.3	8.3	44	34	441	37	50	9.7	1000	59	2	0	1061			F
	LINDSEY	01/25/85	6.	7.4	9.2	56	46	558	12										F
5016	LINDSEY	02/13/85	10.5	7.3	6.7	43	35	381	110	50		1200	65	3	0	1268			F
	LINDSEY	02/22/85	11.	7.4	8.6	57	39	445	65										F

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (THM Formation Potential, ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
5032	LINDSEY	03/13/85	12.5	7.6	9.1	51	41	482	60										F
5056	LINDSEY	04/10/85	18.	7.7	8.6	61	44	531	20	15		580	86	9	0	675			F
5066	LINDSEY	05/08/85	17.	8.1	8.8	60	47	574	18	20		660	88	4	0	752			F
5095	LINDSEY	05/29/85	20.	7.9	8.6	55	47	571	27										F
5083	LINDSEY	06/12/85	25.	7.9	7.1	51	45	541	28	30		900	97	6	0	1003			F
5106	LINDSEY	07/24/85	22.	7.6	7.	40	33	421	36										F
5117	LINDSEY	08/14/85	21.	7.8	8.6	38	32	405	48	30	8.2	750	69	5	0	824			F
5125	LINDSEY	09/11/85	19.5	7.7	7.5	40	37	443	30	25	9.8	820	54	4	0	878			F
5143	LINDSEY	10/09/85	16.5	7.6	8.1	42	41	496	31	38	17.	1500	66	3	0	1569			F
5178	LINDSEY	11/19/85	8.5	7.5	10.	40	37	442	18	15	7.7								F
5187	LINDSEY	12/03/85	11.5	7.4	8.7	56	63	569	25	60	15.	1300	70	2	0	1372			F
6001	LINDSEY	01/16/86	10.5	7.3	6.7	65	58	458	38	80	15.	2200	56	2	0	2258			F
6018	LINDSEY	02/27/86	16.5	6.8	3.	21	16	208	46	60	10.	790	26	0	0	816			F
6033	LINDSEY	03/13/86	13.5	7.1	6.2	23	20	221	68	100	15.	1300	47	1	0	1348			F
6048	LINDSEY	04/23/86	18.5	7.6	5.3	44	39	387	48	70	12.	1100	84	6	0	1190			F
6083	LINDSEY	05/28/86	20.	8.	6.	52	47	528	26	25	8.	380	38	5	2	425			F
6120	LINDSEY	06/25/86	20.	7.9	7.	44	38	480	38	10	8.4	270	34	8	3	315			QD
6115	LINDSEY	06/25/86	21.5	8.	7.2	43	37	461	38	20	22.	350	36	4	1	391			QD
6115	LINDSEY	06/25/86	21.5	8.	7.2	43	37	461	38	20	4.4	350	36	4	1	391			F
6135	LINDSEY	07/23/86	20.5	7.7	7.4	38	33	431	32	30	14.								F
6156	LINDSEY	08/27/86	20.5	7.6	6.7	46	42	514	50	40	15.	930	65	4	0	999			F
6203	LINDSEY	09/09/86	18.5	7.8	7.6	42	39	466	37	40	14.	860	71	5	0	936			F
[illegible]73	LINDSEY	11/05/86	14.5	7.5	8.5	44	44	490	25	25	5.2	780	59	5	0	844			F
[illegible]94	LINDSEY	12/03/86	9.5	7.5	9.5	42	43	498	22	25	5.4	2600	110	5	0	2715			QD
6295	LINDSEY	12/03/86	9.5	7.5	9.5	48	43	496	22	25	5.4								F
6295	LINDSEY	12/03/86	9.5	7.5	9.5	48	43	496	22	25	5.4	6294							QD
7001	LINDSEY	01/08/87	7.5	7.3	10.1	44	46	492	24	20	4.4								F
7023	LINDSEY	02/05/87	10.	7.5	9.6	52	53	547	24	20	4.7	550	76	0	0	626			F
7061	LINDSEY	03/03/87	11.	8.	9.9	50	52	518	37	20	6.3	1200	62	0	0	1262			F
7164	LINDSEY	04/09/87	16.5	7.9	8.7	65	63	606	25	20	5.8	870	120	9	0	999			F
7198	LINDSEY	05/13/87	23.5	7.9	7.3	48	44	530	24	20	5.	160	85	12	0	257			F
7234	LINDSEY	06/04/87	19.5	7.9	7.7	53	53	593	38	25	6.2	800	67	6	0	873			F
7387	LINDSEY	09/03/87	21.9	7.2	6.	41	36	460	90										F
7387	LINDSEY	09/03/87	21.2	7.5	6.5					25	7.2	1200	63	2	0	1265			F
7428	LINDSEY	10/08/87	20.	7.4	8.1					25									F
7428	LINDSEY	10/08/87	20.	7.4	8.1	39	36	523	21			630	62	3					F
7531	LINDSEY	11/03/87	15.5	7.6	8.2	48	43	513	19	20		1200	63	4					F
7554	LINDSEY	12/01/87	10.9	7.4	9.7	46	46	509	19	25		720	47	3					F
8003	LINDSEY	01/06/88	11.2	7.3	10.					60									F
6140	LITTLECON	07/09/86	23.	7.9	7.6	10	11	153	8	10	6.2	310	67	2	0	379			QD
6130	LITTLECON	07/09/86	23.	7.7	7.6	10	10	154	9	10	5.	280	30	1	0	311			QD
3068	MALLARD	07/28/83	24.2	7.3	8.6	11	11	137	18	5	3.3	260	26	2	0	288			F
3087	MALLARD	08/25/83	21.	7.6	8.	21	27	216	19	15	3.4	300	65	13	0	378			F
3105	MALLARD	09/20/83	21.	7.3	7.7	15	16	181	13	15	3.4	410	21	3	0	434			F
3135	MALLARD	10/18/83	17.5	7.3	8.5	13	13	152	9	30	3.2								F
3158	MALLARD	11/21/83	12.5	7.2	9.5	15	16	180	16	40	4.5	170	36	4	0	210			F
3177	MALLARD	12/28/83	10.	7.3	10.3	13	13	168	38	30	3.7	390	30	5	0	425			F
5014	MALLARD	02/13/85	11.5	7.7	11.9	96	155	749	12	25		220	190	130	28	568			F
[illegible]30	MALLARD	03/13/85	14.	8.4	13.5	320	558	2160	10										F
5054	MALLARD	04/10/85	16.	7.5	8.	348	569	2210	25	5		90	180	260	280	810			F
5064	MALLARDIS	05/08/85	16.	7.8	8.7	1740	2890	9290	14	10		12	84	330	650	1076	7E3		F
5093	MALLARDIS	05/29/85	17.	7.7	8.7	454	736	2720	26								9E3		F
5080	MALLARDIS	06/12/85	21.5	7.8	8.	469	840	2980	19	5		65	170	340	300	875	4E3		F

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (THM Formation Potential, ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
5115	MALLARDIS	08/14/85	19.	8.	8.5	1390	2510	8480	19	5	3.7	61	54	250	680	1045	2E3		F
5129	MALLARDIS	09/11/85	18.5	7.9	8.2	1230	2180	7320	12	5	3.	21	94	370	500	985	4E3		F
5141	MALLARDIS	10/09/85	17.	8.	8.4	980	1880	6330	10	5	4.5	21	140	340	520	1021	2E3		F
5179	MALLARDIS	11/19/85	11.5	8.1	9.6	2340	4260	13100	9	5	3.1						5E3		F
5189	MALLARDIS	12/03/85	12.	7.5	9.9	1760	3130	9950	8	5	7.1	9	78	280	540	907			QD
5185	MALLARDIS	12/03/85	12.	7.5	9.9	1760	3130	9970	8	8	3.4	11	72	340	640	1063	2E4		F
5185	MALLARDIS	12/03/85	12.	7.5	9.9	1760	3130	9970	8	8	3.4	11	72	340	640	1063			QD
6002	MALLARDIS	01/16/86	10.	7.7	10.2	2180	3540	10700	16	20	4.6	5	44	320	990	1359	8E3		F
6019	MALLARDIS	02/27/86	14.5	7.	8.8	12	12	169	58	25	5.3	490	29	1	0	520	2E4		F
6035	MALLARDIS	03/13/86	13.	7.3	9.4	12	14	161	51	30	5.4	670	38	2	0	710	2E5		F
6050	MALLARDIS	04/23/86	16.5	7.3	8.9	20	23	226	22	20	3.5	440	64	8	0	512	3E4		F
6085	MALLARDIS	05/28/86	17.	7.6	8.6	680	1240	4160	26	15	7.1	39	88	260	350	737	1E4		F
6117	MALLARDIS	06/25/86	21.	7.7	8.1	689	1280	4250	36	10	2.1	24	84	78	320	506	7E3		F
6137	MALLARDIS	07/23/86	20.5	7.9	8.1	892	1630	5330	28	10	4.6						9E3		F
6158	MALLARDIS	08/27/86	20.5	7.8	8.9	634	1140	3970	36	5	7.2	44	150	350	300	844	4E3		F
6205	MALLARDIS	09/09/86	18.5	7.9	8.7	1000	1840	6180	63	5	5.9	28	130	440	690	1288	8E3		F
6275	MALLARDIS	11/05/86	17.5	7.7	9.5	699	1260	4550	13	5	1.5	25	80	160	280	545	1E4		F
6297	MALLARDIS	12/03/86	13.	7.5	9.7	1180	2230	7330	13	5	1.4						1E4		F
7003	MALLARDIS	01/08/87	9.	7.5	10.5	1260	2310	7800	21	5	1.7	16	75	180	400	671			F
7025	MALLARDIS	02/05/87	11.	7.7	10.6	972	1710	5780	18	10	2.	30	88	73	280	471			F
7063	MALLARDIS	03/03/87	11.5	7.4	9.9	359	620	2280	30	15	3.3	160	250	220	270	900			F
7167	MALLARDIS	04/09/87	18.	7.6	9.2	280	470	1780	45	10	3.2	230	370	340	210	1150			F
[illegible]200	MALLARDIS	05/13/87	23.	8.2	5.	1240	2250	7480	20	5	2.3	26	140	290	480	936			F
[illegible]36	MALLARDIS	06/04/87	20.5	7.9	8.5	1980	3640	12000	12	10	1.9	10	57	250	500	817			F
7430	MALLARDIS	10/08/87	20.8	7.9	7.4					10									F
7430	MALLARDIS	10/08/87	20.8	7.9	7.4	2110	3960	12200	12			3	19	160	450	632			F
7533	MALLARDIS	11/03/87	18.8	7.8	7.8	2370	4430	13700	13	5		1	28	210	660	899			F
7556	MALLARDIS	12/01/87	13.2	7.9	8.2					5				170	790				F
8005	MALLARDIS	01/06/88	7.8	8.	11.4					15									F
	MALLARDIS																		F
7090	MANDEVLLE 01	03/16/87										3500	300	14	0	3814			D
7091	MANDEVLLE 02	03/16/87										2900	220	14	0	3134			D
7118	MCCORWIL01	03/25/87	15.	7.2	9.2	30	28	494	44		4.3	460	40	4	0	504			D
7312	MCCORWIL01	08/07/87	22.	6.9	6.5	11	7	186	60		0.	400	11	0	0	411			D
	MCCORWIL01	10/20/87	16.4	7.3	5.5					5									D
7483	MCCORWIL01	10/20/87	16.4	7.3	5.5							1000	40	10					D
7119	MCCORWIL02	03/25/87	17.	7.2	9.8	24	21	487	23		4.2	370	36	3	0	409			D
7313	MCCORWIL02	08/07/87	25.3	7.7	7.1	11	7	173	54		2.3	380	9	0	0	389			D
7484	MCCORWIL02	10/20/87	15.	7.2	4.9							82	16						D
	MCCORWIL02	10/20/87	15.	7.2	4.9					0									D
7100	MERRITT ISPP	03/16/87										420	140	42	9	611			D
5009	MIDDLER	02/06/85	6.5	7.3	11.2	38	43	391	13	25		780	84	20	0	884			F
5025	MIDDLER	03/06/85	10.	7.4	10.	31	34	339	12										F
5043	MIDDLER	04/05/85	17.	7.5	8.9	40	40	378	6	5		300	76	16	0	392			F
5059	MIDDLER	05/01/85	19.	7.6	9.3	29	29	303	9	10		410	68	10	0	488			F
5075	MIDDLER	06/05/85	20.	7.8	9.	26	25	252	17	5		550	67	8	0	625			F
5097	MIDDLER	06/07/85	23.5	7.7	8.9	23	25	256	16										F
5110	MIDDLER	08/01/85	22.	7.4	7.8	35	46	331	12	20	3.9	660	110	26	1	797			F
136	MIDDLER	10/23/85	18.	7.5	9.4	40	61	396	7	10	2.2	380	120	45	2	547			F
5171	MIDDLER	12/03/85	11.5	7.4	10.3	54	83	464	8	12	4.6	340	160	68	5	573			F
6029	MIDDLER	03/11/86	14.5	7.3	8.2	30	38	343	24	25	6.2	530	110	12	0	652			F
6044	MIDDLER	04/17/86	14.	7.3	8.8	20	26	213	12	25	3.5	440	60	9	0	509			F
6079	MIDDLER	05/13/86	19.5	7.3	8.1	26	30	270	13	30	4.	480	76	11	0	567			F

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (<---- THM Formation Potential ----> ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
6110	MIDDLER	06/11/86	22.5	7.3	7.8	28	34	272	14	20	5.2	380	35	6	0	421			F
6129	MIDDLER	07/09/86	23.5	7.3	7.7	24	26	263	14	15	6.7	320	52	5	0	377			F
6149	MIDDLER	08/13/86	23.	7.3	7.3	24	27	260	16	10	5.9								F
6196	MIDDLER	09/11/86	21.5	7.3	7.5	26	30	284	16	20	5.2	340	68	13	0	421			F
6291	MIDDLER	11/19/86	14.5	7.4	9.1	20	24	241	9	10	2.3	370	40	6	0	416			QD
6281	MIDDLER	11/19/86	14.5	7.4	9.1	20	24	230	9	15	2.4	380	41	6	0	427			F
6281	MIDDLER	11/19/86	14.5	7.4	9.1	20	24	230	9	15	2.4	380	41	6	0	427			QD
6298	MIDDLER	12/10/86	10.	7.2	9.6	26	25	255	12	10	2.8								F
7006	MIDDLER	01/13/87	8.5	7.3	10.	31	39	333	6	20	4.6	310	74	7	0	391			F
7048	MIDDLER	02/10/87	11.5	7.2	9.8	36	46	384	9	20	5.3	520	78	280	0	878			F
7067	MIDDLER	03/10/87	13.5	7.1	8.8	43	52	436	11	20	5.1	340	68	9	0	417			F
7169	MIDDLER	04/16/87	20.	7.2	7.8	40	50	440	8	10	4.1	540	100	15	0	655			F
7204	MIDDLER	05/20/87	21.5	7.2	6.8	25	32	293	10	10	2.4	320	61	12	0	393			F
7254	MIDDLER	06/11/87	23.	6.9	8.9					15	3.	360	86	23	0	469			QD
7242	MIDDLER	06/11/87	23.	6.9	8.9	39	51	404	9	15	2.8	290	82	21	0	393			F
7242	MIDDLER	06/11/87	23.	6.9	8.9					15	2.8	290	82	21	0	393			QD
	MIDDLER	06/11/87	22.	7.2	9.1	38	52	405	10										QD
7404	MIDDLER	09/24/87	21.6	7.3	7.1					15	3.								F
7404	MIDDLER	09/24/87	20.8	7.3	7.4	59	83	603	10			230	86	47	4	367			F
7410	MIDDLER	09/24/87	21.6	7.3	7.1					10	2.7								QD
7404	MIDDLER	09/24/87	21.6	7.3	7.1					15	3.								QD
7447	MIDDLER	10/28/87	20.5	7.3	7.3	69	97	565	6	5		194	151	85	9	439			F
[illegible]47	MIDDLER	10/28/87	20.5	7.3	7.3						2.9								F
[illegible]45	MIDDLER	11/24/87	14.5	7.2	8.5					10		290	120	66	6	482			F
7604	MIDDLER	12/16/87	10.2	7.3	12.					25									F
3042	MOKELUMNE	07/21/83	18.	7.2	9.6	2	1	34	3	2	1.4	230	3	0	0	233	2E3		F
3078	MOKELUMNE	08/18/83	19.	6.6	9.2	2	1	34	2	5	1.2	240	8	0	0	248	928.		F
3096	MOKELUMNE	09/13/83	19.	7.1	8.8	2	1	33	2	2	1.3	250	6	2	0	258	1E3		F
3121	MOKELUMNE	10/04/83	17.5	6.8	9.5	2	1	32	2	5	1.4	240	4	0	0	244	1E3		F
3147	MOKELUMNE	11/01/83	16.5	6.6	8.3	1	1	31	6	8	1.6	190	3	0	0	193	1E3		F
3163	MOKELUMNE	12/06/83	12.	6.8	10.4	2	1	38	6	8	4.6	190	3	0	0	193	3E3		F
4002	MOKELUMNE	01/10/84	10.5	6.9	11.	2	1	42	9	12	1.8	220	3	0	0	223	4E3		F
4014	MOKELUMNE	02/01/84	9.5	6.7	11.2	2	1	44	6	10	1.4	110	5	0	0	115	1E3		F
4027	MOKELUMNE	03/07/84	11.	7.2	11.5	2	1	45	3	8	1.5	260	5	0	0	265	907.		F
4039	MOKELUMNE	04/04/84	13.	7.3	10.9	2	1	47	2	2	1.5	230	5	0	0	235	439.		F
4069	MOKELUMNE	05/02/84	14.	7.2	10.7	2	1	46	2	5	1.7	200	4	0	0	204	270.		F
4084	MOKELUMNE	06/06/84	15.5	7.3	10.2	2	1	47	2	2	1.5	230	7	0	0	237	265.		F
4098	MOKELUMNE	07/10/84	17.5	7.3	9.5	2	1	48	1	2	1.6	360	5	0	0	365	333.		F
4110	MOKELUMNE	08/01/84	23.5	7.2	9.5	2	1	47	1	0	1.7	310	5	0	0	315	303.		F
4156	MOKELUMNE	09/05/84	18.5	7.3	9.3	2	1	48	1	5	1.5	420	5	0	0	425			F
4175	MOKELUMNE	10/04/84	17.5	7.2	9.4	2	1	44	2	2	1.6	290	5	0	0	295			F
4191	MOKELUMNE	11/08/84	16.	7.	9.6	2	1	45	7	8	2.3	260	4	0	0	264			F
4211	MOKELUMNE	12/05/84	12.	7.2	10.9	2	2	46	4	5	1.8	200	4	0	0	204			F
7123	MOSSDALE01	03/31/87	14.	7.2	6.	190	232	1650	6		12.	800	250	59	0	1109			D
7317	MOSSDALE01	08/14/87	18.9	6.9	2.9						7.2	860	110	16	0	986			D
7317	MOSSDALE01	08/14/87	18.9	6.9	2.9	96	132	842	72										D
7488	MOSSDALE01	10/15/87	17.4	7.5	4.7							120	76	29	5	230			D
	MOSSDALE01	10/15/87	17.4	7.5	4.7					0									D
	MOSSDALE01											1300	98	33	30	1461			D
	MOSSDALE01											390	38	12	47	487			D
7124	MOSSDALE02	03/31/87	15.	7.6	2.4	72	76	722	50		3.3	220	94	29	0	343			D
7318	MOSSDALE02	08/14/87	20.	7.3	3.6	72	93	690	22										D
7318	MOSSDALE02	08/14/87	20.	7.3	3.6						3.7	520	120	27	0	667			D

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	<---- THM Formation Potential----> CHCL3 ug/L	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7125	MOSSDALE03	03/31/87	13.5	7.	4.6	45	60	513	22		2.4	190	78	16	0	284			D
7319	MOSSDALE03	08/14/87	16.5	6.9	3.5	113	148	980	52										D
7319	MOSSDALE03	08/14/87	16.5	6.9	3.5						8.4	1100	160	22	0	1282			D
7158	MOSSDALE04	03/31/87	16.	7.5	3.			7126			1.6	170	87	19	0	276			QD
7126	MOSSDALE04	03/31/87	16.	7.5	3.	50	53	519	4	0	1.5	150	68	19	0	237			QD
7126	MOSSDALE04	03/31/87	16.	7.5	3.	50	53	519	4		1.5	150	68	19	0	237			D
7320	MOSSDALE04	08/14/87	17.8	7.3	4.3	274	289	1970	13										D
7320	MOSSDALE04	08/14/87	17.8	7.3	4.3						5.9	690	300	78	16	1084			D
	MOSSDALE04	10/15/87	15.4	7.9	4.1					50									D
7127	MOSSDALE05	03/31/87	13.5	7.	5.6	94	107	1370	15		16.	930	130	11	0	1071			D
7321	MOSSDALE05	08/14/87	17.9	7.2	3.4						7.1	950	130	24	0	1104			D
7321	MOSSDALE05	08/14/87	17.9	7.2	3.4	115	134	922	7										D
7128	MOSSDALE06	03/31/87	16.	8.	1.8	316	409	2410	34		14.	640	330	170	23	1163			D
7322	MOSSDALE06	08/05/87	23.5	7.1	1.						18.	2300	210	14	0	2524			D
7322	MOSSDALE06	08/05/87	23.5	7.1	1.	106	130	969	12										D
7129	MOSSDALE08	03/31/87	13.	7.3	0.6	102	159	1100	28		37.	1500	290	30	0	1820			D
7324	MOSSDALE08	08/05/87	24.6	7.3	6.1	102	124	886	32		4.4	500	200	110	7	817		P	D
7521	MOSSDALE08	10/15/87	14.9	7.1	2.5					40									QD
	MOSSDALE08	10/15/87	14.9	7.1	2.5					40									D
7495	MOSSDALE08	10/15/87	14.9	7.1	2.5					40									QD
7521	MOSSDALE08	10/15/87	15.2	7.	2.8	104	124	897	230			730	150	39					QD
7131	MOSSDALE09	03/31/87	15.5	8.1	7.5	159	446	2470	2		10.	330	320	240	47	937			D
7325	MOSSDALE09	08/05/87	22.1	7.4	7.1	104	125	917	7		9.1	1200	190	46	2	1438			D
[illegible]23	MOSSDALE09	10/15/87	14.5	7.3	6.2					10									QD
	MOSSDALE09	10/15/87	14.5	7.3	6.2					15									D
7496	MOSSDALE09	10/15/87	14.5	7.3	6.2					15									QD
7522	MOSSDALE09	10/15/87	14.1	7.1	5.8	114	139	958	38			450	150	81	3	684			QD
7132	MOSSDALE10	03/31/87	19.5	7.3	10.2	52	47	773	9		13.	470	74	7	0	551			D
7326	MOSSDALE10	08/14/87	18.3	7.3	2.						5.6	640	180	67	4	891			D
7326	MOSSDALE10	08/14/87	18.3	7.3	2.	196	134	1370	3										D
	MOSSDALE10	10/15/87	14.8	7.3	1.8					20									D
7327	MOSSDALE11	08/14/87	18.2	7.5	9.2						5.	730	36	3	0	769			D
7327	MOSSDALE11	08/14/87	18.2	7.5	9.2	16	12	268	34										D
7120	MOSSTRPP01	03/30/87	21.5	6.8	8.8	115	97	1130	7		4.4	230	140	38	12	420			D
7121	MOSSTRPP02	03/30/87	19.	7.2	4.8	104	140	1040	2		5.8	290	190	77	27	584			D
7315	MOSSTRPP02	08/14/87	22.6	7.5	6.2	104	134	838	21										D
7315	MOSSTRPP02	08/14/87	22.6	7.5	6.2						5.9	1200	150	75	4	1429			D
	MOSSTRPP02	10/19/87	20.3	7.5	7.5					5									D
7486	MOSSTRPP02	10/19/87	20.3	7.5	7.5							620	94	43					D
7122	MOSSTRPP03	03/30/87	19.	7.8	8.9	46	50	465	10		6.5	510	92	11	0	613			D
7316	MOSSTRPP03	08/14/87	22.8	7.5	7.	66	82	601	26										D
7316	MOSSTRPP03	08/14/87	22.8	7.5	7.						9.4	630	70	27	0	727			D
	MOSSTRPP03	10/19/87	20.5	7.4	7.					5									D
7487	MOSSTRPP03	10/19/87	20.5	7.4	7.							460	86	38	2	586			D
	MOURNIAN 01	11/26/86										450	310	260	130	1150			D
	MOURNIAN 07*	11/26/86										34	150	610	1400	2194			D
	MROBERT 03	12/01/86										250	55	23	5	333			D
6368	MROBERT 04 *	12/01/86				132	234	1223				860	270	120	27	1277			D
	NATOMAS	08/26/87										870	36	2	5	913			D
7426	NATOMAS	09/24/87	18.2	7.4	5.7					10	3.5								D
7426	NATOMAS	09/24/87	18.2	7.4	5.7	44	43	614	35			550	58	7	1	616			D
7453	NATOMAS	10/28/87	19.5	7.3	5.5						7.6								D
7453	NATOMAS	10/28/87	19.5	7.3	5.5	24	26	334	56	30		923	59	5	1	988			D

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (THM Formation Potential, ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7550	NATOMAS	11/24/87	11.7	8.	6.6					10		390	76	17	1	484			D
7609	NATOMAS	12/16/87	7.7	7.5	10.3					40									D
7329	NETHERLANDPP	08/13/87	18.6	7.3	5.	15	9	243	100										D
7328	NETHERLANDPP	08/13/87	17.6	7.5	8.1	22	15	289	132										D
7499	NETHERLANDPP	10/20/87	16.5	7.4	8.6							180	32	3					D
7134	NETHERPP01	03/25/87	17.5	8.	9.9	152	239	1550	24		5.7	270	200	76	18	564			D
7328	NETHERPP01	08/13/87	17.6	7.5	8.1						5.5	650	32	3	0	685			D
	NETHERPP01	10/20/87	16.5	7.4	8.6					0									D
7135	NETHERPP02	03/25/87	19.5	8.	12.	96	139	1030	125		6.5	750	170	34	0	954			D
7329	NETHERPP02	08/13/87	18.6	7.3	5.						4.1	860	17	0	0	877			D
	NETHERPP02	10/20/87	15.7	7.3	5.6					5									D
3067	NOBAY	07/28/83	21.	7.9	9.	10	5	301	4	5	2.7	290	15	1	0	306	5.		F
3086	NOBAY	08/25/83	19.	8.5	8.9	10	5	301	4	5	2.7	340	26	2	0	368	5.		F
3104	NOBAY	09/20/83	20.	7.6	9.7	9	5	301	2	5	3.1	350	9	0	0	359	5.		F
3134	NOBAY	10/18/83	17.	8.9	9.5	10	5	298	2	12	3.2						11.1		F
3157	NOBAY	11/21/83	11.	7.8	10.4	11	7	312	11	25	3.	280	18	1	0	299	1.		F
3176	NOBAY	12/28/83	11.5	7.6	10.2	11	6	279	22	20	2.6	270	17	5	0	292	1.		F
4010	NOBAY	01/31/84	11.5	8.2	11.3	12	7	322	4	8	2.6	300	18	1	0	319	1.		F
4018	NOBAY	02/22/84	12.	8.2	10.7	12	6	314	6	8	3.1	290	18	1	0	309	0.5		F
4030	NOBAY	03/14/84	16.	8.3	8.2	13	6	333	4	5	3.	340	21	1	0	362	0.		F
4043	NOBAY	04/11/84	15.	8.4	10.4	10	6	310	4	2	2.8	290	18	1	.0	309	1.		F
4072	NOBAY	05/23/84	20.	8.4	9.3	10	5	312	4	5	3.2	400	18	1	0	419	1.5		F
088	NOBAY	06/13/84	17.5	8.5	9.5	9	5	306	1	5	2.8	400	18	1	0	419	4.		F
01	NOBAY	07/11/84	19.5	7.5	9.1	9	5	308	4	5	2.9	340	17	1	0	358	4.5		F
4121	NOBAY	08/22/84	19.	8.4	9.2	10	5	314	8	8	2.8	340	17	1	0	358	5.		F
4159	NOBAY	09/12/84	19.5	8.4	9.	9	5	321	2	2	3.	380	20	1	0	401	4.5		F
4179	NOBAY	10/11/84	18.	8.2	9.1	9	5	312	3	5	2.5	470	20	1	0	491	7.		F
4194	NOBAY	11/15/84	13.	8.	9.4	10	6	296	4	10	2.6	310	15	1	0	326	11.		F
4215	NOBAY	12/06/84	10.5	8.1	10.1	15	10	339	12	18	3.6	400	23	1	0	424	11.		F
5015	NOBAY	02/13/85	10.5	8.	8.7	18	10	321	60	50		750	31	1	0	782	13.		F
5031	NOBAY	03/13/85	13.	8.3	10.	13	8	350	4								1.		F
5055	NOBAY	04/10/85	17.5	8.4	9.5	14	8	371	3	0		260	22	2	0	284	4.5		F
5065	NOBAY	05/08/85	16.	8.1	9.8	11	5	334	4	10		300	22	1	0	323	4.5		F
5081	NOBAY	06/12/85	20.	8.2	9.2	10	5	325	4	10		320	26	1	0	347	6.5		F
5116	NOBAY	08/14/85	18.	8.3	10.1	10	5	336	2	5	3.4	250	27	1	0	278	5.5		F
5142	NOBAY	10/09/85	16.	8.3	9.7	9	5	330	1	5	3.2	310	20	2	0	332	6.		F
5186	NOBAY	12/03/85	11.5	8.	10.3	10	6	320	7	5	3.9	300	24	1	0	325	13.		F
6034	NOBAY	03/13/86	14.	8.	9.5	11	6	278	30	20	3.7	520	22	1	0	543	3.		F
6049	NOBAY	04/23/86	18.	8.2	9.1	13	7	336	7	10	2.7	320	24	2	0	346	3.		F
6084	NOBAY	05/28/86	19.5	8.3	9.6	10	5	306	7	5	3.1	300	15	1	0	316	5.		F
6084	NOBAY	05/28/86	19.5	8.3	9.6	10	5	306	7	5	3.1	300	15	1	0	316			QD
6088	NOBAY	05/28/86	19.5	8.3	9.5	9	5	300	6	10	7.3	120	8	3	2	133			QD
6116	NOBAY	06/25/86	19.	8.3	9.2	9	5	293	5	10	1.5	150	8	2	1	161	7.		F
6136	NOBAY	07/23/86	19.	8.4	8.9	9	5	296	4	5	4.5								F
6157	NOBAY	08/27/86	18.5	8.3	9.6	9	6	298	4	5	4.	310	17	0	0	327			F
6204	NOBAY	09/09/86	18.5	8.2	9.2	8	5	286	4	5	3.8	310	17	0	0	327			F
6274	NOBAY	11/05/86	13.5	8.2	9.6	10	6	299	4	10	2.2	300	13	0	0	313	1.5		F
6296	NOBAY	12/03/86	10.5	8.2	11.2	10	5	293	3	10	1.9						2.		F
02	NOBAY	01/08/87	9.	8.	11.5	8	4	301	2	15	2.	340	18	0	0	358			F
7024	NOBAY	02/05/87	11.5	8.2	11.	10	6	316	3	5	2.2	320	17	0	0	337			F
7062	NOBAY	03/03/87	12.	8.4	11.2	9	6	331	3	0	2.	220	5	0	0	225			F
7168	NOBAY	04/09/87	1705.	8.5	9.8	11	6	323	3	0	2.2	210	32	3	0	245			QD
7166	NOBAY	04/09/87	17.5	8.5	9.8	11	6	322	3	5	2.5	240	32	0	0	272			F

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (THM Formation Potential, ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7166	NOBAY	04/09/87	1705.	8.5	9.8	11	6	322	3	5	2.5	240	32	0	0	272			QD
7199	NOBAY	05/13/87	20.	8.1	9.	9	5	327	5	5	2.4	260	20	1	0	281			F
7235	NOBAY	06/04/87	18.	8.3	9.3	9	5	328	3	5	2.1	230	18	1	0	249			F
7388	NOBAY	09/03/87									2.7	270	18	0	0	288			F
7388	NOBAY	09/03/87	18.8	7.5	9.8	10	5	309	2										F
7429	NOBAY	10/08/87	17.1	8.4	9.6					5									F
7429	NOBAY	10/08/87	17.1	8.4	9.6	10	7	353				210	20	1					F
7532	NOBAY	11/03/87	14.5	8.1	10.1	9	5	313	1	0		120	23						F
7555	NOBAY	12/01/87	11.9	8.1	10.1	9	6	310	1	0		230	14						F
8004	NOBAY	01/06/88	11.	8.	11.8					5									F
7102	PALM TR PP	03/17/87										2700	170	18	0	2888			D
7136	PESCADERO01	04/01/87	15.5	7.3	7.5	149	431	2040	9		4.2	140	180	90	23	433			D
7330	PESCADERO01	08/05/87	22.2	7.3	3.1	159	243	1480	32		7.3	930	360	160	8	1458		P	D
	PESCADERO01	10/15/87	16.2	7.3	6.3					5									D
7137	PESCADERO02	04/01/87	16.	7.4	8.6	133	342	1700	16		3.8	160	180	100	29	469			D
7331	PESCADERO02	08/05/87	22.4	7.3	5.4	196	291	1750	26		9.	820	450	210	15	1495			D
	PESCADERO02	10/15/87	15.3	7.3	4.					5									D
7138	PESCADERO03	04/01/87	16.5	7.6	4.8	294	570	2810	19		4.9	110	260	190	96	656		P	D
7332	PESCADERO03	08/05/87	22.2	7.3	5.9						5.9	460	370	230	24	1084			D
	PESCADERO03	10/15/87	15.7	7.1	5.4					5									D
7332	PESCADEROPP0	08/05/87	22.2	7.3	5.9	183	300	1770	57										D
7501	PESCADEROPP0	10/15/87	16.2	7.3	6.3							99	194	159	78	530			D
[illegible]02	PESCADEROPP0	10/15/87	15.3	7.3	4.							110	178	164	97	549			D
[illegible]03	PESCADEROPP0	10/15/87	15.7	7.1	5.4							78	190	210	150	628			D
	PICO-NAGL 02	11/26/86										310	310	300	180	1100			D
7140	PIERSONPP01	03/25/87	19.5	7.2	8.8	50	61	638	21		18.	780	160	17	0	957			D
7335	PIERSONPP01	08/06/87	22.5	7.1	5.8	17	15	248	26		3.1	580	38	20	2	640			D
7506	PIERSONPP01	10/16/87	15.2	7.2	6.							630	45	2					D
	PIERSONPP01	10/16/87	15.2	7.2	6.					25									D
7335	PROSP01A	08/13/87	19.4	6.9	4.8							680	17	0	0	697			QD
7335	PROSP01B	08/13/87	19.4	6.9	4.8							660	19	0	0	679			QD
7335	PROSP01C	08/13/87	19.4	6.9	4.8							660	17	0	0	677			QD
7335	PROSP01D	08/13/87	19.4	6.9	4.8							690	18	0	0	708			QD
7335	PROSP01E	08/13/87	19.4	6.9	4.8							700	18	0	0	718			QD
7336	PROSPECT01	08/13/87	19.4	6.9	4.8							640	12	0	0	652			QD
7142	PROSPECTPP01	03/25/87	19.5	7.8	8.	12	7	187	12		1.9	950	140	7	0	1097			D
7336	PROSPECTPP01	08/13/87	19.4	6.9	4.8						3.4	640	12	0	0	652			D
7336	PROSPECTPP01	08/13/87	19.4	6.9	4.8	12	7	200	19										D
7507	PROSPECTPP01	10/20/87	16.	7.4	4.8							1100	42						D
	PROSPECTPP01	10/20/87	16.	7.4	4.8					50									D
7141	PROSPECTPP02	03/25/87	14.5	7.2	4.2	74	46	1210	21		18.	440	25	0	0	465			D
7145	RINDGEPP01	03/26/87	14.5	7.1	5.1	166	285	1550	14		16.	820	300	73	12	1205		P	D
7338	RINDGEPP01	08/07/87	20.4	6.6	3.9						21.	2700	130	5	2	2837		P	D
7338	RINDGEPP01	08/07/87	20.4	6.6	3.9	60	79	611	7										D
7509	RINDGEPP01	10/19/87	17.	6.7	2.1							800	240	62	3	1105			D
	RINDGEPP01	10/19/87	17.	6.7	2.1					40									D
7582	RINDGEPP01	12/10/87	15.	6.8	6.3					100									D
7144	RINDGEPP02	03/26/87	14.5	7.	6.7	107	203	1180	14		21.	1500	310	65	0	1875			D
[illegible]339	RINDGEPP02	08/07/87	22.2	6.3	3.3	31	43	363	9		12.	1900	84	3	0	1987		P	D
	RINDGEPP02	10/19/87	17.	7.1	3.8					60									D
7510	RINDGEPP02	10/19/87	17.	7.1	3.8							930	140	20					D
7583	RINDGEPP02	12/10/87	13.5	6.2	3.2					160									D
7512	RIOBLANCOPP0	10/19/87	14.5	7.3	6.9							380	220	93	15	708			D

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (THM Formation Potential, ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7511	RIOBLANCOPP0	10/19/87	16.5	7.5	8.7							170	260	200	81	711			D
7585	RIOBLANCOPP0	12/10/87	16.5	7.4	7.6					25									D
7584	RIOBLANCOPP0	12/10/87	15.5	7.4	7.6					20									D
7143	RIOBLANCPP01	03/26/87	20.	8.1	11.6	121	189	1160	15		6.	280	230	110	50	670		P	D
7340	RIOBLANCPP01	08/07/87	21.1	7.3	8.6	138	181	1290	13		3.5	240	190	160	28	618		P	D
	RIOBLANCPP01	10/19/87	16.5	7.5	8.7					10									D
7146	RIOBLANCPP02	03/26/87	17.	7.6	4.	187	330	1820	22		5.	260	370	150	49	829			D
7341	RIOBLANCPP02	08/07/87	21.2	7.1	4.1	38	38	450	14		0.	620	59	8	0	687			D
	RIOBLANCPP02	10/19/87	14.5	7.3	6.9					10									D
3050	ROCKSL	07/26/83	23.	7.	7.	15	16	158	16	8	3.4	310	34	5	0	349			F
3085	ROCKSL	08/23/83	24.5	7.2	6.9	15	14	171	17	8	2.6	440	35	4	0	479			F
3103	ROCKSL	09/14/83	25.	7.1	6.1	26	29	254	15	35	4.6	440	43	9	0	492			F
3130	ROCKSL	10/12/83	21.	7.1	7.7	17	21	177	11	20	2.8	270	39	6	6	321			F
3155	ROCKSL	11/08/83	17.	7.2	8.4	22	23	224	10	25	3.5	260	37	7	0	304			F
3171	ROCKSL	12/13/83	12.	6.9	9.8	20	21	202	11	30	3.	270	36	4	0	310			F
4009	ROCKSL	01/24/84	10.	7.3	10.8	25	25	248	16	35	3.3	320	42	8	0	370			F
4025	ROCKSL	02/28/84	13.5	7.5	10.	32	35	316	11	30	3.6	340	65	12	0	417			F
4037	ROCKSL	03/27/84	16.5	7.5	9.8	22	24	254	17	30	3.2	370	54	8	0	432			F
4050	ROCKSL	04/25/84	16.5	7.3	9.6	15	14	193	14	15	3.4	310	31	4	0	345			F
4079	ROCKSL	05/30/84	24.	7.5	8.1	15	15	194	16	12	3.8	360	39	5	0	404			F
4095	ROCKSL	06/27/84	26.	7.2	6.8	16	15	189	12	30	3.5	380	39	4	0	423			F
4108	ROCKSL	07/25/84	24.	7.7	8.1	22	27	217	10	15	2.5	320	63	17	0	400			F
128	ROCKSL	08/29/84	24.	7.4	8.2	21	26	221	5	12	2.6	310	60	16	0	386			F
67	ROCKSL	09/27/84	23.	7.8	8.3	16	14	199	9	10	2.8	310	31	3	0	344			F
4186	ROCKSL	10/25/84	17.	8.	10.9	16	15	194	8	12	3.2	330	32	4	0	366			F
4201	ROCKSL	11/29/84	12.	7.4	10.5	14	13	186	10	30	3.7	580	32	2	0	614			F
4222	ROCKSL	12/12/84	11.	7.3	9.7	14	13	195	11	30	4.4	410	31	2	0	443			F
5004	ROCKSL	01/30/85	8.	7.2	10.8	22	24	284	3										F
5023	ROCKSL	02/27/85	14.	7.5	10.3	21	21	258	6	25		350	45	5	0	400			F
5039	ROCKSL	03/27/85	12.	7.4	10.1	24	25	269	6										F
5052	ROCKSL	04/24/85	18.	7.8	10.1	21	18	232	7	2		430	42	5	0	477			F
5073	ROCKSL	05/22/85	21.5	8.2	9.2	21	24	225	17	15		520	56	11	0	587			F
5099	ROCKSL	06/07/85	23.	7.9	9.1	25	30	252	16										F
5089	ROCKSL	06/26/85	23.	7.6	8.	41	56	360	19	10		600	110	60	3	773			F
5104	ROCKSL	07/10/85	25.	7.3	7.6	60	81	453	8										F
5123	ROCKSL	08/28/85	23.5	7.6	8.1	81	122	630	8	10	2.8	340	160	100	19	619			F
5134	ROCKSL	09/25/85	22.5	7.6	8.1	101	164	776	8										F
5149	ROCKSL	10/23/85	17.5	7.8	10.	99	158	738	7	5	2.1	210	210	140	36	596			F
5176	ROCKSL	11/15/85	12.5	7.5	10.4	135	238	988	4										F
5170	ROCKSL	12/03/85	11.5	7.4	10.5	133	228	965	6	10	3.1	140	200	210	24	574			F
6011	ROCKSL	01/23/86	11.	7.3	9.6	66	85	476	6										F
6016	ROCKSL	02/13/86	11.5	7.4	10.2	36	50	319	13										F
6027	ROCKSL	03/04/86	17.5	7.3	6.2	32	35	342	16	35	8.4	670	67	6	0	743			F
6042	ROCKSL	04/09/86	17.	7.3	8.5	29	31	262	11	20	3.5	520	81	11	0	612			F
6077	ROCKSL	05/07/86	17.	7.2	7.4	21	23	227	13	20	7.8	510	48	5	0	563			F
6108	ROCKSL	06/04/86	22.5	7.3	7.6	19	21	225	21		4.	200	23	2	0	225			F
6126	ROCKSL	07/02/86	25.5	7.3	6.3	19	19	225	15	20	7.2	390	49	4	0	443			F
6145	ROCKSL	08/14/86	23.5	7.5	8.1	21	26	219	22	20	5.3								QD
146	ROCKSL	08/14/86	23.5	7.5	8.1	21	26	220	22	5	5.5								QD
6145	ROCKSL	08/14/86	23.5	7.5	8.1	21	26	219	22	20	5.3								F
6175	ROCKSL	09/24/86	20.	7.5	8.1	9	31	285	17	5	2.9	300	62	18	0	380			F
6280	ROCKSL	11/12/86	14.5	7.3	9.4	13	14	180	15	5	1.8	240	14	2	0	256			F
6311	ROCKSL	12/17/86	10.	7.3	9.5	25	36	272	9	5	1.1	290	59	11	0	360			F

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (<---- THM Formation Potential ----> ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7020	ROCKSL	01/22/87	6.5	7.3	11.8	24	30	268	18	10	3.	480	58	7	0	545			F
7060	ROCKSL	02/24/87	11.	7.3	10.5	30	41	355	12	20	4.	670	83	22	0	775			F
7110	ROCKSL	03/24/87	13.	7.3	10.2	25	30	302	12	20	4.3	480	58	5	0	543			F
7187	ROCKSL	04/30/87	19.5	8.3	9.81	25	28	314	13	10	2.6	260	54	8	0	322			F
7222	ROCKSL	05/28/87	20.5	7.3	7.3					10	2.3	320	140	72	0	532			F
7284	ROCKSL	06/23/87	23.5	7.3	7.3	54	87	488	15	5									F
7402	ROCKSL	09/09/87	22.6	7.4	9.1					5	2.6								F
7402	ROCKSL	09/09/87	22.6	7.4	9.1	125	210	923	11			190	140	120	44	494			F
7446	ROCKSL	10/22/87	19.	7.4	8.3						2.6								QD
7445	ROCKSL	10/22/87	19.	7.4	8.3						2.8								QD
7445	ROCKSL	10/22/87	19.	7.4	8.3						2.8								F
7446	ROCKSL	10/22/87	19.	7.4	8.2	119	201	872	4	0		140	120	130	44	434			QD
7543	ROCKSL	11/05/87	17.5	7.3	8.9	73	116	617	4	5		390	91	84	34	599			F
7570	ROCKSL	12/08/87	11.3	7.3	10.1	154	277	1140	5	15		250	190	160	53	653			F
8015	ROCKSL	01/07/88	8.4	7.3	11.8					20									QD
7098	RYER IS PP01	03/16/87										2700	100	9	0	2809			D
7099	RYER IS PP02	03/16/87										1800	80	0	0	1880			D
7092	SHERMAN PP01	03/16/87										1500	470	85	15	2070			D
7083	SHERMAN PP02	03/16/87										2400	290	32	0	2722			D
7084	SHERMAN PP03	03/16/87										1700	630	130	10	2470			D
7085	SHERMAN PP03	03/26/87										1200	280	30	0	1510			D
7086	SHERMAN PP05	03/26/87										2600	620	69	0	3289			D
[illegible]47	SHIMATR	03/26/87	20.	7.8	8.8	53	73	754	6		4.8	360	110	21	0	491		P	D
[illegible]42	SHIMATR	08/07/87	21.8	7.1	4.4	47	55	631	7		5.9	860	89	9	0	958			D
7513	SHIMATR	10/19/87	17.5	7.3	4.8							770	91	10					D
	SHIMATR	10/19/87	17.5	7.3	4.8					15									D
7588	SHIMATR	12/10/87	14.	7.3	5.7					40									D
3038	SLDCK17	07/20/83	23.5	8.5	9.	2130	1590	11500	1	5	9.5	34	160	520	610	1324	11.6		D
3073	SLDCK17	08/16/83	30.5	7.9	9.4	2120	1580	11500	2	8	10.	30	140	750	340	1260	10.3		D
3092	SLDCK17	09/06/83	25.5	7.9	8.	2180	1560	11700	5	12	18.	70	310	600	470	1450	9.48		D
3126	SLDCK17	10/05/83	23.	8.6	12.5	2160	1600	11800	2	30	29.	31	210	750	680	1671			D
3142	SLDCK17	11/15/83	16.5	8.6	11.5	2300	1440	11700	3	25	19.	35	230	580	710	1555	6.91		D
3039	SLDCK2	07/20/83	25.	8.6	9.	2420	1760	12600	1	5	9.2	19	140	500	550	1209	11.6		D
3074	SLDCK2	08/17/83	28.	7.9	8.	2120	1640	11600	1	8	9.3	26	110	420	280	836	9.65		D
3093	SLDCK2	09/06/83	26.5	7.8	8.	2220	1660	11900	1	10	9.5	67	340	720	380	1507	8.82		D
3127	SLDCK2	10/06/83	21.5	8.4	8.3	2200	1610	11900	2	25	28.	36	260	710	630	1636	7.37		D
3143	SLDCK2	11/15/83	15.5	8.8	13.	2140	1470	11300	6	45	30.	39	280	710	680	1709	8.49		D
3174	SLDCK2	12/20/83	13.5	8.2	10.3	2120	1380	10500	1	18	7.5	42	190	410	330	972	15.5		D
3037	SLDCK41	07/20/83	21.5	8.3	9.5	1970	1500	11000	1	5	7.3	37	150	480	540	1207	11.6		D
3082	SLDCK41	08/16/83	25.	7.6	7.5	2020	1540	11100	4	8	10.	18	130	420	250	818	9.48		D
3091	SLDCK41	09/06/83	23.5	7.9	11.6	2070	1560	11400	3	15	11.	100	330	350	180	960	9.15		D
3125	SLDCK41	10/05/83	22.	8.3	7.7	2040	1600	11400	1	15	13.	30	160	370	280	840	7.53		D
3141	SLDCK41	11/15/83	16.5	8.6	15.5	2700	1580	13400	4	25	21.	25	200	480	230	935	6.91		D
3172	SLDCK41	12/20/83	15.	8.1	10.8	1760	1340	9320	2	8	9.8	32	140	310	230	712	13.6		D
3069	SLDPC	07/28/83	23.	7.5	8.4	944	865	5890	3	2	4.2	36	120	190	140	486			D
3088	SLDPC	08/25/83	20.	8.1	8.8	940	860	5900	3	5	4.	42	170	260	140	612			D
3106	SLDPC	09/20/83	22.5	7.6	8.5	1120	1010	6910	96	5	4.3	38	110	290	160	598			D
3040	SLDPD5	07/20/83	22.	8.6	4.	2940	2160	14700	0	12	11.	21	180	780	950	1931			D
[illegible]75	SLDPD5	08/17/83	25.	7.5	1.4	2980	2250	15200	1	12	11.	20	190	720	520	1450			D
3094	SLDPD5	09/06/83	24.	7.5	1.5	2540	1960	13600	0	8	8.7	76	340	750	490	1656			D
3128	SLDPD5	10/06/83	20.	7.7	3.3	2300	1780	12500	0	25	11.	58	270	660	1300	2288			D
3144	SLDPD5	11/15/83	13.	8.6	10.8	2120	1520	11200	2	35	26.	59	320	750	960	2089			D
3175	SLDPD5	12/20/83	13.	8.	8.7	2020	1390	10200	1	20	11.	63	220	470	380	1133			D

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (<---- THM Formation Potential ----> ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
7101	SUTTER IS PP	03/16/87										810	39	0	0	849			D
7343	TERMPP01	08/06/87	24.7	7.	6.1	33	59	472	7		6.5	1300	130	15	0	1445		P	D
7514	TERMPP01	10/16/87	17.8	7.1	7.8							320	110	42	16	488			D
	TERMPP01	10/16/87	17.8	7.1	7.8					35									D
7153	TERMPP02	03/26/87	12.5	7.2	4.4	71	150	850	8		8.9	640	220	48	7	915		P	D
7344	TERMPP02	08/06/87	23.6	7.2	6.5	46	99	587	6		4.8	770	170	45	0	985		P	D
	TERMPP02	10/16/87	16.7	7.1	5.2					20									D
7515	TERMPP02	10/16/87	16.7	7.1	5.2														D
7590	TERMPP02	12/11/87	11.	6.9	7.2					100									D
7154	TYLER PP01	03/30/87	15.5	7.	7.6	40	77	611	30	25	11.	1100	170	14	0	1284			QD
7155	TYLER PP01	03/30/87	15.5	7.	7.6		7	7154			11.	870	150	15	0	1035			QD
7154	TYLERPP01	03/30/87	15.5	7.	7.6	40	77	611	30		11.	1100	170	14	0	1284			D
7175	TYLERPP01	04/16/87	17.	7.2	6.8					35	7.5	1300	95	2	0	1397			D
7156	TYLERPP02	03/30/87	15.	7.4	6.4	99	162	1070	36		20.	1800	300	32	0	2132			D
7103	UP ANDRS 01	03/16/87										2800	240	15	0	3055			D
7149	UP JONES02	03/30/87	17.	7.	5.4	52	60	507	33	200	27.	2600	160	10	0	2770			QD
7157	UP JONES02	03/30/87	17.	7.	5.4			7149			28.	1900	160	10	0	2070			QD
7345	UPEGBERTPP01	08/13/87	18.6	7.5	7.3	31	22	382	124										D
7345	UPEGBERTPP01	08/13/87	18.6	7.5	7.3						6.2	1400	37	2	0	1439			D
	UPEGBERTPP01	10/20/87	15.7	7.4	1.					30									D
7346	UPEGBERTPP02	08/13/87	18.3	7.3	7.						6.6	980	43	4	0	1027			D
7346	UPEGBERTPP02	08/13/87	18.3	7.3	7.	28	20	375	100										D
[illegible]517	UPEGBERTPP02	10/20/87	17.	7.3	4.9							648	77	2					D
	UPEGBERTPP02	10/20/87	17.	7.3	4.9					60									D
7347	UPEGBERTPP03	08/13/87	20.	7.3	6.6	49	60	538	72										D
7347	UPEGBERTPP03	08/13/87	20.	7.3	6.6						9.4	1000	47	2	0	1049			D
7518	UPEGBERTPP03	10/20/87	16.7	7.5	5.9	62	44	781	68			1500	53	10					D
	UPEGBERTPP03	10/20/87	16.7	7.5	5.9					25									D
7148	UPJONESPP01	03/30/87	17.5	6.8	5.	124	163	1010	35		11.	960	190	27	0	1177		P	D
7149	UPJONESPP02	03/30/87	17.	7.	5.4	52	60	507	33		27.	2600	160	10	0	2770			D
7349	UPJONESPP02	08/12/87	20.4	6.9	3.8	68	96	626	29										D
7349	UPJONESPP02	08/12/87	20.4	6.9	3.8						7.7	1200	160	21	0	1381		P	D
	UPJONESPP02	10/19/87	17.5	6.7	4.8					25									D
7520	UPJONESPP02	10/19/87	17.5	6.7	4.8	78	124	739	30			800	120	24					D
2058	VERNALIS	03/30/82	10.5	7.3	9.9		36	341	14	13		1400	67	9	0	1476	1E4		F
2117	VERNALIS	06/29/82	18.	7.7	8.4		30	267	15			470	93	12	0	575	7E3		F
2133	VERNALIS	08/26/82	21.	7.7	7.3		50	392	22			390	71	19	0	480	4E3		F
2138	VERNALIS	10/21/82	16.	7.3	9.		17	166	8			330	37	0	0	367	7E3		F
2141	VERNALIS	12/29/82	9.	7.	9.3		12	152	28			770	37	0	0	807	2E4		F
3005	VERNALIS	02/24/83	13.	7.5	9.6		26	264	18			190	24	4	0	218	3E4		F
3008	VERNALIS	04/27/83		7.1	9.7		11	150	12			310	20	6	5	341	4E4		F
3034	VERNALIS	06/22/83	21.	7.	8.5		10	117	23			380	23	2	0	405	2E4		F
3046	VERNALIS	07/26/83	20.	7.3	7.7	29	30	288	29	5	3.5	290	54	12	0	356	1E4		F
3081	VERNALIS	08/23/83	20.	7.2	8.	23	24	247	19	5	3.	420	39	7	0	466	9E3		F
3099	VERNALIS	09/14/83	20.	7.4	8.2	15	14	158	16	10	2.8	350	21	3	0	374	1E4		F
3131	VERNALIS	10/12/83	17.5	7.1	8.5	11	11	126	12	10	2.8	270	24	3	0	297	1E4		F
3151	VERNALIS	11/08/83	15.	7.3	8.2	39	38	381	18	25	4.2	300	62	12	0	374	9E3		F
3167	VERNALIS	12/13/83	11.	7.1	10.	14	13	155	14	30	3.2	330	22	2	0	354	2E4		F
[illegible]05	VERNALIS	01/24/84	10.	7.	10.	21	19	210	14	25	3.1	340	32	4	0	376	2E4		F
4021	VERNALIS	02/28/84	12.	7.5	9.7	38	39	352	10	15	3.2	250	60	15	0	325	1E4		F
4033	VERNALIS	03/27/84	14.5	7.3	9.4	48	52	464	34	15	3.9	280	86	23	2	391	6E3		F
4046	VERNALIS	04/25/84	14.	7.3	8.8	59	66	547	24	8	4.8	290	110	42	2	444	4E3		F
4075	VERNALIS	05/30/84	24.5	7.9	7.3	69	80	629	75	10	6.1	380	120	56	3	559	2E3		F

05/13/88

DATA REPORT

LABNO	STA. NAME	SAMP.DATE	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	EC uS/cm	TURB T.U.	COL C.U.	TOC mg/L	CHCL3 (THM Formation Potential, ug/L)	CHBRCL2	CHBR2CL	CHBR3	TTHMFP	FLOW cfs	PUMP	TYPE
4091	VERNALIS	06/27/84	25.5	7.3	6.3	77	88	694	50	25	5.8	360	130	58	3	551	2E3		F
4104	VERNALIS	07/25/84	23.	7.5	6.5		92	640		15	5.4	450	150	72	7	679	2E3		F
4124	VERNALIS	08/29/84	24.	7.6	7.1	58	62	549	24	20	4.8	350	110	48	2	510	3E3		F
4163	VERNALIS	09/27/84	20.	7.4	8.3	39	43	388	17	10	4.2	280	79	21	0	380	3E3		F
4182	VERNALIS	10/25/84	15.5	7.4	7.9	39	41	378	15	12	3.9	260	64	23	1	348	4E3		F
4197	VERNALIS	11/29/84	11.5	7.1	9.2	43	44	400	10	25	4.4	380	68	15	0	463	3E3		F
4218	VERNALIS	12/12/84	11.	7.3	9.2	34	32	324	6	12	3.6	240	50	12	0	302	5E3		F
5001	VERNALIS	01/30/85	8.	7.4	10.5	54	55	483	3								4E3		F
	VERNALIS	02/22/85	12.	7.4	6.4	75	69	598	10	20							3E3		F
5018	VERNALIS	02/27/85	12.5	7.4	9.6	70	73	629	8	25		220	97	48	6	371	3E3		F
5034	VERNALIS	03/27/85	12.	7.4	9.	92	97	801	17								3E3		F
5048	VERNALIS	04/24/85	17.	7.4	7.9	87	80	667	19	5		360	140	61	3	564	3E3		F
5069	VERNALIS	05/22/85	20.5	7.4	7.2	84	99	756	31	10		400	160	68	12	640	2E3		F
5092	VERNALIS	05/29/85	18.	7.7	7.9	89	98	774	28								2E3		F
5085	VERNALIS	06/26/85	23.	7.5	7.3	81	94	717	52	10		540	160	66	7	773	1E3		F
5100	VERNALIS	07/10/85	22.5	7.4	7.1	55	58	490	28	5		520	130	41	3	694	3E3		F
5119	VERNALIS	08/28/85	19.5	7.7	7.4	52	60	487	18	5	3.9	410	100	34	2	546	2E3		F
5130	VERNALIS	09/25/85	21.5	7.4	6.8	59	70	563	21	5	3.1	380	98	30	4	512	2E3		F
5145	VERNALIS	10/23/85	15.5	7.4	7.4	53	65	519	12	5	2.4	320	110	29	2	461	2E3		F
5177	VERNALIS	11/15/85	8.5	7.5	9.7	80	94	709	7	5	4.1	240	130	71	8	449			QD
5172	VERNALIS	11/15/85	8.5	7.5	9.7	80	94	706	7	15	2.9	220	130	71	7	428	1E3		F
5172	VERNALIS	11/15/85	8.5	7.5	9.7	80	94	706	7	15	2.9	220	130	71	7	428			QD
166	VERNALIS	12/03/85	13.5	7.4	8.9	66	74	604	18	18	6.5	590	140	32	0	762	2E3		F
07	VERNALIS	01/23/86	12.	7.5	8.8	99	107	790	18	15	3.2	930	160	76	7	1173	2E3		F
6012	VERNALIS	02/13/86	11.5	7.3	9.	82	86	686	15	5	4.3	450	140	56	3	649	2E3		F
6023	VERNALIS	03/04/86	15.	7.3	8.3	28	26	268	26	35	7.8	540	56	6	0	602	2E4		F
6038	VERNALIS	04/09/86	15.	7.3	9.2	18	18	169	20	25	5.3	650	47	4	0	701	2E4		F
6073	VERNALIS	05/07/86	14.5	7.3	8.8	27	27	257	17	15	6.	330	51	6	0	387	1E4		F
6104	VERNALIS	06/04/86	20.5	7.3	8.	26	28	254	22	10	4.8	220	41	6	0	267	8E3		F
6122	VERNALIS	07/02/86	23.	7.5	7.9	65	75	595	9	5	7.8	318	144	41	2	505	3E3		F
6141	VERNALIS	08/14/86	21.5	7.6	7.6	60	67	557	25	5	6.3						3E3		F
6170	VERNALIS	09/24/86	17.5	7.3	8.2	32	34	317		15	6.	320	85	23	0	428	4E3		F
6276	VERNALIS	11/12/86	13.5	7.3	9.7	47	55	447	10	5	2.	250	60	41	1	352	3E3		F
6307	VERNALIS	12/17/86	11.5	7.3	10.5	34	37	331	10	5	1.4	160	38	9	0	207	4E3		F
7016	VERNALIS	01/22/87	8.5	7.3	11.1	73	88	679	10	5	2.5	220	85	41	4	350	2E3		F
7056	VERNALIS	02/24/87	11.5	7.5	9.9	93	105	868	12	5	2.7	310	200	120	9	639	3E3		F
7105	VERNALIS	03/24/87	13.	7.3	9.6	100	105	831	16	5	3.8	320	140	38	8	506	3E3		F
7182	VERNALIS	04/30/87	19.	7.3	8.4	59	74	564	27	10	2.6	200	90	40	4	334	3E3		F
7217	VERNALIS	05/28/87	18.	7.4	8.2	66	77	622	25	15	2.6	410	130	53	0	593			F
7280	VERNALIS	06/23/87	22.5	7.7	4.6														F
7280	VERNALIS	06/23/87	22.5	7.7	4.6	88	104	807	42	10									F
7292	VERNALIS	06/24/87	23.	7.5	1.9						2.9	260	150	78	14	502			F
	VERNALIS	08/25/87										370	130	63	4	567			F
7396	VERNALIS	09/09/87	21.5	6.8	7.2					5	5.5								F
7396	VERNALIS	09/09/87	21.5	6.8	7.2	81	99	734	21			310	110	50	11	481			F
7439	VERNALIS	10/22/87	18.5	7.4	8.2	91	117	807	13	0		140	89	62	17	308			F
7439	VERNALIS	10/22/87	18.5	7.4	8.2						3.3								F
7538	VERNALIS	11/05/87	15.	7.6	8.7	118	142	951	17	5		400	130	78	6	614			F
565	VERNALIS	12/08/87	13.6	7.4	9.4					10		170	70	39	11	290			F
7096	VICTORIA 02	03/17/87										670	110	11	0	791			D

SCREEN

Appendix D.

PESTICIDE MONITORING SELECTION SCHEME & DATA

PESTICIDE MONITORING SELECTION SCHEME

As part of the Interagency Delta Health Aspects Monitoring Program, surface waters were monitored for agricultural chemicals that might be difficult to control using conventional water treatment practices. In general, such chemicals are water soluble and have a low affinity for adsorption onto particulate matter. Consequently, flocculation, settling, and filtration processes are ineffective in removing these dissolved substances. On the other hand, chemicals with sparingly low water solubilities tend to be readily attracted to solid media and can be controlled in a typical treatment facility.

Selection of chemicals and timing for monitoring at a site can be difficult. Broad scans for hundreds of chemicals are expensive (thousands of dollars per sample) and do not produce significantly more information than does taking a sensible and rational approach. The continued practice of limiting analyses to traditionally monitored chemicals such as banned chlorinated pesticides may even be less productive in assessing current water quality conditions.

The Department chose to develop and use a selection scheme based on a combination of quantitative information (e.g. reported chemical usage patterns and properties) and judgmental assessments (e.g. major activities upstream of a sampling site). A database of the quantitative information was compiled for the selection process.

The objective of the scheme was to develop a list of those chemicals with the highest probability of posing treatment difficulties to public water supplies in the Delta. Chemicals on this list would be monitored.

The selection scheme produced site- and time-specific target lists of chemicals for monitoring. The scheme and database can also be used in other types of monitoring programs (e.g. ground water, biological contamination surveys) by using different selection criteria values (e.g. ranges of water solubilities and partition coefficients). Target lists could be developed for different environmental compartments (e.g. sediment, water, biota).

Method

Pesticide and crop pattern data of the State Department of Food and Agriculture were compiled to determine the amount and period of usage. Data were obtained for 1983, the most recent database containing a full year of record at the time of the compilation. Data for pesticide usage were ranked for each county and then combined for watersheds of interest to this program (those encompassing our sampling sites). The chemicals were then ranked by usage for each watershed.

Information was compiled for each chemical on water solubility, log P (octanol/water partition coefficients), log Koc (soil activity coefficients), estimated half-life in water, period of use by month, type of use, and whether it was on the AB-1803 list. (The AB-1803 list is the California Assembly Bill 1803 list of chemicals that must be monitored in ground water by the Department of Health Services).

The octanol/water partition coefficient is defined as the ratio of a chemical's concentration in the octanol phase to that in the aqueous phase of a two-phase octanol/water system. The ratios are often reported in logarithmic units (log P). Values of P are meaningful since they represent the tendency of a chemical to partition itself between an organic phase (e.g. soil, fish) and an aqueous phase. Chemicals with low P values are relatively hydrophilic (i.e. water soluble) and have small soil/sediment absorption coefficients, and small bioconcentration factors for aquatic life. Chemicals with high P values (e.g. log P greater than 4) are very hydrophobic. The P values can be measured in the laboratory or estimated from water solubility relationships, knowledge of chemical structure, and other solvent/water partition coefficients.

The soil adsorption coefficient, Koc, is the ratio of the amount of chemical adsorbed per unit weight of organic carbon (oc) in the soil or sediment to that amount in solution at equilibrium. Logarithmic values, log Koc, are reported because of the high range of values. The degree of adsorption affects the chemical's mobility, volatilization, photolysis, hydrolysis, and biodegradation. Koc can be measured in the laboratory and estimated from empirical relationships with other chemical properties (e.g. solubility, log P).

Information on the chemical properties was compiled from numerous recent publications /1-11/ and the ISHOW (Information System for Hazardous Organics in the Water Environment) computer database of EPA. When conflicting values were found, the lower values were entered into the database. An excellent discussion of the degree of error associated with measurements of chemical properties is presented in Lyman et al /12/.

The chemicals were grouped by selected ranges of reported or calculated water solubilities and specified ranges of partition coefficients as measured by their affinities for water or organic-laden soil (e.g. by log P and log Koc values). Eight groups were created from the following criteria:

Group	Water Solubility	log P and log Koc
1	> 999 mg/L	equal to or <2
2	> 999 mg/L	>2 but < or equal to 3
3	100-999 mg/L	equal to or <2
4	100-999 mg/L	>2 but < or equal to 3
5	10-99 mg/L	equal to or <2
6	10-99 mg/L	>2 but < or equal to 3
7	< 10 mg/L	equal to or <2
8	< 10 mg/L	>2 but < or equal to 3

A ninth group that would comprise those chemicals of log P or Koc values above 3 was not pertinent because it represented the very hydrophobic chemicals generally controllable in a modern water treatment plant.

Chemicals that had certain water solubilities and both log P and log Koc values were sorted and placed into the appropriate groups. However, those chemicals missing solubility data, log P, or Koc data were read as zero values by the computer software program, Lotus Symphony.

The groups represented those chemicals more likely to be dissolved in water (Groups 1 and 2) and those more likely to be in suspended material and organic particles in the water column (increasingly hydrophobic in order of group number).

The selection process for developing a list of candidate chemicals to be monitored consisted of inclusion of the most water soluble chemicals (Group 1 and 2 chemicals) and those with moderate water solubilities and partition coefficients (Groups 3 and 4). Additional pesticides, regardless of solubilities and partition coefficients, were added to the list when applied amounts were significant (among the top in ranked usage for the watershed) and the application method might lead to water contamination. For example, rice herbicides were added to the list because of the large quantities used and because they are applied to rice ponds just a few days before pond water and surface agricultural drainage are discharged into nearby rivers. To eliminate selection bias, each chemical was given a unique code for identification during the sorting and selection of pesticides for inclusion in the candidate lists. This step was taken to avoid inclusion of chemicals that technically might not meet the selection criteria but that were popular or traditional chemicals in other monitoring studies.

A final target list of chemicals to be monitored at specific sampling stations was developed after site location data on riverflow direction and upstream pesticide use and cropping pattern data were considered. This step reduced the list to those chemicals with the higher probability of contaminating waters upstream of the sites. For example, pesticide use data for the watershed where the American River water treatment plant is located represented use data for Sacramento, El Dorado, and Placer counties. The rice chemicals molinate and thiobencarb ranked high in use and were on the list of candidate chemicals for monitoring. However, rice fields are not located upstream of this site and therefore these two chemicals were not on the final target list of chemicals to be monitored at the American River water treatment plant site.

Site- and time-specific target lists were developed, since information on the months of application (based on cropping patterns) were included in the database. The monthly target lists provided information on which water soluble chemicals would more likely be detected in water (dissolved phase) at the Delta sampling stations.

Conclusion

The database will be revised as new information on pesticide use, application, and physical-chemical properties is received. The success in developing target lists depends on the reliability and accuracy of such data. The resulting tabulations and information can also be used to predict which chemicals would be found in different compartments of an aquatic system (e.g. sediment, water, biota).

The described protocol illustrates the need to combine numerical selection criteria (e.g. usage, solubilities, and partition values) and non-numerical information (e.g. station location and upstream activities) to improve the possibility of detecting chemicals in the aquatic system.

References

1 W. T. Thomson, Agricultural Chemicals Book I Insecticides, 1982-83 Revision, Thomson Publications, Fresno, CA.

2 W. T. Thomson, Agricultural Chemicals Book II Herbicides, 1983-84 Revision, Thomson Publications, Fresno, CA.

3 W. T. Thomson, Agricultural Chemicals Book III Fumigants, Growth, Regulators, Repellents, and Rodenticides, 1983 Revision, Thomson Publications, Fresno, CA.

4 W. T. Thomson, Agricultural Chemicals Book IV Fungicides, 1982-83 Revision, Thomson Publications, Fresno, CA.

5 Weed Science Society of America, Herbicide Handbook, Third Edition 1974, Champaign, IL.

6 Weed Science Society of America, Herbicide Handbook, Fourth Edition 1979, Champaign, IL.

7 B. G. Page and W. T. Thomson, The Insecticide, Herbicide, Fungicide Quick Guide 1981, Thomson Publications, Fresno, CA.

8 U. S. Environmental Protection Agency, Recognition and Management of Pesticide Poisonings, Second Edition, EPA-540/9-77-013, Office of Pesticide Programs, August 1977.

9 K. Verschueren, Handbook of Environmental Data on Organic Chemicals, Second Edition, Van Nostrand Reinhold Co., New York, 1310 pp, 1983.

10 The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals, Tenth Edition, Merck and Co., New Jersey, 1983.

11 J. W. Cornacchia, D. B. Cohen, G. W. Bowes, R. J. Schnagl, and B. L. Montoya, Rice Herbicides: Molinate and Thiobencarb, Special Projects Report 84-4sp, California State Water Resources Control Board, April 1984.

12 W. J. Lyman, W. F. Reehl, and D. H. Rosenblatt, Handbook of Chemical Property Estimation Methods -- Environmental Behavior of Organic Compounds, McGraw-Hill Book Co., 960 pp, 1982.

Table [redacted]

SPECIFIC PESTICIDE MONITORING

	Concentrations Detected at Stations Monitored (ug/L)*								
	Am.R. @ WTP	Banks P.P.	Cache Sl. @V.P.P.	Cosum. R. @Dill.Rd.	Lindsey Sl. @Hast.Ct.	Mok.R. @Woodbr.	No.Bay P.P.	Sac.R. @Grns.	SanJoaq. nr.Vern.
I. Target Compounds Detected									
Atrazine/Simazine			0.21		0.22				
Dacthal									0.02
Methyl Parathion			0.06						
Parathion			0.05						
2,4-D			0.08						
II. Other Compounds Detected									
Chloropropham									
Chloropyrifos			0.17		0.01				
Monocrotophos			0.02						
PCP			0.12						
Unknowns			0.04		0.02				
Trichloroethylene	0.2								
Sampling Date (1984)	10/4	9/27	9/12	10/4	9/12	10/4	9/12	10/4	10/4

* Blank spaces indicate compound not detected.

Table [illegible]

PESTICIDE MONITORING DATA, 1985 AND 1986
(All Units in ug/L)

Target pesticide	Sampling date	Detection limits	Cache Slough	Lindsey Slough	Sac.R.@ Grn's Ldg	Empire ag.dr.	Grand Is. ag. dr.nr.	S.J.R. Vern.	Banks P.P.	DMC intake	Middle River	Mallard Isl.	Natomas main dr.	Clift..C. intake	Action Level
2,4-D salt	07/16/85	0.1			ND	ND	ND	ND	0.1	ND	ND	ND			----
	08/20/85	0.01			ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	0.01				ND						ND	ND		----
	05/21/86	0.5				1		ND						ND	----
bentazon	07/16/85	0.1			1.6	ND	ND	ND	0.3	ND	ND	ND			----
	08/20/85	0.2			ND	ND	ND	ND	0.5	ND	ND	ND			----
	12/04/85	0.5				ND						ND	ND		----
	05/21/86	1				ND		ND						ND	----
carbofuran	07/16/85	0.5			ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	0.5			ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	0.1				ND						ND	ND		----
	05/21/86	0.2				ND		ND						ND	----
chloropicrin	07/16/85	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			*50
	08/20/85	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			*50
	12/04/85	0.1			ND	ND		ND	ND			ND	ND		*50
	05/21/86	0.1				ND		ND						ND	*50
copper ~~dactinal~~	12/04/85	5			5	13		8	ND			8	10		----
dacthal	07/16/85	0.01			ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	0.05			ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	0.3				ND						ND	ND		----
	05/21/86	0.01				ND		ND						ND	----
D-D mixture	07/16/85	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	0.5			ND	ND		ND	ND			ND	ND		----
	05/21/86	0.2				ND		ND						ND	----
MCPA	07/16/85	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	2				ND						ND	ND		----
	05/21/86	20				ND		ND						ND	----
metalaxyl	07/16/85	1			ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	10			ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/86	0.1				ND						ND	ND		----
	05/21/86	0.05				ND		ND						ND	----
methamidophos	07/16/85	2			ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	0.5			ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	5				ND						ND	ND		----
	05/21/86	5				ND		ND						ND	----
methyl bromide	07/16/85	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	0.7			ND	ND		ND	ND			ND	ND		----
	05/21/86	0.5				ND		ND						ND	----
methyl parathion	07/16/85	2.5			ND	ND	ND	2.5	ND	ND	ND	ND			30
	08/20/85	1			ND	ND	ND	ND	ND	ND	ND	ND			30
	12/04/85	0.01				ND						ND	ND		30
	05/21/86	0.005				ND		ND						0.03	30
molinate	07/16/85	1	ND	1	ND	ND	ND	ND	ND	ND	ND	ND			20
	08/20/85	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			20
	12/04/85	0.05				ND						ND	ND		20
	05/21/86	0.05				ND		ND						ND	20
paraquat dichloride	07/16/85	10			ND	ND	ND	ND	ND	ND	ND	ND			----
	08/20/85	10			ND	ND	ND	ND	ND	ND	ND	ND			----
	12/04/85	20				ND						ND	ND		----
	05/21/86	10				ND		ND						ND	----
thiobencarb	07/16/85	8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			*10
	08/20/85	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			*10
	12/04/85	0.05				ND						ND	ND		*10
	05/21/86	0.05				ND		ND						ND	*10
xylene	07/16/85	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			620
	08/20/85	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			620
	12/04/85	0.4			ND	ND		ND	ND			ND	ND		620
	05/21/86	0.2				ND		ND						ND	620

* Tentative recommended action level. The recommended action level for taste and odor threshold is 1.0 ug/L for thiobencarb and 37 ug/L for chloropicrin.

Note: Blanks indicate no analysis performed for that chemical.
ND = Not detected when less than twice the blank value.

Analyses performed by McKesson Environmental Services.

Results of Pesticide Analysis
San Joaquin River near Vernalis
Units is ug/L (parts per billion)

Pesticides Analysis Results
San Joaquin River near Vernalis

Chemical	3/24/87	5/28/87
2,4-D Salt	<0.2	<0.2
Bentazon	<1.0	<1.0
Carbofuran	<0.5	0.08
Chloropicrin	<0.01	<0.01
Decthal	<0.04	<0.04
MCPA	<30.0	<30.0
Metalaxyl	<0.4	<0.4
Methamidophos	<10.0	<10.0
Methyl Parathion	<0.01	<0.01
Molinate	<0.01	0.08
Paraquat Dichloride	50.0	<20.0
Thiobencarb	<0.01	0.09

Results of Pesticide Analysis
September 18,1987
Units in ug/L (parts per billion)

	Pierson PP	Sac Rv @ Greenes	Ag Drain @ Grand	Ag Drain @ Empire
Diquat	<40.0		<40.0	<40.0
Paraquat	<20.0	<20.0	<20.0	<20.0
Dithiocarbamate	<3.0		<3.0	<3.0
Carbofuran	<0.5	<0.5	<0.5	<0.5
Methyl parathion	<0.1	<0.1	<0.1	<0.1
Diazinon	<0.1	<0.1	<0.1	<0.1
Parathion	<0.1	<0.1	<0.1	<0.1
Ordram	<0.5	<0.5	<0.5	<0.5
Bolero	<0.5	<0.5	<0.5	<0.5
Atrazine		<0.1	<0.1	<0.1
Simazine		<0.1	<0.1	<0.1
Dacthal	<0.1	<0.1	<0.1	<0.1
Dicofol	<0.2	<0.2	<0.2	<0.2
Alachlor	<0.1	<0.1	<0.1	<0.1
Captan	<0.5	<0.5	<0.5	<0.5
2,4-D	0.9	<0.25	<0.25	0.67
Dinoseb	<0.25	<0.25	<0.25	<0.25
Propanil	<0.5		<0.5	<0.5
Bentazon	<0.5	<0.5	<0.5	<0.5
Carbaryl	<2.0	<2.0	<2.0	<2.0
Propham	<2.0	<2.0	<2.0	<2.0
Methomyl	<2.0	<2.0	<2.0	<2.0
Glyphosate	<1.0	<1.0	<1.0	10.0

Results of Pesticide Analysis
September 17, 1987
Units in ug/L (parts per billion)

	Barker Slough at PP	Sac Rv at Mallard Is	Lindsey Slough @ Hastings	Nether-lands PP # 2
Diquat	<40.0		<40.0	<40.0
Paraquat	<20.0	<20.0	<20.0	<20.0
Dithiocarbamate	<3.0		<3.0	<3.0
Carbofuran	<0.5	<0.5	<0.5	<0.5
Methyl parathion	<0.1	<0.1	<0.1	<0.1
Diazinon	<0.1	<0.1	<0.1	<0.1
Parathion	<0.1	<0.1	<0.1	<0.1
Ordram	<0.5	<0.5	<0.5	<0.5
Bolero	<0.5	<0.5	<0.5	<0.5
Atrazine	<0.1		<0.1	<0.1
Simazine	<0.1		<0.1	<0.1
Dacthal	<0.1	<0.1	<0.1	<0.1
Dicofol	<0.2	<0.2	<0.2	<0.2
Alachlor	<0.1	<0.1	<0.1	<0.1
Captan	<0.5	<0.5	<0.5	<0.5
2,4-D	<0.25	<0.25	<0.25	<0.25
Dinoseb	<0.25	<0.25	<0.25	<0.25
Propanil	<0.5	NA	<0.5	<0.5
Bentazon	<0.5	<0.5	<0.5	<0.5
Carbaryl	<2.0		<2.0	<2.0
Propham	<2.0		<2.0	<2.0
Methomyl	<2.0		<2.0	<2.0
Glyphosate	NA		NA	<1.0

Results of Pesticide Analysis
September 16, 1987
Units in ug/L (parts per billion)

Chemical	Mossdale PP # 10	Sac Rv @ Vernalis	Banks PP	Delta Mendota Canal	Upper Jones PP # 2	Rock Slough	Middle River
Diquat	<40.0	<40.0	<40.0	<40.0	<40.0		
Paraquat	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0
Dithiocarbamate	<3.0	<3.0	<3.0	<3.0	<3.0		
Carbofuran	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl parathion	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2
Parathion	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ordram	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bolero	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Atrazine	<0.1	<0.1	<0.1	<0.1	<0.1		
Simazine	<0.1	<0.1	<0.1	0.36	<0.1		
Dacthal	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dicofol	<0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Alachlor	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Captan	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Dinoseb	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Propanil	<0.5	<0.5	<0.5	<0.5	<0.5	NA	NA
Bentazon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbaryl	<2.0	<2.0	<2.0	<2.0	<2.0		
Propham	<2.0	<2.0	<2.0	<2.0	<2.0		
Methomyl	4.8	<2.0	<2.0	<2.0	<2.0		
Glyphosate	<1.0	NA	NA	NA	<1.0		

Results of Pesticide Analysis
October 20, 1987
Units in ug/L (parts per billion)

	Barker Slough
Diquat	<40.0
Paraquat	<20.0
Carbofuran	<0.5
Methyl parathion	<0.1
Diazinon	<0.1
Parathion	<0.1
Ordram	<0.5
Bolero	<0.5
Atrazine	<0.1
Simazine	<0.1
Dacthal	<0.1
Dicofol	<0.1
Alachlor	<0.1
Captan	5.5
2,4-D	<2.5
Dinoseb	<0.25
Propanil	<0.5
Bentazon	<0.5
Carbaryl	<2.0
Propham	<2.0
Methomyl	<2.0

Quality Control Data
Duplicates

Units in ug/l (parts per billion)
Matrix Samples-MS 1, MS 2.

Station Duplicated	Date Sampled	Chemical	Spike	Quanity Found MS 1	MS 2
Rock Slough	8/18/87	Dithiocarbamate	100	110	80
		2,4-D	10	11.4	12.2
		DNBP	10	12.1	13
Netherlands Pumping Plant 1	8/19/87	Paraquat	100	100	99
		Diquat	200	220	224
		Bentazon	10	11	9.9
		Dithiocarbamate	30	24	26
Banks	8/17/87	Alachlor	2	2.5	2.1
		Dacthal	0.5	0.52	0.48
		Captan	4	4.1	3.9
		Dicofol	4	3.7	3.2
		Carbofuran	100	125	110
		Methyl Parathion	20	19	17
		Diazinon	20	21	17
		Parathion	20	18	16
		Molinate	100	105	60
		Thiobencarb	100	120	100
		2,4-D	10	11.6	12.8
		DNBP	10	12.2	13.9
		Atrazine	2	1.6	2.4
		Simazine	2	1.9	2.2
		Methomyl	50	38	32
		Carbaryl	50	44	37
		Propham	50	45	37
		Propanil	10	9.2	8.4
		Bentazon	2	1.5	1.3
Barker Slough	9/17/87	Dithiocarbamate	30	29.7	24.2
Barker Slough	10/20/87	Bentazon	10	12.3	11.9
		Paraquat	200	197	198
		Diquat	400	424	425
		2,4-D	5	5.7	6
		DNBP	5	6.6	6.1
		Methomyl	50	45	46
		Carbaryl	50	51	53
		Propham	50	44	47
Mossdale PP #10	9/16/87	Dithiocarbamate	30	27.9	22.1
Rock Slough		Paraquat	200	190	178
		Diquat	400	298	408

Results of Pesticide Analysis
August 18, 1987

Units in ug/L (parts per billion)

	Mossdale PP # 1	Sac Rv @ Vernalis	Delta Mendota Canal	Rock Slough	Middle Rv.	Upper Jones PP # 2	Banks PP (8/17)
Diquat	<40.0	<40.0	<40.0	<40.0	<40.0	<40.0	<40.0
Paraquat	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0
Dithiocarbamate	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0
Carbofuran	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl parathion	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	<0.1	0.10	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ordram	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Bolero	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Atrazine	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1
Simazine	<0.1	<0.1	0.21	<0.1		<0.1	<0.1
Dacthal	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Dicofol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Alachlor	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Captan	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
2,4-D	<0.25	<0.25	<0.25	<0.25	<0.25	<1.25	<0.25
Dinoseb	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Propanil	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Bentazon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbaryl	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Propham	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Methomyl	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Gylphosate							<1.0

Results of Pesticide Analysis
August 26, 1987
Units in ug/L (parts per billion)

Chemical	Sac Rv. above Colusa	Colusa Main Drain	Karnack Pumping Plant	Sac Slough @ Karnack	Natomas Main Drain	Sac Rv. @ Greenes
Carbofuran	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Parathion	NA	NA	NA	NA	NA	NA
Diazinon	NA	NA	NA	NA	NA	NA
Parathion	NA	NA	NA	NA	NA	NA
Ordram	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bolero	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bentazon	<0.5	0.7	0.6	1.2	1.1	<0.5

Results of Pesticide Analysis
August 20, 1987
Units in ug/l (parts per billion)

Chemical	Pierson PP	Sac Rv @ Greenes	Ag Drain @ Grand	Ag Drain @ Empire
Dithiocarbamate	<6.0	<6.0	<6.0	<6.0
Paraquat	<20.0	<20.0	<20.0	<20.0
Diquat	<40.0	<40.0	<40.0	<40.0
Carbofuran	<0.5	<0.5	<0.5	<0.5
Methyl parathion	<0.1	<0.1	<0.1	<0.1
Diazinon	<0.1	<0.1	<0.1	<0.1
Parathion	<0.1	<0.1	<0.1	<0.1
Ordram	<0.5	<0.5	<0.5	<0.5
Bolero	<0.5	<0.5	1.7	<0.5
2,4-D	0.5	<0.25	<0.25	0.5
Dinoseb	<0.25	<0.25	<0.25	<0.25
Propanil	<0.5	<0.5	<0.5	<0.5
Bentazon	<0.5	<0.5	<0.5	<0.5
Dacthal	<1.0	<0.1	0.15	<0.5
Dicofal	<1.0	<0.1	<0.1	<0.5
Alachlor	<1.0	<0.1	<0.1	<0.5
Captan	<5.0	<0.5	<0.5	<2.5
Carbaryl	<2.0	<2.0	<2.0	<2.0
Propham	<2.0	<2.0	<2.0	<2.0
Methomyl	<2.0	<2.0	<2.0	<2.0
Atrazine	0.29	<0.1	<0.1	0.18
Simazine	<0.1	<0.1	<0.1	<0.1
Glyphosate	<1.0		<1.0	<2.0

Results of Pesticide Analysis
August 19, 1987
Units in ug/l (parts per billion)

Chemical	Barker Slough	Lindsey Slough	Sac Rv @ Mallard Is	Netherlands PP # 1
Dithiocarbamate	<6.0	<6.0	<6.0	<6.0
Paraquat	<20.0	<20.0	<20.0	<20.0
Diquat	<40.0	<40.0	<40.0	<40.0
Atrazine	<0.1	<0.1		<0.1
Simazine	<0.1	<0.1		0.45
Carbofuran	<0.5	<0.5	<0.5	<0.5
Methyl parathion	<0.1	<0.1	<0.1	<0.1
Diazinon	<0.1	<0.1	<0.1	<0.1
Parathion	<0.1	<0.1	<0.1	<0.1
Ordram	<0.5	<0.5		<0.5
Bolero	<0.5	<0.5		<0.5
Dacthal	<0.1	<0.1	<0.1	<0.1
Dicofol	<0.1	<0.1	<0.1	<0.1
Alachlor	<0.1	<0.1	<0.1	<0.1
Captan	<0.5	<0.5	<0.5	<0.5
2,4-D	<0.25	0.35		<0.25
Dinoseb	<0.25	<0.25		<0.25
Propanil	<0.5	<0.5		<0.5
Bentazon	<0.5	<0.5		<0.5
Carbaryl	<2.0	<2.0		<2.0
Propham	<2.0	<2.0		<2.0
Methomyl	<2.0	<2.0		<2.0
Glyphosate				<3.0

Appendix E.

LABORATORY QUALITY CONTROL & ASSURANCE DATA

1○

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
AUGUST 17, 1987.

UNITS IN ug/L (PARTS PER BILLION).

CHEMICAL	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED		% ACCURACY				RPD	
	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
2,4-D	10.	11.4	12.2	114.	122.	1E2	NC	6.8	NC
ALACHLOR	2.	2.1	2.	105.	100.	1E2	NC	4.3	NC
ATRAZINE	2.	1.7	2.	85.	100.	93.0	NC	18.	NC
BENTAZON	2.	0.9	1.3	45.	65.	55.0	NC	36.	NC
ENTAZON	2.	0.9	1.3	45.	65.	55.0	NC	36.	32
CAPTAN	4.	3.9	3.8	98.	95.	96.5	NC	3.1	NC
CARBARYL	50.	42.	42.	84.	84.	84.0	NC	0.	NC
CARBARYL	50.	42.	42.	84.	84.	84.0	102-11	0.	11
DACTHAL	0.5	0.41	0.4	103.	80.	92.0	NC	22.	NC
DIAZINON	20.	19.	18.	95.	90.	92.5	17-118	5.4	21
DICOFOL	4.	4.8	4.6	120.	115.	1E2	NC	4.2	NC
DNBP	10.	12.1	13.	121.	130.	1E2	NC	7.2	NC
M-PARATHION	20.	17.	18.	85.	90.	87.5	35-119	5.7	24
METHOMYL	50.	43.	43.	86.	86.	86.0	NC	0.	NC
METHOMYL	50.	43.	43.	86.	86.	86.0	NC	0.	NC
PARATHION	20.	17.	17.	85.	85.	85.0	19-125	0.	30
PROPANIL	10.	9.6	9.3	96.	93.	94.5	NC	3.1	NC
PROPHAM	50.	49.	50.	98.	100.	99.0	NC	1.	NC
PROPHAM	50.	49.	50.	98.	100.	99.0	NC	1.	NC
SIMAZINE	2.	1.5	1.9	75.	95.	85.0	NC	27.	NC

(TABLE 1)

```
PRINT aug18 SORTED BY Chemical
-ERROR- Report data is incorrect - check the data
-ERROR-  aug18 is an undefined report
PRINT aug18 SORTED BY Chemical
-ERROR- Report data is incorrect - check the data
-ERROR-  aug18 is an undefined report
OUTPUT PRINTER
PRINT aug18 SORTED BY Chemical
-ERROR- Report data is incorrect - check the data
```

CALIFORNIA ANALYTICAL LABORATORY

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
AUGUST 18, 1987.

UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED		% ACCURACY				RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
2,4-D	10.	11.4	12.2	114.	122.	1.2E2	NC	6.8	NC
ALACHLOR	2.	2.1	2.	105.	100.	1.E2	NC	4.9	NC
ATRAZINE	2.	1.7	2.	85.	100.	92.50	NC	16.	NC
BENTAZON	10.	9.57	6.4	95.7	64.	79.90	NC	40.	NC
CAPTAN	4.	3.9	3.8	98.	95.	96.50	NC	3.1	NC
CARBARYL	50.	42.	42.	84.	84.	84.00	NC	0.	NC
DACTHAL	0.5	0.41	0.4	82.	80.	81.00	NC	0.3	NC
DIAZINON	20.	19.	18.	95.	90.	92.50	NC	5.4	NC
DICOFOL	4.	4.8	4.6	120.	115.	1.2E2	NC	4.3	NC
DNBP	10.	12.1	13.	121.	130.	1.3E2	NC	7.2	NC
ETHION	20.	17.	18.	85.	90.	87.50	NC	5.7	NC
METHOMYL	50.	43.	43.	86.	86.	86.00	NC	0.	NC
PARATHION, ETHYL	20.	17.	17.	85.	85.	85.00	55-138	0.	55-13
PROPANIL	10.	9.6	9.3	96.	93.	94.50	NC	3.2	NC
PROPHAM	50.	49.	50.	98.	100.	99.00	NC	1.	NC
SIMAZINE	2.	1.5	1.9	75.	95.	85.00	NC	24.	NC

{ TABLE 2 }

PRINT AUG19 SORTED BY Chemical
-ERROR- Report data is incorrect - check the data
-ERROR- AUG19 is an undefined report
PRINT AUG19 SORTED BY Chemical

CALIFORNIA ANALYTICAL LABORATORY

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
AUGUST 19, 1987.

UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED			% ACCURACY			RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
?,4,5-T	10.	12.1	13.	121.	130.	1.3E2	NC	7.2	NC
_,4,5-TP (SILVEX)	10.	11.4	12.2	114.	122.	1.2E2	72.98	6.8	72.98
ALACHOLR	2.	2.1	2.	105.	100.	1.E2	NC	4.9	NC
BENTAZON	2.	0.9	1.3	45.	65.	55.00	NC	36.	NC
CAPTAN	4.	3.9	3.8	98.	95.	96.50	NC	3.1	NC
DACTHAL	0.5	0.41	0.4	82.	80.	81.00	NC	0.3	NC
DIAZINON	20.	19.	18.	95.	90.	92.50	NC	5.4	NC
DICOFOL	4.	4.8	4.6	120.	115.	1.2E2	NC	4.3	NC
ETHION	20.	17.	18.	85.	90.5	87.50	NC	5.7	NC
PARATHION, ETHYL	20.	17.	17.	85.	85.	85.00	55-138	0.	55-13
PROPANIL	10.	9.6	9.3	96.	93.	94.50	NC	3.2	NC

{ TABLE 3 }
PRINT aug20 SORTED BY Chemical

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES

AUGUST 20, 1987.
UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED		% ACCURACY				RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
2,4-D	10.	11.4	12.2	114.	122.	1E2	NC	6.8	NC
ALACHLOR	2.	2.1	2.	105.	100.	1E2	NC	5.	NC
ATRAZINE	2.	2.4	2.1	120.	105.	1E2	NC	18.	NC
CAPTAN	4.	3.9	3.8	98.	95.	97.0	NC	3.2	NC
CARBARYL	50.	42.	42.	84.	84.	84.0	102-11	0.	11
DACTHAL	0.5	0.41	0.04	103.	80.	92.0	NC	13.	NC
DIAZINON	20.	19.	18.	95.	90.	92.5	17-118	5.4	21
DICOFOL	4.	4.8	4.6	120.	115.	1E2	NC	4.4	NC
DNBP	10.	12.1	13.	121.	130.	1E2	NC	7.2	NC
ETHION	20.	17.	18.	85.	90.	87.5	35-119	5.7	24
GLYPHOSATE	6.	5.9	58.	98.	83.	91.0	NC	16.	NC
METHOMYL	50.	43.	43.	86.	86.	86.0	NC	0.	NC
PARATHION	20.	17.	17.	85.	85.	85.0	19-125	0.	30
PROPANIL	10.	96.	93.	96.	93.	95.0	NC	3.1	NC
PROPHAM	50.	49.	50.	98.	100.	99.0	NC	1.	NC
SIMAZINE	2.	2.5	2.2	125.	110.	1E2	NC	13.	NC

{ TABLE 4 }
PRINT aug26 SORTED BY Chemical

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
AUGUST 26, 1987.

UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED		% ACCURACY				RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
BENTAZON	2.	1.3	1.7	65.	85.	75.0	NC	27.	NC
BOLERO	10.	7.27	7.74	72.7	77.4	75.1	NC	6.3	NC
ORDRAM	10.	6.73	6.83	67.3	68.3	67.8	NC	1.5	NC

. TABLE 5 >
PRINT sept16 SORTED BY Chemical

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
SEPTEMBER 16, 1987.

UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED			% ACCURACY			RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
2,4-D	10.	10.	9.6	100.	96.	98.0	NC	4.1	NC
ALACHLOR	2.	1.6	1.5	80.	75.	78.0	NC	6.4	NC
ATRAZINE	2.	1.7	3.73	85.	186.	1E2	NC	75.	NC
BENTAZON	10.	9.3	6.2	93.	62.	78.0	NC	40.	NC
CAPTAN	4.	0.75	0.79	19.	20.	20.0	NC	5.	NC
CARBARYL	50.	43.	46.	86.	92.	84.0	102-11	7.1	11
CARBOFURAN	100.	144.	102.	144.	102.	1E2	NC	34.	NC
DACTHAL	0.5	0.4	0.39	80.	78.	79.0	NC	2.5	NC
DIAZINON	20.	23.3	14.5	117.	72.5	94.5	NC	47.	NC
DICOFOL	4.	3.	3.3	75.	85.	79.0	NC	10.	NC
DNBP	10.	11.7	10.8	117.	108.	1E2	NC	8.	NC
GLYPHOSATE	6.	5.7	5.6	95.	93.	94.0	NC	2.1	NC
METHYL PARATHION	20.	22.5	14.9	113.	74.5	93.5	NC	41.	NC
MOLINATE	100.	134.	79.3	134.	79.3	1E2	NC	51.	NC
PARATHION	20.	22.2	14.6	113.	73.5	92.8	NC	43.	NC
PROPANIL	10.	7.2	6.7	72.	67.	70.0	NC	7.1	NC
SIMAZINE	2.	1.63	3.88	81.5	194.	1E2	NC	82.	NC
THIOBENCARB	100.	119.	86.6	119.	86.6	1E2	NC	32.	NC

{ TABLE 6 }

```
PRINT sept17 SORTED BY Chemical
-ERROR- Report data is incorrect - check the data
-ERROR-  sept17 is an undefined report
PRINT sept17 SORTED BY Chemical
```

CALIFORNIA ANALYTICAL LABORATORY

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
SEPTEMBER 17, 1987.

UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED		% ACCURACY				RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
2,4-D	10.	10.	9.6	100.	96.	98.00	NC	4.1	NC
LCHLOR	2.	1.6	1.5	80.	75.	78.00	NC	6.4	NC
BENTAZON	10.	9.3	6.2	93.	62.	78.00	NC	40.	NC
CAPTAN	4.	0.75	0.79	19.	20.	20.00	NC	4.7	NC
CARBARYL	50.	43.	46.	86.	92.	84.00	102-11	7.1	102-1
CARBOFURAN	100.	144.	102.	144.	102.	1.2E2	NC	34.	NC
DACTHAL	0.5	0.4	0.39	80.	78.	79.00	NC	2.5	NC
DIAZINON	20.	23.3	14.5	117.	72.7	94.50	NC	47.	NC
DICOFOL	4.	4.3	4.1	108.	103.	1.1E2	NC	4.7	NC
DNBP	10.	11.7	10.8	117.	108.	1.1E2	NC	8.	NC
GLYPHOSATE	6.	5.7	5.6	95.	93.	94.00	NC	2.1	NC
METHYL PARATHION	20.	22.5	14.9	113.	74.5	9.00	-0-	-0-	-0-
MOLINATE	100.	134.	79.3	134.	79.3	1.1E2	NC	51.	NC
PARATHION	20.	22.5	14.6	113.	73.	92.80	NC	43.	NC
PROPANIL	10.	7.2	9.5	72.	95.	84.00	NC	28.	NC
THIOBENCARB	100.	119.	86.6	119.	86.6	1.E2	NC	32.	NC

{ TABLE 7 }

PRINT sept18 SORTED BY Chemical

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
SEPTEMBER 18, 1987.

UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED		% ACCURACY				RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
2,4-D	5.	4.7	5.	94.	100.	97.0	NC	6.2	NC
ALACHLOR	2.	1.6	1.5	80.	75.	78.0	NC	6.4	NC
ATRAZINE	2.	1.7	3.73	85.	186.	1E2	NC	75.	NC
BENTAZON	10.	9.[illegible]	6.2	93.	62.	78.0	NC	40.	NC
CAPTAN	4.	0.7[illegible]	0.79	19.	20.	1E2	NC	5.	NC
CARBARYL	50.	43.	46.	86.	92.	84.0	102-11	7.1	11
CARBOFURAN	100.	144.	102.	144.	102.	1E2	NC	34.	NC
DACTNAL	0.5	0.4	0.39	80.	78.	79.0	NC	2.5	NC
DIAZINON	20.	23.3	14.5	117.	72.5	94.5	17-118	47.	21
DICOFOL	4.	4.3	4.1	108.	103.	1E2	NC	4.7	NC
DNBP	5.	5.9	5.82	118.	116.	1E2	NC	1.7	NC
METHYL PARATHION	20.	225.	14.9	113.	74.5	93.5	NC	41.	NC
MOLINATE	100.	134.	79.3	134.	79.3	1E2	NC	51.	NC
PARATHION, ETHYL	20.	22.2	14.6	113.	73.	92.8	19-125	43.	30
PROPANIL	10.	7.2	9.5	72.	95.	84.0	NC	28.	NC
SIMAZINE	2.	1.63	3.88	81.5	194.	1E2	NC	82.	NC
THIOBENCARB	100.	119.	86.6	119.	86.6	1E2	NC	32.	NC

{ TABLE 8 }
PRINT Finalrpt SORTED BY Chemical

QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLES
OCTOBER 20, 1987.

UNITS IN ug/L (PARTS PER BILLION).

	CONCENTRATION			ACCURACY				PRECISION	
		MEASURED		% ACCURACY				RPD	
CHEMICAL	SPIKE	LCS1	LCS2	LCS1	LCS2	AVG	LIMITS	LCS	LIMIT
2,4-D	2.	4.4	4.9	88.	98.	93.0	NC	11.	NC
ALOCHLOR	2.	1.58	1.76	79.	88.	84.0	NC	11.	NC
ATRAZINE	2.	3.33	2.19	167.	110.	1E2	NC	41.	NC
BENTAZON	10.	8.4	6.1	84.	61.	72.0	NC	32.	NC
CAPTAN	4.	7.3	8.7	182.	218.	2E2	NC	9.8	NC
CARBOFURAN	100.	69.9	77.5	70.	78.	74.0	NC	11.	NC
DACTHAL	0.5	0.38	0.42	76.	84.	80.0	NC	10.	NC
DIAZINON	20.	14.2	13.5	71.	68.	70.0	17-118	4.3	21
DICOFOL S	4.	3.	3.5	75.	88.	82.0	NC	15.	NC
DNBP	5.	5.9	6.6	118.	132.	1E2	NC	11.	NC
METHYL PARATHION	20.	14.9	14.4	75.	72.	74.0	NC	4.1	NC
MOLINATE	100.	47.2	48.8	47.	49.	48.0	NC	4.2	NC
PARATHION	20.	14.9	13.7	75.	69.	72.0	19-125	8.3	30
PROPANIL	10.	7.35	7.78	74.	78.	76.0	NC	5.3	NC
SIMAZINE	2.	3.23	2.08	162.	104.	1E2	NC	44.	NC
THIOBENCARB	100.	56.5	52.1	57.	52.	55.0	NC	9.1	NC

(TABLE 9)

LCS (Laboratory Control Sample) is a well-characterized blank water matrix which is spiked with a certain target parameter and analyzed at approximately 10% of the sample load to establish method-specific control limits.

Accuracy is measured by percent recovery:

$$\frac{\text{(measured concentration)}}{\text{(actual concentration)}} * 100$$

Control limits for percent recovery are based on the average.

Precision is measured by RPD (Relative Percent Difference) by using the recovery rated from duplicate tests:

$$\frac{(\%\ LCS1 - \%\ LCS2\ )}{(\%\ LCS1 - \%\ LCS2\ )\ /\ 2)} * 100$$

Control limits for precision (RPD) range from zero to the average.

195

Appendix F.

CLIFTON COURT GATE OPERATING CRITERIA

[redacted]

Clifton Court Gate Operating Criteria

A. The Department of Water Resources and South Delta Water Agency assume that the following information is correct until better data are available:

1. Middle River water levels are most adversely affected by spring tides, such as shown in Attachment B.1 (May 24-26), and meterological conditions that cause low mean half-tides.

2. Tom Paine Slough water levels are most adversely affected by tides that have nearly equal high tide magnitudes along with large differences in the low tides, such as shown in Attachment B.1 (May 14-16).

B. The Department of Water Resources and South Delta Agency agree to the following Clifton Court gate operating criteria.

1. To reduce or eliminate the State Water Project water level impacts in Middle River, the Clifton Court intake gates are to be closed for the period of time starting 2 hours before LOW-LOW tide and ending at least 1 hour after LOW-LOW tide for all daily tidal cycles, and when the Clifton Court intake would cause the HIGH-LOW tide water level at tide gage Station B95500, Middle River at Bordon Highway to be drawn below 0.0 msl. Furthermore, the Clifton Court diversion rate starting 1 hour after LOW-LOW tide shall not cause the tide level at that station to recede below 0.4 feet above the prior LOW-LOW tide level.

2. To reduce or eliminate the State Water Project water level impacts in Tom Paine Slough, the Clifton Court intake gates are to be opened only during the following two periods:

   a. Starting one hour after LOW-LOW tide and ending 1 hour before HIGH-LOW tide.

   b. Starting one hour after HIGH-HIGH tide and ending 2 hours before LOW-LOW tide.

3. Items 1 and/or 2 will be relaxed after mitigation dredging and facilities are in place, and during combinations of high San Joaquin River flows, high mean tide levels, and/or low seasonal agricultural diversion rates, such that the degree of relaxation will not result in inadequate pump draft in Middle River and Tom Paine Slough caused by State Water Project operations.

4. SDWA and DWR, through model studies and field testing programs, will work together to develop criteria for the degree of relaxation appropriate under varying conditions of river flow, driving tide and irrigation diversions.