RECOMMENDATIONS FOR SALINITY STANDARDS TO MAINTAIN THE WETLANDS OF SUISUN MARSH

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1. INTRODUCTION

Suisun Marsh is the largest brackish estuarine marsh remaining on the Pacific Coast and is a major wintering area for waterfowl using the Pacific Flyway. The nature and use of the marsh is affected by increasing salinity caused by the reductions of fresh water outflows from the Delta. These outflows have been significantly reduced by upstream water development.

Under California's Suisun Marsh Preservation Act of 1974, the Bay Conservation and Development Commission (BCDC) has the responsibility for overseeing the management and protection of Suisun Marsh. In 1978, the State Water Resources Control Board, which has responsibility for regulating salinity in Suisun Bay, adopted flow and salinity standards intended to protect waterfowl use of the managed diked brackish wetlands of Suisun Marsh. These were specified in Provision 7 and Table II of D1485 (see Appendix B).

The managed wetlands around Suisun Bay occupy approximately 52,000 acres of the marsh, 44,000 acres of which are operated as duck clubs. Protection of at least 10,000 acres of brackish tidal marsh was not specifically included in D1485.

In the forthcoming Bay-Delta hearings the State Water Resources Control Board will be reviewing salinity standards for protecting the environmental resources of the San Francisco Bay-Delta Estuary.

The first hearing concerning environmental resources is one on wildlife uses of the estuary. Protection of Suisun Marsh wildlife habitat is one of the most important wildlife management issues.

This report for BCDC reviews management goals and salinity requirements for Suisun Marsh based on information developed since 1978. It makes recommendations for modifications to the salinity standards to protect both the managed and natural brackish wetlands of Suisun Marsh and adjacent areas. Although this report is limited to addressing the salinity requirements of Suisun Marsh it should be noted that these standards, if enforced, could have major beneficial impacts on the aquatic resources of San Francisco Bay. Recommendations for protecting aquatic resources Bay will be made as part of a subsequent report for BCDC on salinity standards for San Francisco Bay.

2. CONCLUSIONS

A. The wetlands surrounding Suisun Bay are the largest remaining brackish wetland in Western North America. They are a major wintering ground for waterfowl of the Pacific Flyway, and provide habitat for up to 28% of California's waterfowl. The 44,000 acres of wetland managed as duck clubs and the 10,000 acres of brackish tidal marsh and adjacent uplands provide habitat for 29 rare and endangered species, including clapper rail, black rail, salt marsh harvest mouse, Suisun shrew, and Sacramento perch.

B. In the last 70 years, increasing water diversions have caused significant increases in salinity in Suisun Bay. High-tide salinities that naturally occurred downstream of Martinez are now experienced in Suisun Bay. Salinities that were typical of Suisun Bay are now experienced upstream at Chipps Island.

C. The increase in salinity has affected the soil salinity in managed wetlands, resulting in reduced waterfowl food plant production. It has also caused the conversion of the upper portions of brackish tidal marsh to salt marsh, and has resulted in lower productivity of the marsh vegetation.

D. With the future increase in water diversions projected by the Department of Water Resources (DWR), average salinities are expected to increase further, resulting in most of

Suisun Bay experiencing salinities that formerly only occurred downstream of Martinez.

E. These changes will cause a further shift from brackish tidal to salt marsh, adversely affecting waterfowl and endangered species habitat.

F. The salinity standards contained in the State Water Resources Control Board's Decision 1485, as originally enacted in 1978, would, if enforced, provide significant protection for the managed wetlands of Suisun Marsh against the effect of increasing salinity due to increasing diversions upstream. It would also have provided incidental protection to about 40% of the tidal brackish marsh. About 6,000 acres of tidal brackish marsh would not have been protected.

G. There are two methods for meeting D1485 salinity standards: maintaining sufficient freshwater outflow from the Delta, and modifying the hydraulic circulation within the Marsh slough channels.

H. Under DWR's plan of protection for Suisun Marsh facilities were originally designed to modify circulation within the Marsh so as to meet the D1485 standards and to be completed by 1984 when the full salinity standards came into effect.

I. Subsequently, it was determined that the facilities could not meet all of the standards as required by D1485. In addition, the facilities are now expected to be completed over the period 1988 to 1997.

J. Mitigation for increasing salinities on up to 839 acres of managed wetland is contemplated in DWR's plan for protecting Suisun Marsh by creating 455 acres of new managed wetland. This has not yet been carried out; however, the Department of Fish and Game anticipates initial mitigation work to start in July 1987. There are no plans for mitigating for the conversion of natural brackish tidal marsh to saltmarsh.

K. In 1985, a dry year, D1485 standards were exceeded in Suisun Marsh.

L. In December 1985, the State Water Resources Control Board modified the provisions of D1485, delaying enforcement of full salinity standards to 1997, and dropping the standard that protected up to about 4,000 acres of managed wetland in the western part of the marsh and provided incidental protection to about 1,000 acres of natural tidal brackish marsh.

M. If the State Water Resources Control Board were to adopt the standards specified in the recent Four Agency Suisun Marsh Preservation Agreement dated March 25, 1987, there would be a further weakening of protection for both the managed and tidal wetlands of Suisun Marsh.

3. RECOMMENDATIONS

A. In order to fully protect the managed wetlands of Suisun Marsh, the original D1485 salinity standards should be reinstated effective immediately and enforced.

B. In order to protect the natural brackish tidal marsh around Suisun Bay against conversion to saltmarsh, salinity standards should be set as recommended in this report and enforced.

C. The State Board should reinstate its annual reporting of compliance with D1485.

D. Technical reports should be made available to the public demonstrating how the Suisun Marsh Protection facilities will meet D1485 standards.

4. DESCRIPTION OF SUISUN MARSH WETLANDS

A. General

The wetlands surrounding Suisun Bay comprise the largest contiguous brackish water wetland system in the nation. The wetlands consist of a unique diversity of habitats, including tidal wetlands, sloughs, and bays; managed diked wetlands; unmanaged seasonal wetlands; freshwater and riparian systems; and lowland grasslands. This diversity is dependent upon a balance between the flow of freshwater from the Sacramento and San Joaquin and the tidally influenced flow from the Pacific Ocean. As a result, water salinities generally range from near freshwater conditions to 10 ppt (parts per thousand) [note: seawater = 33 ppt]. The seasonal fluctuations in salinity, the duration of low salinity periods, and the daily variation in salinity levels, all affect the type of plant and animal communities which have become established in Suisun Marsh.

The value of the marsh to wildlife, particularly waterfowl, has been well established through numerous studies and summaries (Skinner 1962, George et al. 1965, Miller et al. 1975, Harvey et al. 1977, Blanchfield 1976, Josselyn 1983). It is particularly important as a wintering ground for waterfowl using the Pacific flyway. A great deal of information on waterfowl abundance and species diversity has been collected by the Department of Fish and Game and the US Fish and Wildlife Service (see summary in Rumholtz 1979). The diked wetlands provide substantial waterfowl breeding habitat, and additional breeding habitat is also provided by the tidal brackish wetland areas (Anderson 1960). Numerous fish and benthic invertebrates utilize the small tidal sloughs and mudflats of the tidal marsh, including many anadromous species such as salmon and striped bass. The marsh and surrounding uplands also provide habitat to 9 rare or endangered plant species and 20 rare or endangered animals (Blanchfield 1976). These species occupy both the managed and unmanaged marshes. However, management methods within the diked wetlands such as mowing, discing, and burning can be detrimental to the provision of endangered species habitat (Waters 1984) and the tidal marshes may provide refuge for a number of species. Due to the number of diverse habitats in close proximity and the high utilization by fish and wildlife, Suisun Marsh must be considered one of California's, if not the nation's, most significant wildlife areas.

B. Managed Diked Wetlands

Suisun Marsh is actually a combination of both managed and natural wetland habitats. The managed wetlands occur within diked lands (formerly tidal wetlands that were presumably similar to the unmanaged wetlands within Suisun Marsh today) that were first used for pasture and agricultural uses in the early part of the 20th century. As the land drainage was poor and salt levels in the soil unsuitable for most crops, the diked lands were gradually converted to lands managed for duck hunting.

The managed wetlands consist of a variety of vegetative communities ranging from salt-tolerant pickleweed species to freshwater plants such as tules and cattails (Table 1). Although there is considerable overlap in species composition, the majority of species which dominate within the managed wetlands are more tolerant of saline conditions compared to the dominant species within the unmanaged tidal wetlands (Harvey et al. 1977).

The diversity and productivity of wetland plants within the diked wetlands are closely tied to the duration of flooding and the salinity of applied water. Alkali bulrush (Scirpus robustus) is one of the most important species from a waterfowl management perspective. Other species such as fat-hen, tules, brass-buttons, and watergrass are also encouraged, depending upon the specific goals of the wildlife managers. Rollins (1981) described the techniques for water management within diked areas to encourage various waterfowl food species. In general, the management plans consist of winter ponding (to attract waterfowl to open water areas), spring draining and flooding cycles (to leach salts from the soil and initiate wetland plant growth), and summer draining (to reduce mosquito problems). As the water evaporates from the soil during the summer, salts brought in during the winter and spring cycles concentrate in the surface layers. During dry periods, or when water salinities of the applied water during the spring are high, freshwater and brackish plants can be replaced by more salt-tolerant species such as pickleweed. In general, pickleweed is an undesirable species, as it does not provide suitable forage for most waterfowl. Invasion by pickleweed occurred during the drought period of 1976-77, when pickleweed increased 38% over the 1973 acreage (Wernette 1985). Between 1978 and 1981, areas covered by pickleweed have returned to 1973 levels. However, as the period 1978 to 1981 was wetter than average, the long-term trend in vegetation types is unclear.

C. Brackish Tidal Wetlands

The unmanaged tidal marshes within Suisun Marsh are also very extensive. For the most part, these wetland areas consist of tules and cattails, with higher elevation wetlands consisting of pickleweed and saltgrass. Harvey et al (1977) noted the greater occurrence of riparian species such as willow and alder in the unmanaged marshes on the south shore of Suisun Bay compared to managed wetlands. In general, the tidal marshes of Suisun Bay tend to be dominated by species which are less salt tolerant than those found in the managed wetlands which is attributable to the salt buildup during the summer drainage period in the managed wetlands.

The unmanaged wetlands are generally scattered throughout Suisun Marsh as remnant wetlands along sloughs and channels (see Figure 1). However, a few areas such as the mid-Bay islands, the southern edge wetlands between Pittsburg and Martinez, the Peytonia and Nurse Slough wetlands, and the southern portion of Joice Island form extensive brackish tidal marshes. The tidal wetlands to the south of Suisun Bay have frequently been ignored in previous studies because they are not included within the legal boundary of Suisun Marsh as defined in the Suisun Marsh Preservation Act of 1974. However, these wetlands provide the same fish and wildlife habitat requirements as those within the legal boundary and require similar salinities in order to maintain the brackish marsh habitat.

The total acreage of unmanaged tidal wetlands in Suisun Marsh has previously been stated as 6,880 acres by the State Water Resources Control Board (1978). A delineation of wetlands by the US Fish and Wildlife Service from aerial photographs taken in 1985 and recently verified by aerial reconnaissance indicate that there are at least 10,000 acres of brackish water tidal wetlands between Collinsville and the Benicia Bridge (Interstate 680). In some areas, levees have partially failed so that formerly diked areas are now infrequently flooded during monthly higher high tides. The tidal wetlands bordering the southern portion of Suisun Bay total approximately 5,000 acres. This may account for most of the difference between the FWS estimate and the SWRCB, as the latter estimate had excluded these important wetland areas.

DWR's Plan of Protection for Suisun Marsh called for the construction of facilities to provide improved water quality for the managed wetlands within Suisun Marsh. By improving salinity throughout the length of Montezuma Slough, certain unmanaged wetlands would also be protected. These wetlands cover approximately 3,200 acres, leaving about 7,000 acres of brackish tidal marsh unprotected by water control facilities. Most of these wetlands border Honker, Grizzly, and Suisun Bays.

The unmanaged tidal marshes provide supplemental breeding habitat for waterfowl and essential habitat for many non-game species. The mudflats bordering these wetlands and the wetlands themselves support diverse population of migratory shorebirds and rookeries for herons and egrets. They also provide refuge for waterfowl during the hunting season. A number of rare and endangered plant and animal species such as clapper rail, black rail, and mudflat quill plant occur primarily in the unmanaged wetlands. These species are dependent upon the type of shelter and habitat provided by intertidal marsh vegetation. The marsh vegetation bordering the sloughs and channels of Suisun Marsh provide an important fish habitat as well, including habitat for juvenile striped bass. Unlike the managed wetlands, the tidal wetlands also contribute to the productivity of the Bay itself through export of organic (detrital) material. Other functional attributes of the tidal wetlands include shoreline stabilization and water quality improvement (nutrient removal). The conversion of natural brackish tidal marsh to saltmarsh will result in lowered wetland productivity (Atwater et al., 1979), reduced breeding habitat for waterfowl, and elimination of suitable habitat for many brackish tidal marsh wildlife species (USF&WS 1979).

There is evidence of changes in vegetation composition due to increasing salinity in the tidal wetlands of Suisun Marsh. Cordgrass, a salt marsh species formerly not encountered in

Suisun Bay, is now established at the western end of the Bay by the Benicia Bridge (USF&WS 1979). Significant areas of the higher elevation portions of the marsh plain, the areas that are most sensitive to increases in salinity at high tide, are now dominated by pickleweed in the tidal marshes.

The overall changes in high tide salinity in Suisun Bay due to salt water intrusion are summarized in Table 2 and are also illustrated in Figure 2. Table 2 is derived from the calculated frequency distribution of monthly salinities, using DWR's computer program DELSTAT. The results of these calculations are shown in Appendix A as plots of salinity versus percent of the years that particular salinity is exceeded. These plots illustrate the effect of water diversion for three water development scenarios as described in Williams & Fishbain 1987. Mean tide salinities are converted to higher high tide salinities using the equations contained in DWR's computer program SALDIF II. The higher high tide salinities are of greatest significance in assessing impacts on natural tidal marshes, as most of the marsh plain area is at about the mean higher high water elevation.

The plots show that there has already been a significant increase in salinity in Suisun Bay, with mean annual salinities that naturally used to occur at Martinez now moving upstream into Suisun Bay, and Suisun salinities being experienced at Chipps Island. With future increases in water diversions, assuming D1485 stays in effect, there will be a further increase in salinity, with most of Suisun Bay experiencing salinities that naturally only occurred downstream of Martinez.

5. SALINITY REQUIREMENTS

Since the important work completed by Mall (1969) on the relationships between soil salinity and waterfowl food plants, the State Department of Fish and Game and private duck clubs have sought to develop management methods to reduce salt build-up in the diked wetlands of Suisun Marsh. The primary means to achieve salinity objectives within the diked wetlands is rapid flushing of the duck ponds during the late winter and spring (Feb. through May) to leach accumulated salts from the soil (Rollins 1973). Thus, spring salinities (February to May) are critical to the management of diked wetlands.

Salinity not only affects the types of species that will grow within the marsh, but their productivity as well. Mall (1969) observed that maximum seed production in alkali bulrush occurred when soil salinities during May were between 6 and 10 ppt. Other marsh plants show similar relationships with low spring salinities and greater production of either biomass or seed production.

In general, the species found associated with the unmanaged wetlands are less tolerant to salinity then those managed for within the diked wetlands (Table 3). Though more prevalent in brackish water wetlands, alkali bulrush can occur in association with more saline species such as cordgrass and pickleweed in the lower reaches of the estuary (Atwater et al. 1979, Pearcy and Ustin 1984). On the other hand, tules and cattails (the dominants within unmanaged wetlands) are far less tolerant to higher salinity and tend to occur more commonly and exhibit greater productivity in the freshwater delta. Higher salinities (on the order of 5 ppt) have been observed within the diked wetlands compared to Suisun Bay during the same time of year (Warner et al. 1971) suggesting that diked wetland species are more tolerant of these salinities compared to the species within the unmanaged wetlands. It is important to note, however, that the salinity standards and mitigation measures (e.g. Montezuma Slough tidal pump gate and the western marsh water distribution system) are primarily based on water quality needs for the managed wetlands, not the tidal marshes.

There has been only one study of the potential change in community structure of a brackish water marsh in San Francisco Bay exposed to higher salinity conditions. Atwater et al. (1979) observed a marked decline in the number and growth of tules (*Scirpus* spp.) following the drought years of 1976 to 1977 at Southampton Marsh near Benicia (Figure 4). Spring salinities during the months of February to May were 15 to 17 ppt compared to a 25 year average of 5 to 8 ppt. In addition to the decline observed in the tules at Benicia during the drought period of 1976-77, cordgrass, a salt marsh species invaded the Southampton Marsh. Since that time, cordgrass has extended as far inland as the Benicia bridge despite the return of normal waterflow. Thus, relatively short periods of reduced flow (in this case, two years) can have long lasting effects on the composition of the intertidal plant community. Even salinity levels which do not dramatically shift the plant community structure can have an impact on plant productivity and distribution. Decreased productivity occurs in most tidal marsh species as salinity increases (Pearcy and Ustin, 1984). In addition, tules are less able to tolerate submergence as salinity increases and, therefore, their intertidal distributional range is reduced (Atwater, et al., 1979; Deschenes and Serodes, 1985). This reduction in intertidal distribution can have a marked effect on fish habitat since many juvenile fish move into the marsh vegetation during high tide. It is likely the intermediate conditions will also affect the community, especially through the reduction in productivity and subsequently plant cover and food for fish and wildlife.

The primary salinity standards for Suisun Marsh adopted in Decision 1485 were based on the report by Rollins (1973) which recommended applied water salinities to achieve 90 percent maximum alkali bulrush production and 60 percent seed germination. These standards require the provision of water having salinity ranging between 5 to 8 ppt or less during the period of January to May, and between 10 to 12 ppt or less during October to December. These salinities were to be provided throughout Suisun Marsh at points of water intakes to the various managed wetland systems.

No standards have been set for unmanaged wetlands, particularly those bordering the southern edge of Suisun Marsh which comprise over 50% of the tidal marsh in Suisun Bay.

Because of the difficulty in providing water supply structures to the mid-Bay islands that contain managed wetlands, mitigation measures have been proposed by DWR, but these measures would account for only 455 acres (an additional 438 acres of mitigation must be provided for wetland loss associated with the construction of facilities). In addition, mitigation measures were developed to provide habitat for the salt marsh harvest mouse, an endangered species, due to the activities of duck clubs to remove pickleweed from their property (through water management, mowing, and discing). However, no mitigation measures have been adopted for other endangered species associated with the unmanaged marshes that may be affected by reduced freshwater flows.

A deficiency period has been proposed to allow DWR and USBR "operational flexibility" so that they can export more water from the Delta during dry or critical years. The deficiency period may occur under three conditions: as a critical year following a dry or critical year, a dry year following a year in which the Four Basin Index is less than 11.35, or the second consecutive dry year. The Department of Fish and Game has recognized that significant reduction in alkali bulrush will occur in the western Marsh under these conditions. It is likely that more significant changes would occur in the tidal wetlands as these salinities would be similar to those observed by Atwater. Deficiency standards proposed during the months of January to May would be similar to those observed by Atwater et al (1979) which had detrimental effects on brackish vegetation in Southampton Marsh.

6. EVALUATION OF EXISTING SALINITY STANDARDS

A. D1485 Suisun Marsh Standards

In 1978, the State Board established both interim and permanent standards to protect the managed wetlands of Suisun Marsh under section 7 and Table II of D1485 (See Appendix B). The purpose of these standards was to ensure that water in the slough channels within the marsh remained fresh enough during the winter and spring to allow for flushing of salts from the duck clubs to support alkali bulrush, an important food source for waterfowl.

The State Board anticipated that increasing diversions from the Delta would cause higher soil salinities within the managed portions of the Marsh, resulting in the loss of brackish vegetation desirable to waterfowl. Accordingly, the Department of Water Resources and Bureau of Reclamation were instructed to develop a Plan of Protection for Suisun Marsh that would include physical facilities which would alter the hydraulics of the marsh to prevent increases in salinity and maintain the marsh as brackish wetlands.

The State Board originally anticipated that these would be completed by January 1982. However at the request of DWR this deadline, specified in D1485, was extended to October 1, 1984 (p.V-11 EIR appendix).

After October 1, 1984, permanent fixed salinity standards were to be enacted at eight locations within Suisun Marsh for the period October to May for all years whether wet, normal or critically dry (see Figure 3).

Until the facilities were completed by October 1, 1984, interim standards were enacted that specified maximum salinities at Chipps Island during the period October to May and minimum Delta outflows in the period January to May (see Appendix B). However, Delta outflows were conditioned on excess water being stored in the flood control reservation of 2 of the 3 major flood control reservoirs in the Sacramento Valley, a condition that rarely occurs in the spring of dry and critical years. The State Board recognized that the interim standards provided only partial protection to the Marsh in dry years (p.VII-4 WQCP) and were less satisfactory than the permanent standards.

It should be noted that the D1485 standards were intended only to maintain the managed wetlands as brackish habitat. Although the USF&WS argued for protection of the natural brackish wetlands from conversion to saltmarsh, they were not included in D1485. Nevertheless, approximately 40% of the 10,000 acres of unmanaged wetlands would have been provided with some incidental protection under the permanent standards that were then adopted.

As part of Plan of Protection, mitigation was proposed for the conversion of up to 839 acres of brackish managed wetland to tidal salt marsh on Islands within Suisun Bay. The mitigation proposed was the establishment of 455 acres of managed waterfront elsewhere in the Marsh. To date, this mitigation has not been implemented; however, the Department of Fish and Game anticipates initial work to start in July 1987.

B. <u>Plan of Protection for Suisun Marsh</u>

To meet the State Board's requirement for a Suisun Marsh Protection Plan, DWR developed a design for altering the tidal circulation within Suisun Marsh so as to decrease salinity. The main feature of this design is a large tide gate at the eastern end of Montezuma Slough that allows fresher water from the Sacramento River to be drawn into the Slough when the tidal current is westward and closes when the tidal current is eastward. This "tidal pumping" can circulate fresher water through Montezuma Slough. Other new distribution channels were proposed to distribute fresher water from Montezuma Slough to individual duck clubs in the marsh. The Roaring River, Goodyear Slough, and Morrow Island distribution facilities have already been completed. A diagram of the protection facilities is shown in Figure 3.

The design basis for the Protection Facilities was a computer simulation of the hydraulics and salinity of Suisun Marsh that was first developed in 1975 by Professor Fischer and subsequently adapted and revised by others over the next 11 years. The purpose of the computer analysis was to simulate the effect of modifications to the hydraulics of the system and to design them in such a way that the D1485 standards were met at all points in the marsh.

Modelling the complexities of the tidal transport and mixing of salinity in an intricate system like Suisun Marsh is difficult and can be very sensitive to small changes in input data. In 1982, when the design of the facilities were largely complete, Philip Williams and Associates reviewed the status of the Suisun Marsh computer model for BCDC and concluded "it has not yet been demonstrated that the facilities can be designed to achieve D1485 water quality standards in Suisun Marsh with a reliable degree of confidence." (Williams, 1982)

After 1982, even though construction of the facilities proceeded, there were increasing problems with the accuracy and reliability of the Suisun Marsh computer model. Finally in 1986 DWR abandoned the use of the Suisun Marsh model, and has since then adapted its Delta models, DELFLO and DELSAL to simulate flows and salinity in the Montezuma Slough.

At present no computer model results have been made available to the public that demonstrate that the Suisun Marsh protection facilities now under construction would be able to meet past or present D1485 standards.

C. Compliance with D1485 salinity standards

Between 1978 and 1984, the interim standards were in effect. This period was unusually wet, and according to the State Board, the interim standards were met.

However, implementation of the Suisun Marsh protection facilities was significantly delayed, with completion of the Montezuma Slough structure now scheduled for 1988 and final completion of all facilities by 1997. On October 1st, 1984, in accordance with D1485, the permanent standards at 8 locations within Suisun Marsh went into effect.

Water year 1985 was a 1 in 5 dry year (which occurs on an average once in five years), and in the spring and fall insufficient Delta outflows were released and the D1485 standards were violated.

D. Modification of D1485

In February 1984, DWR had concluded that its proposed Suisun Marsh Protection facility would not be able to meet the D1485 permanent salinity standards at the mouth of Montezuma and Suisun Sloughs (DWR EIR 1984) and suggested changes in D1485, both to abandon the station at this location, and to relax the standards in the second year of a two year dry period. Such a relaxation was not included in the original D1485.

At the second triennial review of D1485 in October 1984, State Board staff recommended continuing the original standards until the forthcoming Bay-Delta hearings and no action was taken (SWRCB D1485 2nd Triennial Review 1984).

However, in December 1985, after the violation of the standards during 1985 the State Board adopted significant modifications to D1485 as it affected Suisun Marsh (see Appendix C). There were two major changes, both of tend to reduce protection for the managed and natural marsh as compared to the original standards. These changes are:

- Abandonment of standards for the station at the mouth of Montezuma Slough (represented as S36 in the State Board's analysis) (SWRCB, D1485 Water Quality Control Plan 1978). This station is probably the single most important one in the whole system as it ensures low enough salinity at the mouths of the two major sloughs in the western part of the Marsh.

- Delay in enforcing permanent standards within the marsh to a staggered time period varying from 1988 to 1997 and depending on completion of individual components of the facilities.

It is unclear whether the interim standards were reenacted by this modification, and whether Suisun Marsh now has any protection under D1485. However, it appears that in 1986 and 1987, DWR has been operating the State Water Project as if interim standards were in effect.

Water year 1986-87 is approximately a 1-in-20 dry year that occurs on an average once in 20 years, and it appears that the permanent salinity standards within the Marsh whose enactment had been deferred by this modification, were exceeded in 1987.

E. Adequacy of Modified Standards

It is likely that the existing standards are insufficient to protect the managed and natural wetlands of Suisun Marsh for the following reasons:

i) Managed Wetlands

The original design of the Suisun Marsh protection facilities relied on distributing fresher water during dry years from Montezuma Slough into the western part of the marsh through a new Potrero Hills Ditch, though the existing Cut-Off slough and Hunters Cut, and from the mouth of Montezuma Slough into the mouth of Suisun Slough (see Figure 3). Accordingly, the design was originally set up to meet the D1485 standards at S-36, the station at the mouth of Suisun Slough, whose data was also used to represent salinity at the mouth of Montezuma Slough.

That's 4000, not to mention all areas which were judged less important in D1485 when Suisun Marsh all was supposedly to be protected

Abandonment of the Montezuma Slough mouth standard will allow for greater salinities in Suisun Slough and in the western part of Montezuma Slough than were described in D1485 (SWRCB EIR 1978). About 4,000 acres of highly productive areas in the western marsh, such as Joice Island, are adversely affected.

It is also unclear whether, with this change, standards can be met at the other locations in the western part of the marsh (S21, S49, S33, S35 and S42) or whether these stations are adequate to represent salinity throughout the marsh.

The delay in enforcing salinity standards particularly in the western marsh, up to 10 years in the case of the station at S-42, allows for a continued deterioration of conditions in that time.

ii) Brackish Tidal Marsh

Under the original D1485 standards, about 40% of the 10,000 acres of tidal brackish marsh received incidental protection against increasing salinity. With the December 1985 modification to the standards about 30% will receive this incidental protection (see Figure 4). The reduction in the percentage is due to the increased salinity in Montezuma and Suisun Slough caused by abandoning S-36 as a control station.

The remaining area of natural brackish tidal marsh around Suisun Bay will be vulnerable to increased salinity.

F. Four Agency Suisun Marsh Preservation Agreement

In March 1987, the four agencies concerned with managing Suisun Marsh (DWR, Bureau of Reclamation, Department of Fish and Game, and the Suisun Resource Conservation District) signed an agreement concerning construction and management of the Suisun Marsh Protection Facilities. The Suisun Marsh Preservation Agreement proposed a further weakening of D1485 standards by making the standards subordinate to export demands from the Delta. Clause 3b(ii) of the agreement states: "...those facilities constructed pursuant to this Agreement will be operated to minimize water salinities in the Marsh only so far as such operations do not create a need for additional upstream water releases, do not limit exports, do not harm fishery resources, significantly benefit wildlife habitat..."

In addition, the agreement proposed a relaxation of the standards whenever water contractors are taking a deficiency in their "Scheduled Water" delivery.

7. RECOMMENDATIONS FOR SALINITY STANDARDS

A. Managed Wetlands

By establishing salinity control stations within the Marsh and at the western end of Montezuma Slough, that were to be met in all years, the 1978 version of D1485 established a reasonable basis for criteria that would protect the operation of the managed wetlands. These criteria can be met by providing sufficient freshwater outflow from the Delta with the existing system of reservoirs.

The State Water Resources Control Board also determined that these standards could be met by 1984 by constructing the Suisun Marsh Protection facility and thereby avoid the need to provide larger Delta outflows (WQCP, pp. vii-4). This determination was based on evidence presented by the Bureau of Reclamation and DWR. Later, DWR changed its position (p. 47 DWR EIR) that the facilities can meet the standard at the western end of Montezuma Slough -- the control point based on which the facilities were originally designed. In 1985 the State Board modified D1485, dropping the Montezuma Slough standard and extending the period for full compliance to 1997. This weakening of the 1978 standards exposes areas in the western part of Suisun Marsh to higher salinity water as well as adversely affecting the natural wetlands in the area.

At present, no evidence has yet been provided to demonstrate that the Suisun Marsh Protection facilities will be able to meet the modified D1485 standards.

In the face of these uncertainties, the delays and the adverse affects on the western part of the Marsh; in order to protect the value of the managed wetland habitat, it appears prudent to reinstate the original D1485 standards.

These standards will only protect the Suisun Marsh managed wetlands if they are enforced by the State Board. The State Board ceased publishing D1485 compliance reports after 1984. It would be useful for agencies such as BCDC for the publication of these reports to be reinstated.

It would also be useful for DWR to publish a technical report that explains the analysis and computer modeling on which design decisions for the Suisun Marsh Protection facilities are based. This report should analyze the salinities in Suisun Marsh with and without the facilities.

It should be noted that in the event the facilities do not function as intended, the standards can be met by providing sufficient Delta outflow. If this were to occur, there would be significant benefits to the natural tidal wetlands of Suisun Marsh as well as benefits to the whole San Francisco Bay ecosystem. These benefits will be discussed in later portions of the Bay-Delta hearings.

B. Brackish Tidal Marsh

In order to prevent further salinization of the 10,000 acres of natural tidal brackish marsh, the original D1485 salinities standard should be reinstated and new salinity standards enacted at points around Suisun Bay.

Reinstating the original D1485 standards for all years would protect the tidal marsh adjacent to the Montezuma Slough and Suisun Slough as well as areas around Grizzly Bay. This amounts to about 40% of the total (see Figure 1).

New salinity standards at Martinez could protect all the natural brackish tidal marsh around Suisun Bay. These salinity standards would be intended to ensure that high tide salinities in the spring growing season were sufficiently low to allow brackish vegetation to outcompete saltmarsh species on the marsh plain and to ensure that productivity was not impaired.

A recommended standard for average monthly higher high tide surface salinity is shown in Table 4. This is based on the research carried out by Atwater (Atwater et al 1979), which showed that brackish tidal marshes persisted over the period 1950 to 1977 when average monthly salinity values were as indicated in Table 4. Figure 4 shows the seasonal fluctuation in salinity experienced in the natural tidal marsh studied by Atwater. It should be noted that mean tide salinities have been adjusted to mean higher high tide salinities in Table 4, using the conversion equations for Benicia contained in DWR's SALDIF II model.

A relaxation in the salinity standard in February and March appears permissible in a drought year, as, in the natural condition, there could be infrequent salinity increases in these months. However, as can be seen in Appendix A, salinities in April and May were fairly constant in wet and dry years under natural conditions, due to snowmelt runoff. Therefore, a relaxation of the standard in these months would be detrimental to the tidal marsh.

An example of the impact of the proposed standard on the salinity frequency distribution at Martinez for the month of March is shown in Figure 5.

The standards would be maintained by releasing sufficient Delta outflow in the spring. These releases would also have substantial benefits for other parts of the ecosystem of San Francisco Bay which will be discussed at later stages of the Bay-Delta hearings.

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TABLE 1

DOMINANT PLANTS FOUND IN MANAGED AND UNMANAGED WETLANDS OF SUISUN MARSH

(from Atwater et al. 1979 and Wernette 1985)

UNMANAGED TIDAL WETLANDS	MANAGED DIKED WETLANDS
Scirpus acutus	Scirpus robustus
Scirpus californicus	Salicornia virginica
Typha latifolia	Distichlis spicata
Salicornia virginica	Cotula coronopifolia
Jaumea carnosa	Scirpus olneyi

TABLE 2

CHANGES IN HIGHER HIGH TIDE SALINITY IN SUISUN BAY

Station/Month		Monthly Mean Higher High Tide Salinity ppt[1] Median Values: Natural	Existing	Future
Martinez	(Feb.	8	11	15
	(March	7	11	14
	(April	7	14	15
	(May	7	15	17
Port Chicago	(Feb.	3	6	11
	(March	2	6	8
	(April	2	10	12
	(May	2	11	13
S.36	(Feb.	4	8	10
	(March	3	5	7
	(April	3	7	8
	(May	3	8	11
Chipps Island	(Feb.	1	2	4
	(March	<1	2	2
	(April	<1	3	4
	(May	<1	4	5

10 ppt in May is at level which shows elevated mortality for ducklings, but this will be 11!

(1) 1,000 microsiemens EC = 0.67 ppt TDS

TABLE 3

SALINITY REGIMES FOR THE VARIOUS PLANT SPECIES FOUND IN MANAGED AND UNMANAGED WETLANDS OF SUISUN MARSH

SPECIES	SALINITY RANGE	WETLAND TYPE
Salicornia virginica	5-20 ppt	Managed
Distichis spicata	10-17 ppt	Managed
Scirpus robustus	6-17 ppt	Managed
Atriplex patula	5-10 ppt	Managed
Typha angustifolia	3-10 ppt	Unmanaged
Scirpus olneyi	2-10 ppt	Managed
Phragmites australis	0-10 ppt	Unmanaged
Scirpus americanus	0-10 ppt	Unmanaged

From Mall 1969 and Odum et al 1984. Salinity range is defined as the annual range of salinity in which the species is most commonly observed. Many species grow best at the lowest salinities in the range. Wetland type refers to the habitat in which species are most commonly observed, though overlap between wetland types does occur.

TABLE 4

SALINITY STANDARD TO PROTECT
BRACKISH TIDAL MARSHES
AROUND SUISUN BAY

Location	Parameter	Description	Year Type	Values: Month	Values: EC in mmhos	TDS
Martinez (D6); Suisun Slough at Mouth (S36); Port Chicago (D2); Chipps Island (D10)	Electrical conductivity	Monthly average of daily higher high tide values not to exceed the values shown.	All except when unimpaired delta outflow is less than 1 in 10 dry year.	Feb	15	10
				Mar	15	10
			All	Apr	18	12
			All	May	20	13.4

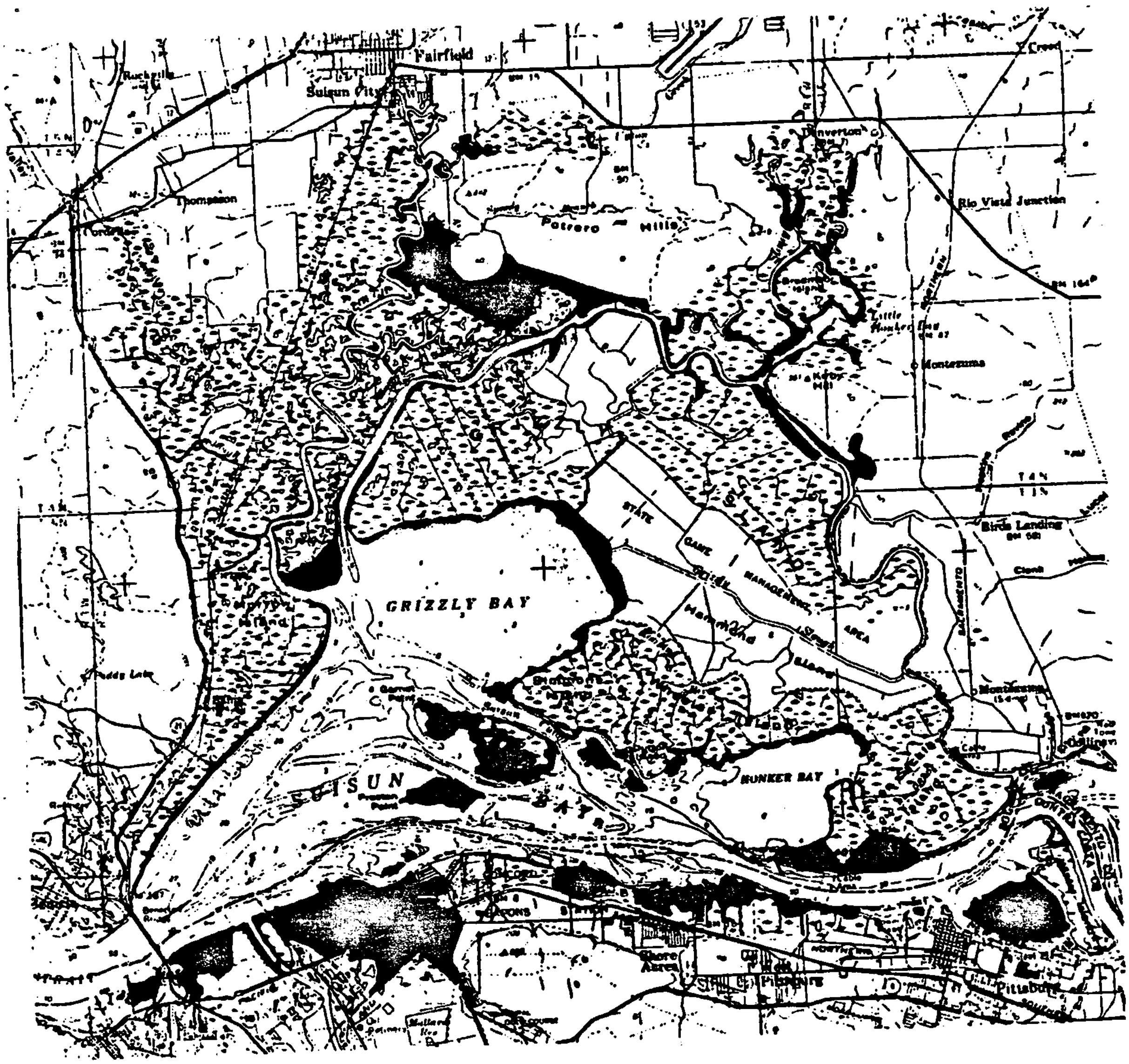


FIGURE 1:

DISTRIBUTION OF BRACKISH TIDAL MARSH IN SUISUN BAY

Philip Williams & Associates
Consultants in Hydrology

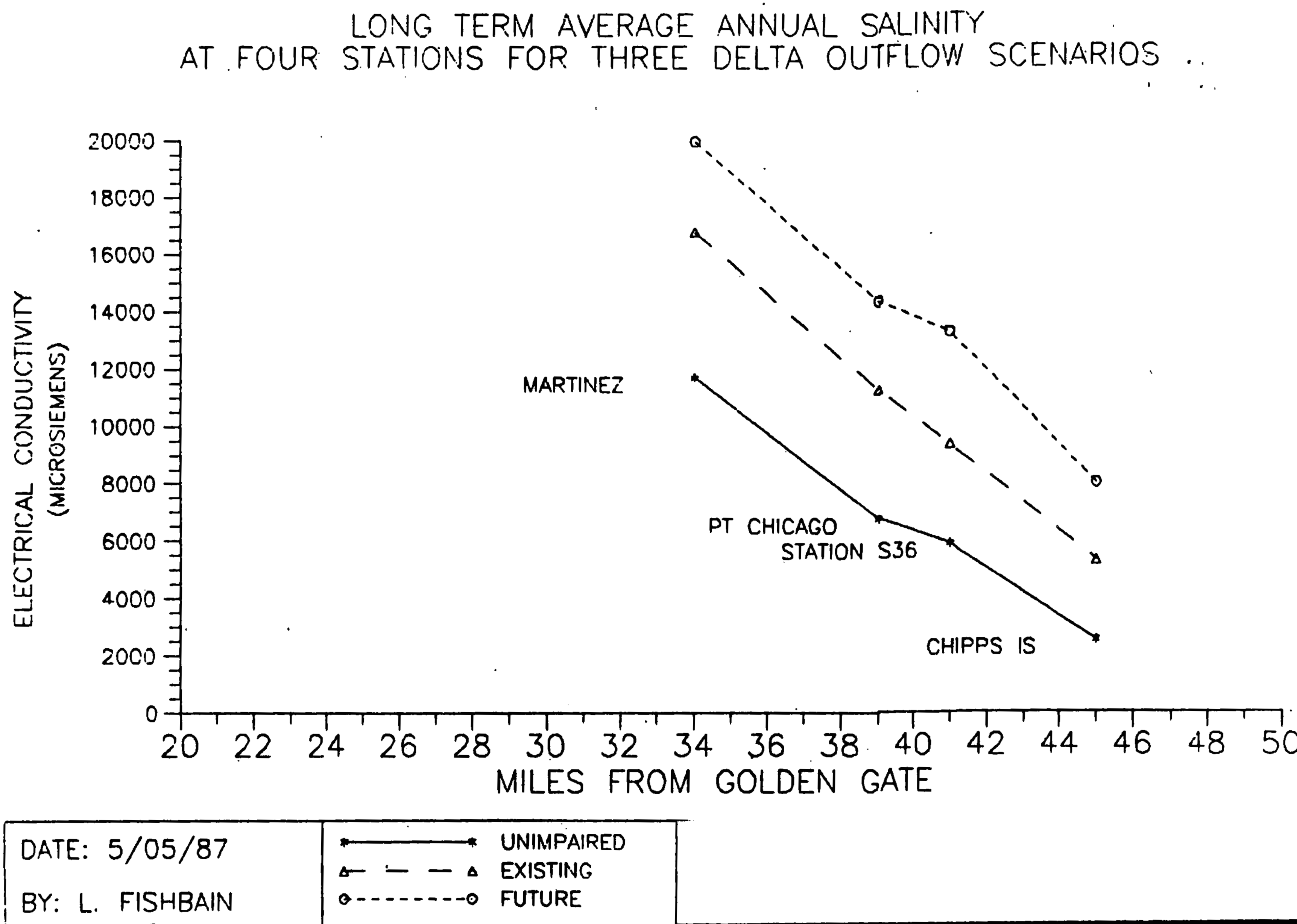


FIGURE 2

(From Williams and Fishbain, 1987)

Philip Williams & Associates
Consultants in Hydrology

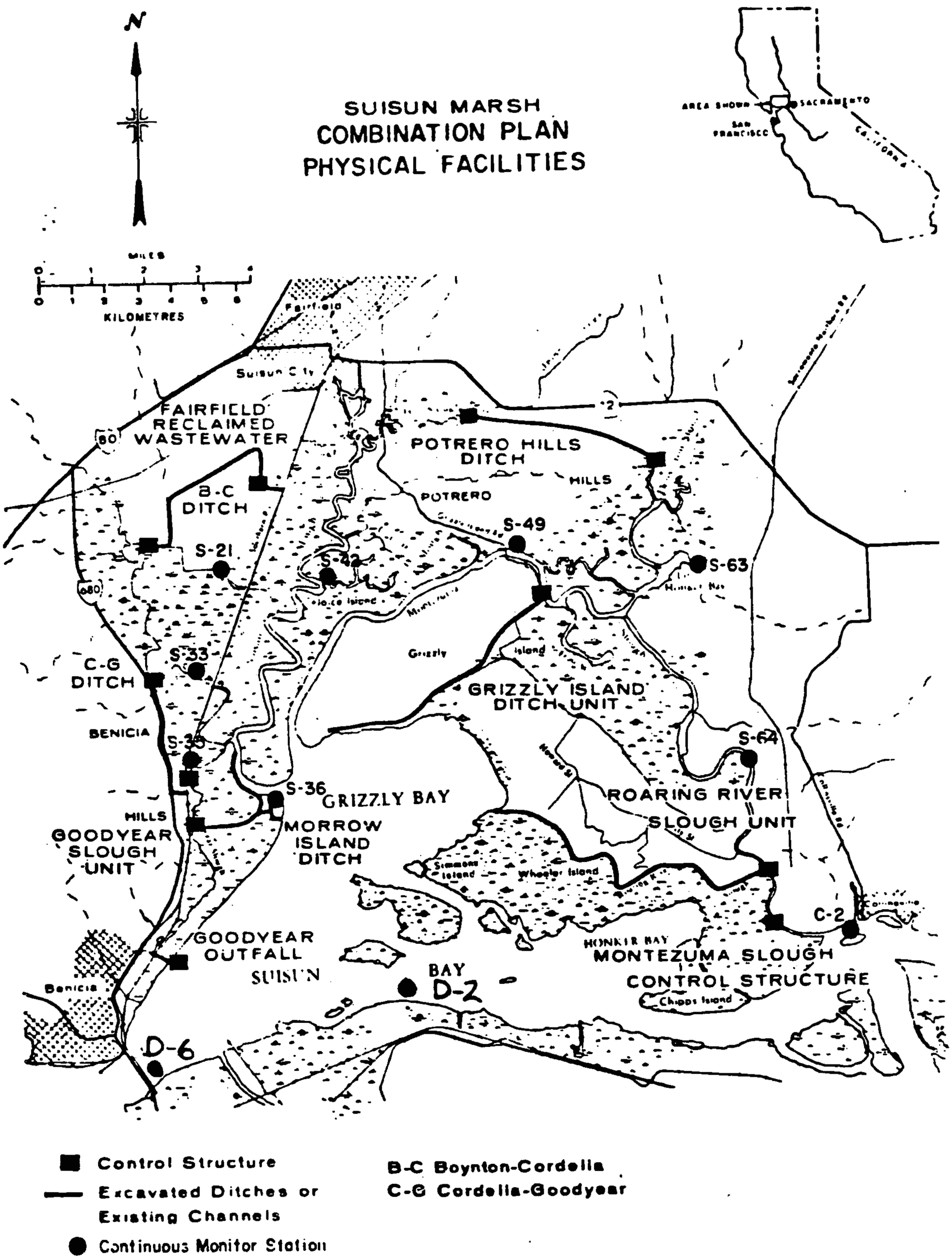
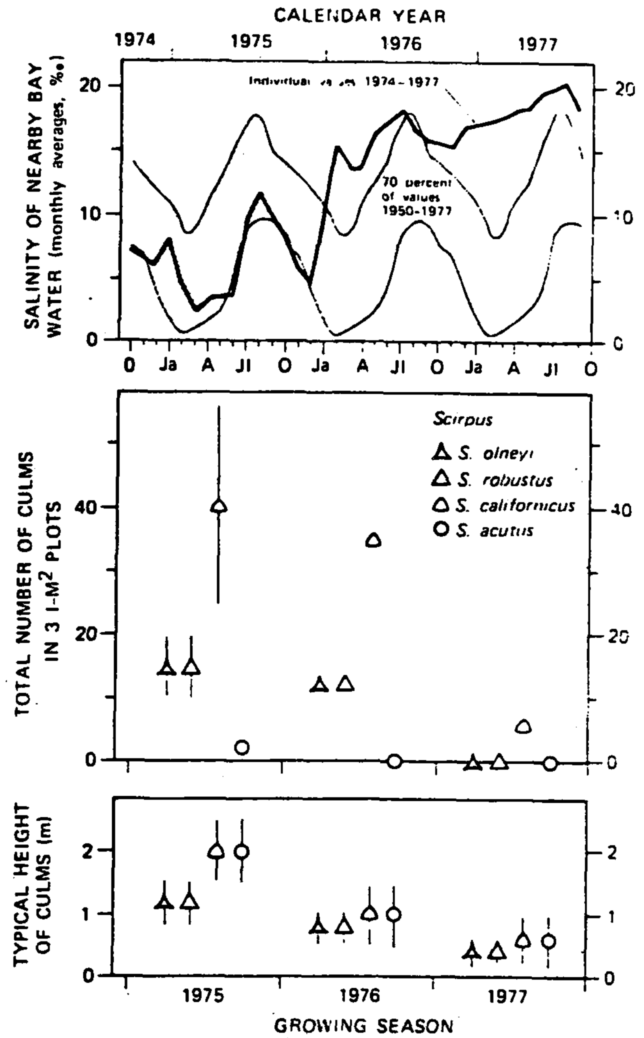


FIGURE 3:

SUISUN MARSH PROTECTION FACILITIES AND D1485 MONITORING STATIONS

Philip Williams & Associates
Consultants in Hydrology



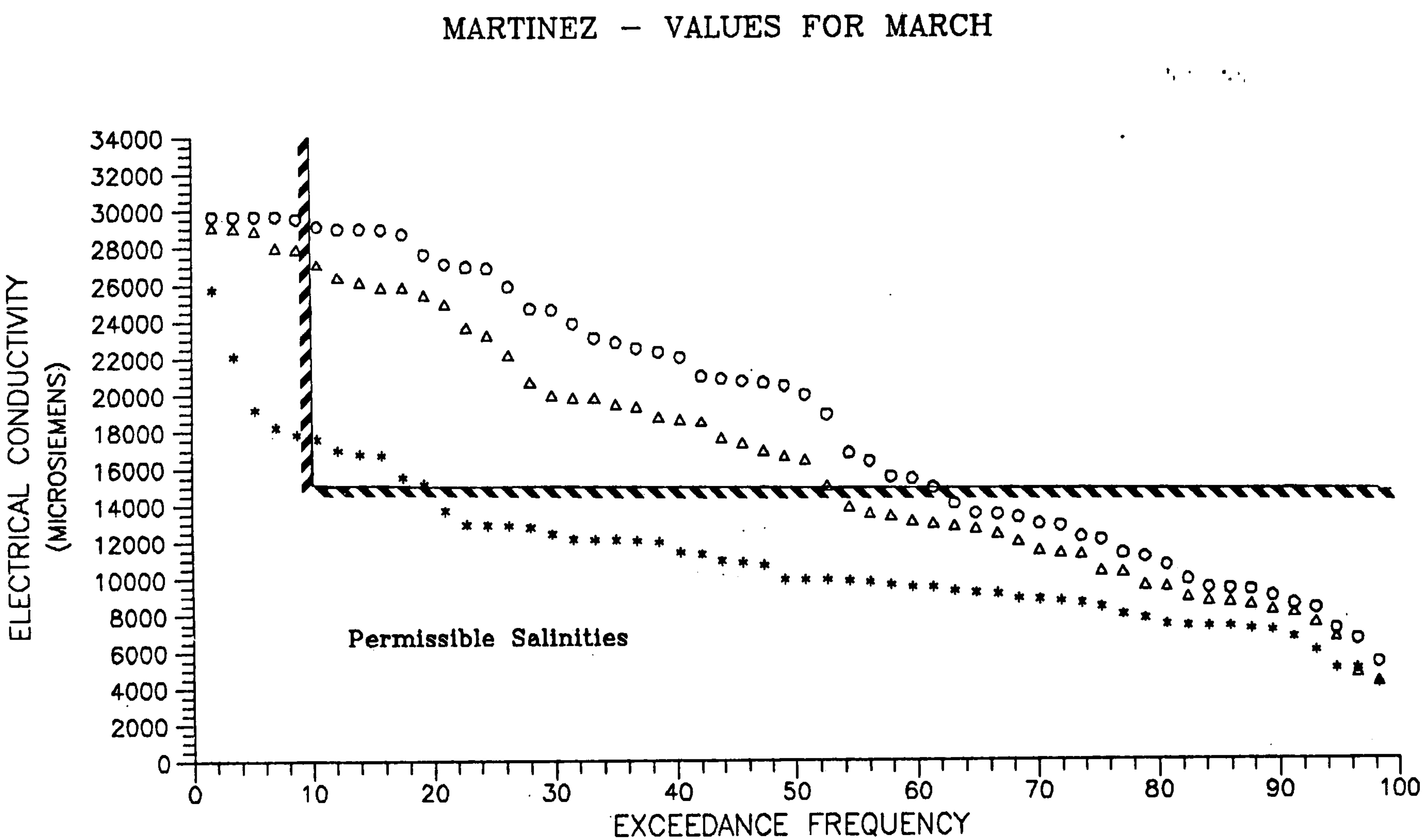
Note: **Decrease in size and abundance of *Scirpus* spp. (bulrushes and tules) bordering Carquinez Strait during the drought of 1976-1977. The plots are located near the leveled transect at Southampton Bay (Fig. 7) at approximate elevations of 0.9 m, 0.4 m, and -0.5 m. Conditions in 1975 are estimated by comparing (qualitatively) living culms (above-ground stems) in plots along the transect in October 1975, with dead culms in September 1976. Measurements and counts of dead culms attempt to exclude those that grew before 1975, but similarities among dead culms of differing vintage result in large uncertainties, particularly for *S. californicus*. Conditions in 1976 and 1977 were determined from measurements and counts of living plants within the plots, excepting heights for 1977, which had to be scaled elsewhere because of the scarcity and absence of *Scirpus* within the plots. Vertical bars approximate the range of observed or estimated values. The top graph shows monthly averages of salinity of near-surface water at the eastern end of Carquinez Strait (USBR station D-6). The shaded area spans 1 SD (approximately 70%) of the monthly averages from October 1974 to September 1977. Data show that Carquinez Strait contained unusually saline water during the winter and spring of 1976 and 1977.**

FIGURE 4:

IMPACT OF SALINITY ON BRACKISH TIDAL MARSH

(From Atwater et al, 1979)

Philip Williams & Associates
Consultants in Hydrology



DATE: 6/10/87	* UNIMPAIRED
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FIGURE 5:

EXAMPLE OF APPLICATION OF SALINITY STANDARD TO PROTECT TIDAL BRACKISH MARSHES IN SUISUN BAY

Philip Williams & Associates
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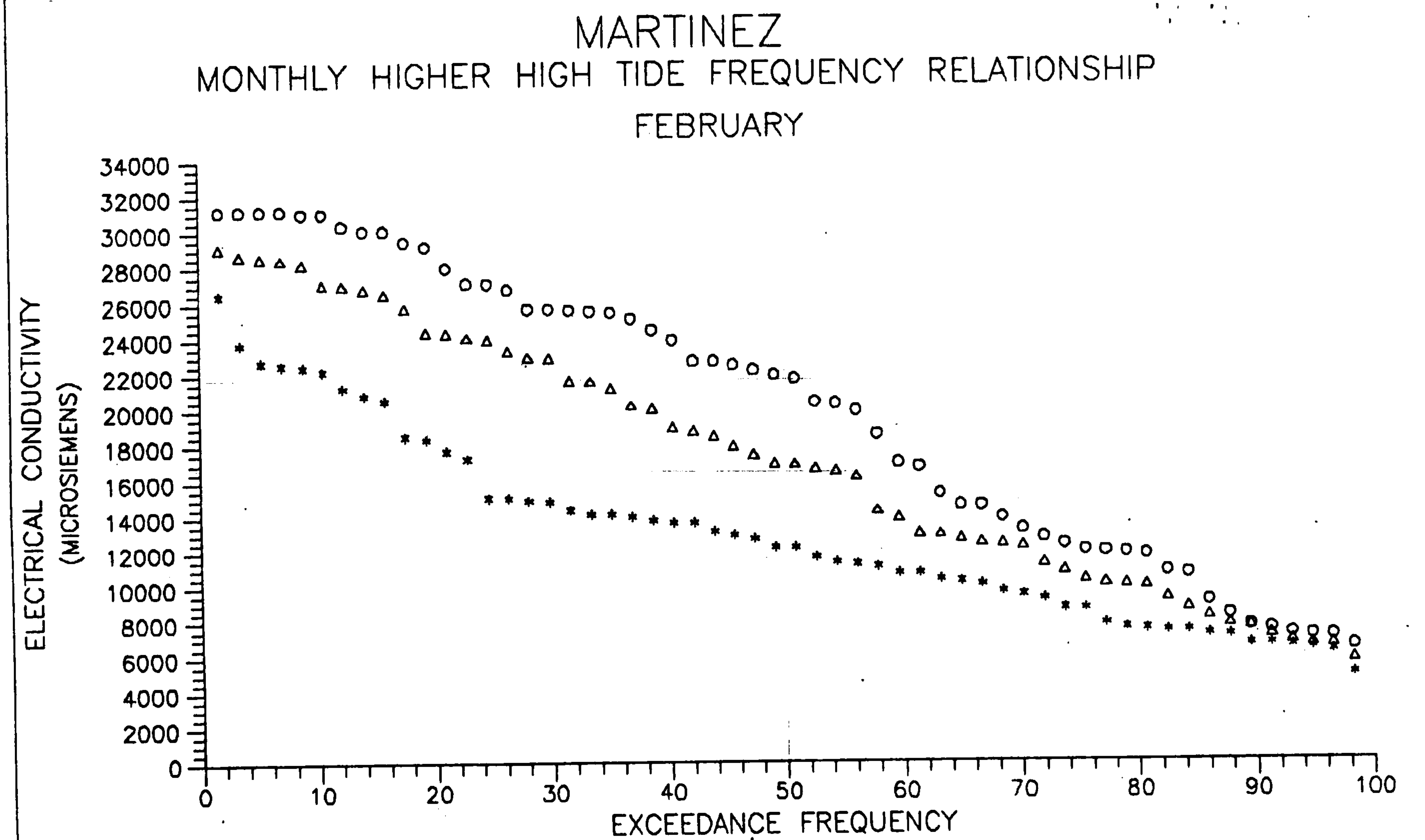
APPENDIX A

SALINITY EXCEEDENCE FREQUENCY PLOTS FOR SUISUN BAY

FEBRUARY THROUGH MAY



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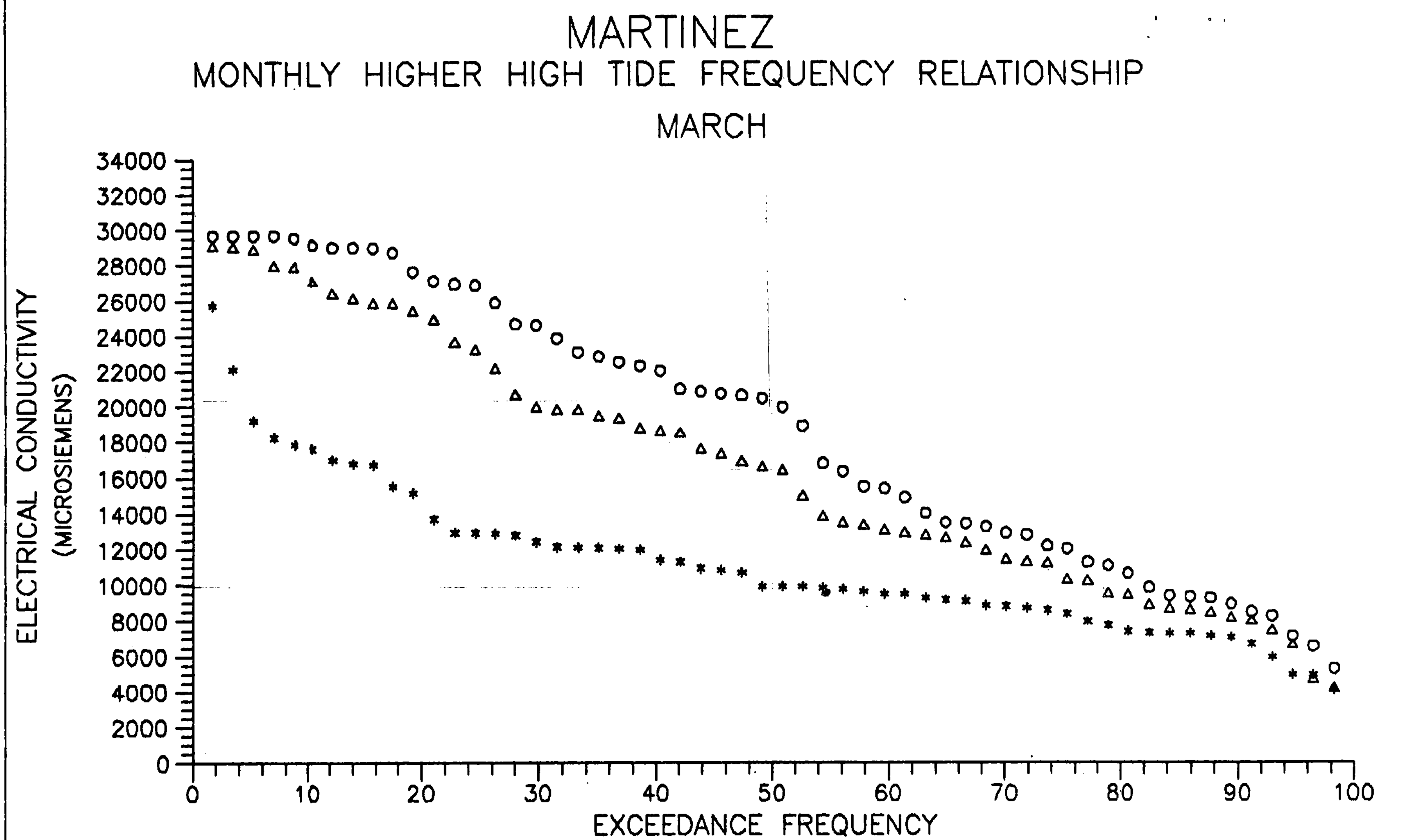

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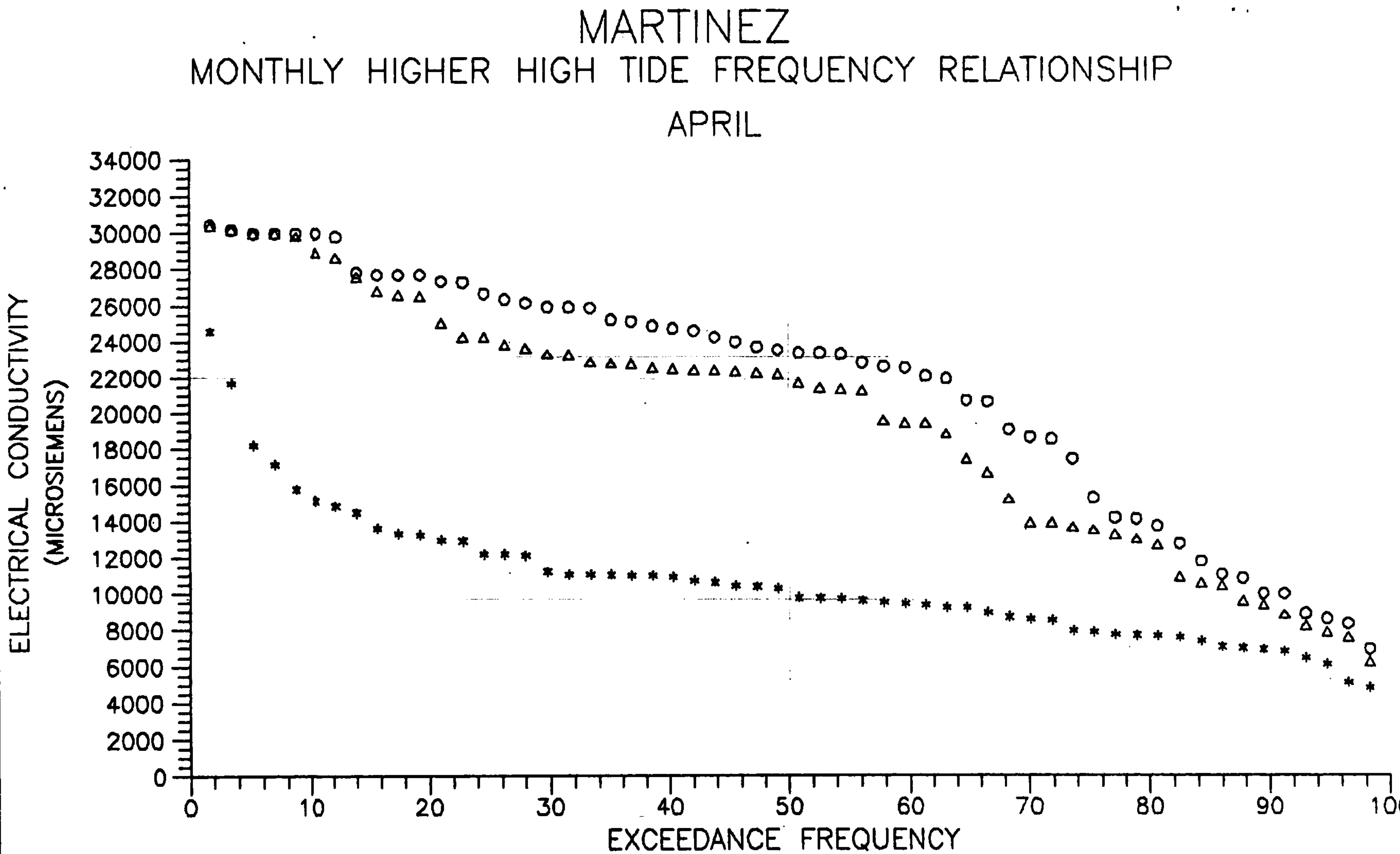

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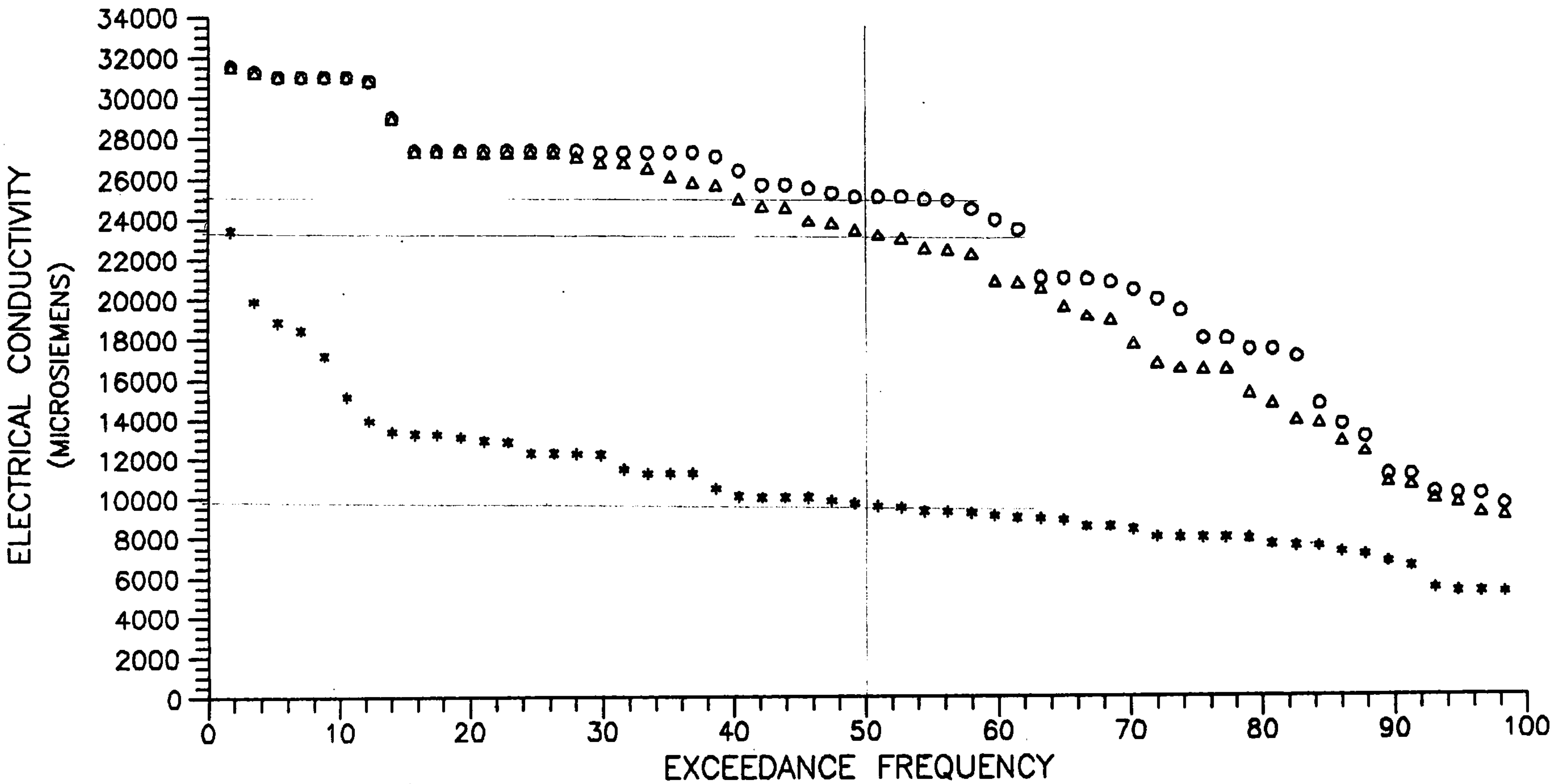
MARTINEZ

MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP

MAY



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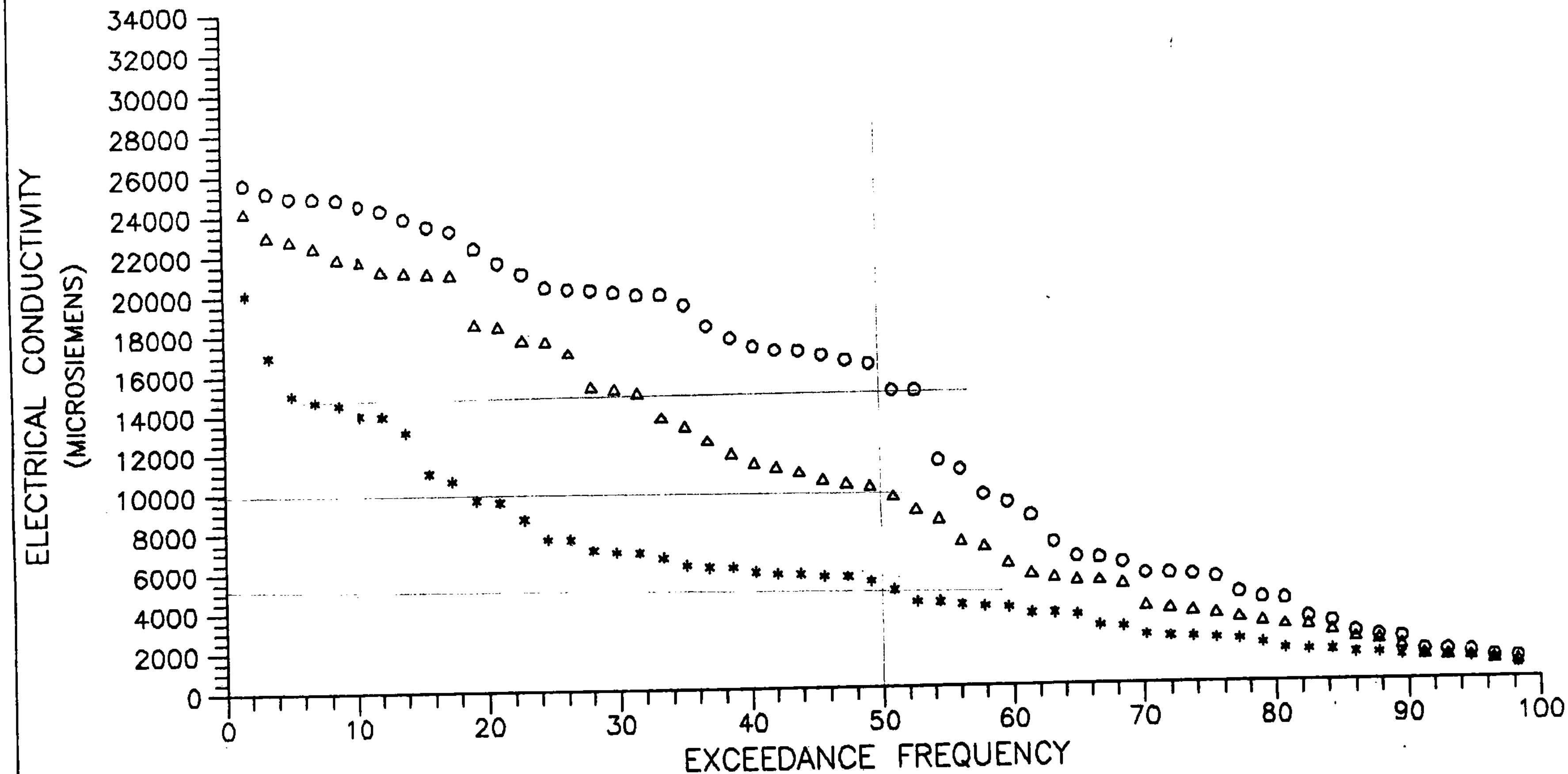
PORT CHICAGO
MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP
FEBRUARY



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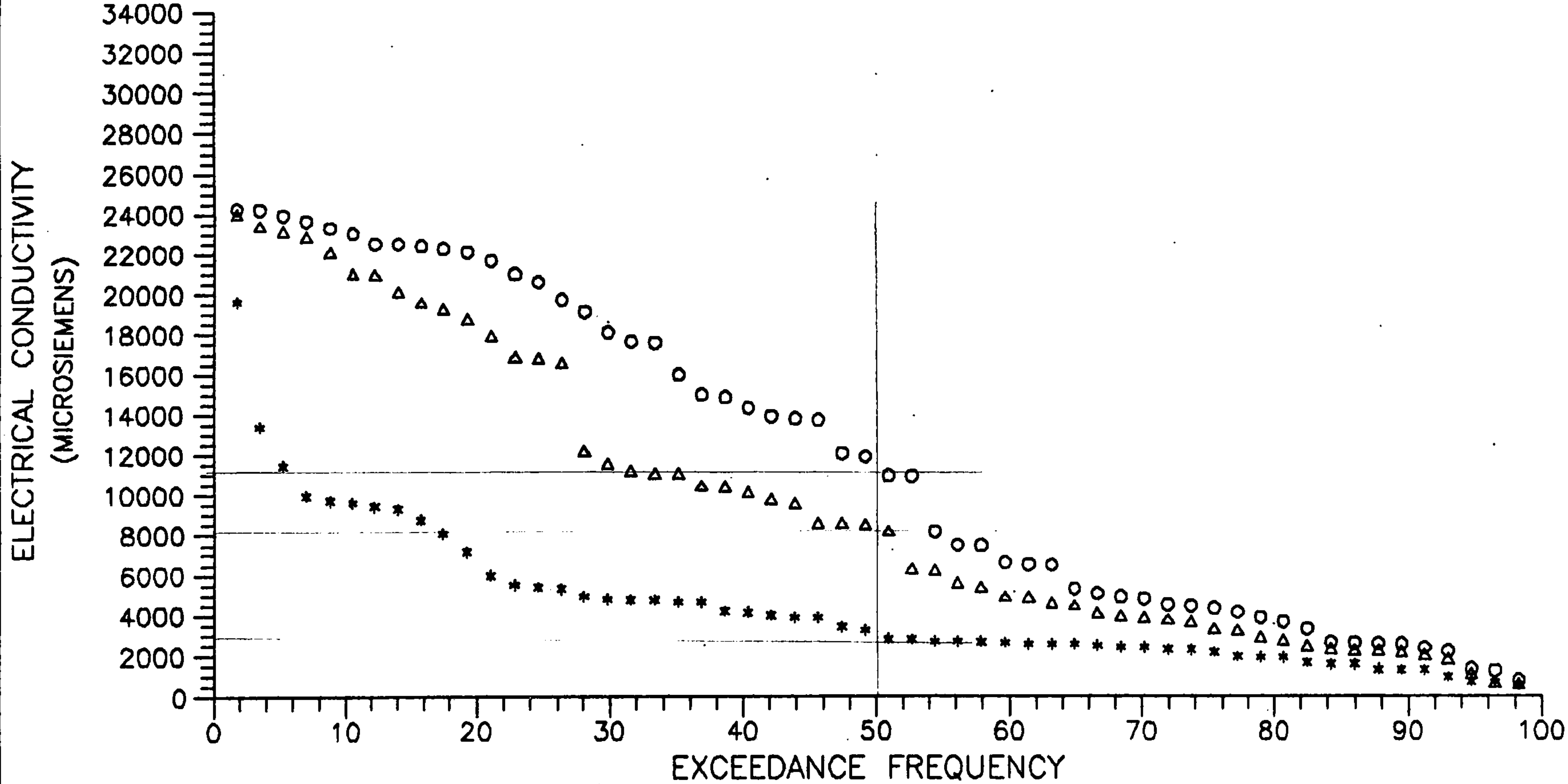
PORT CHICAGO

MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP

MARCH



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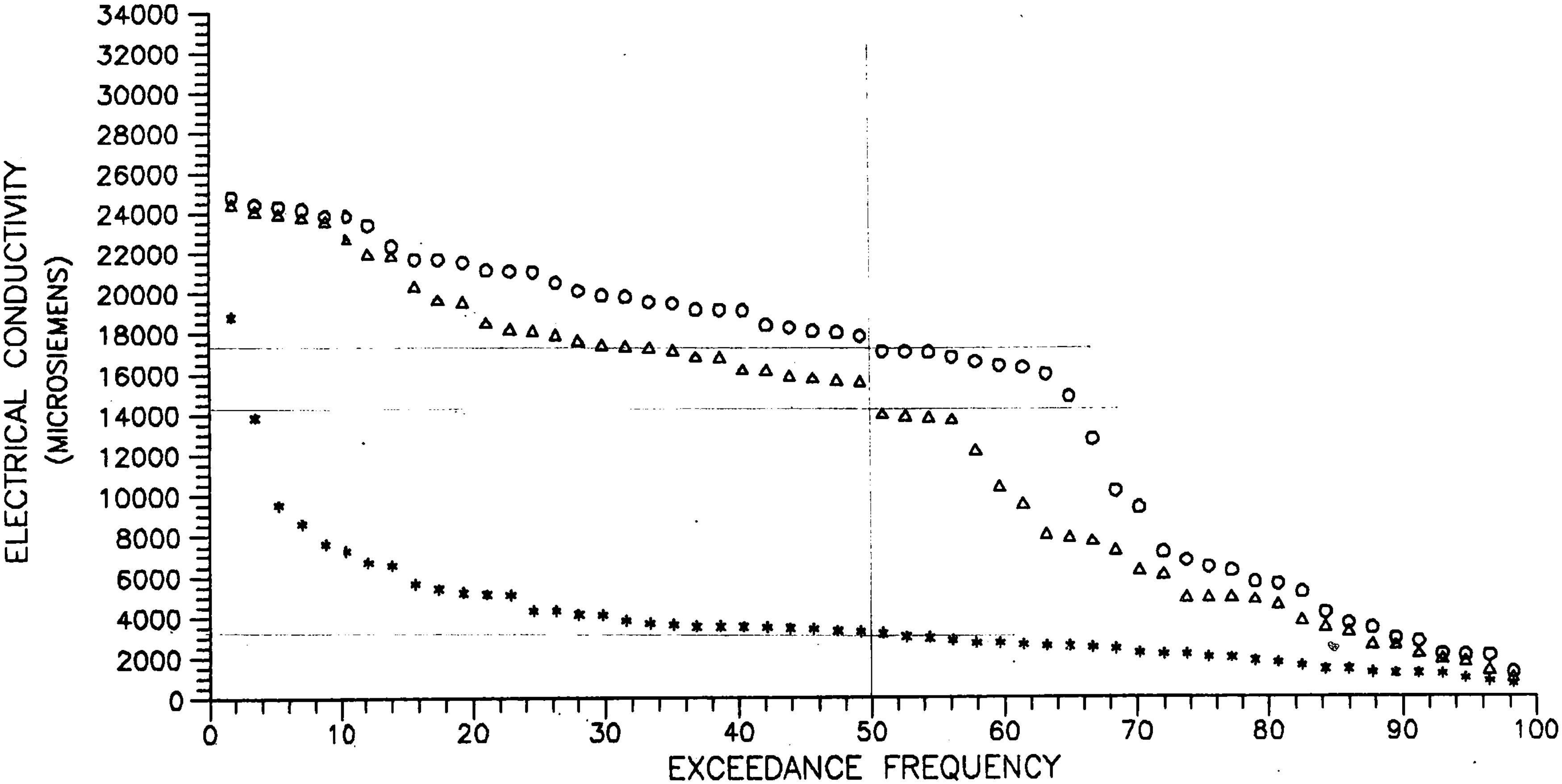
PORT CHICAGO

MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP

APRIL



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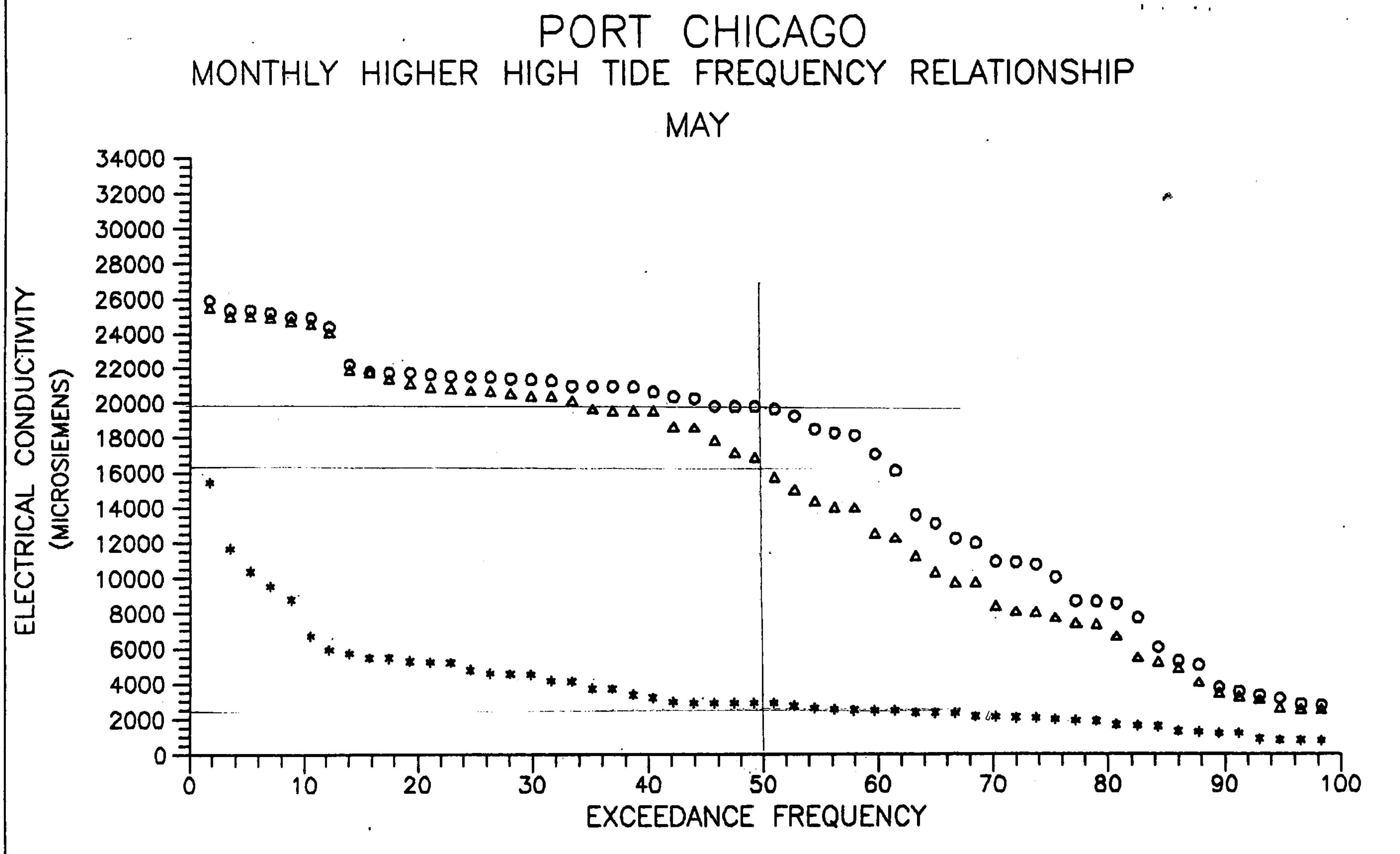

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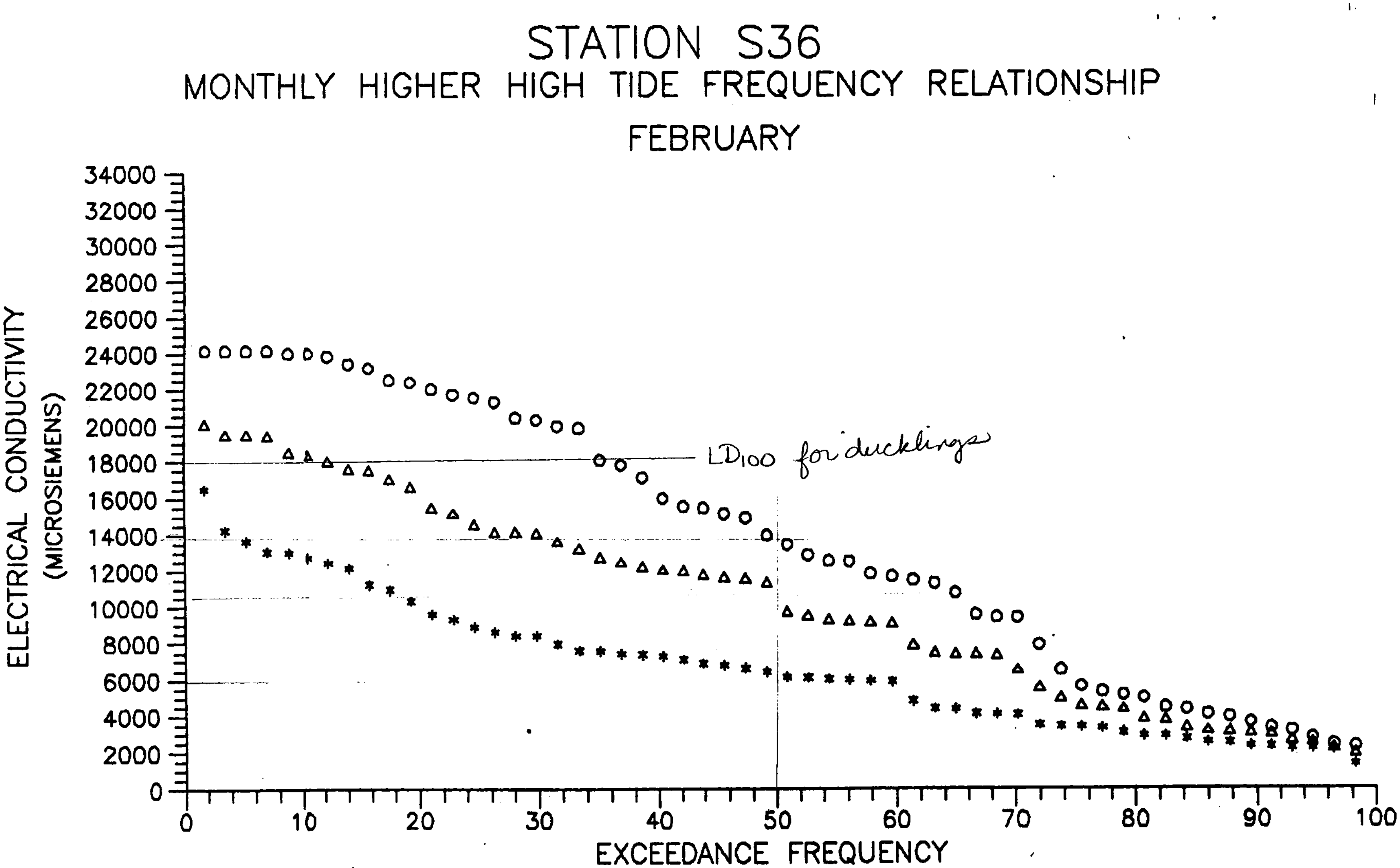
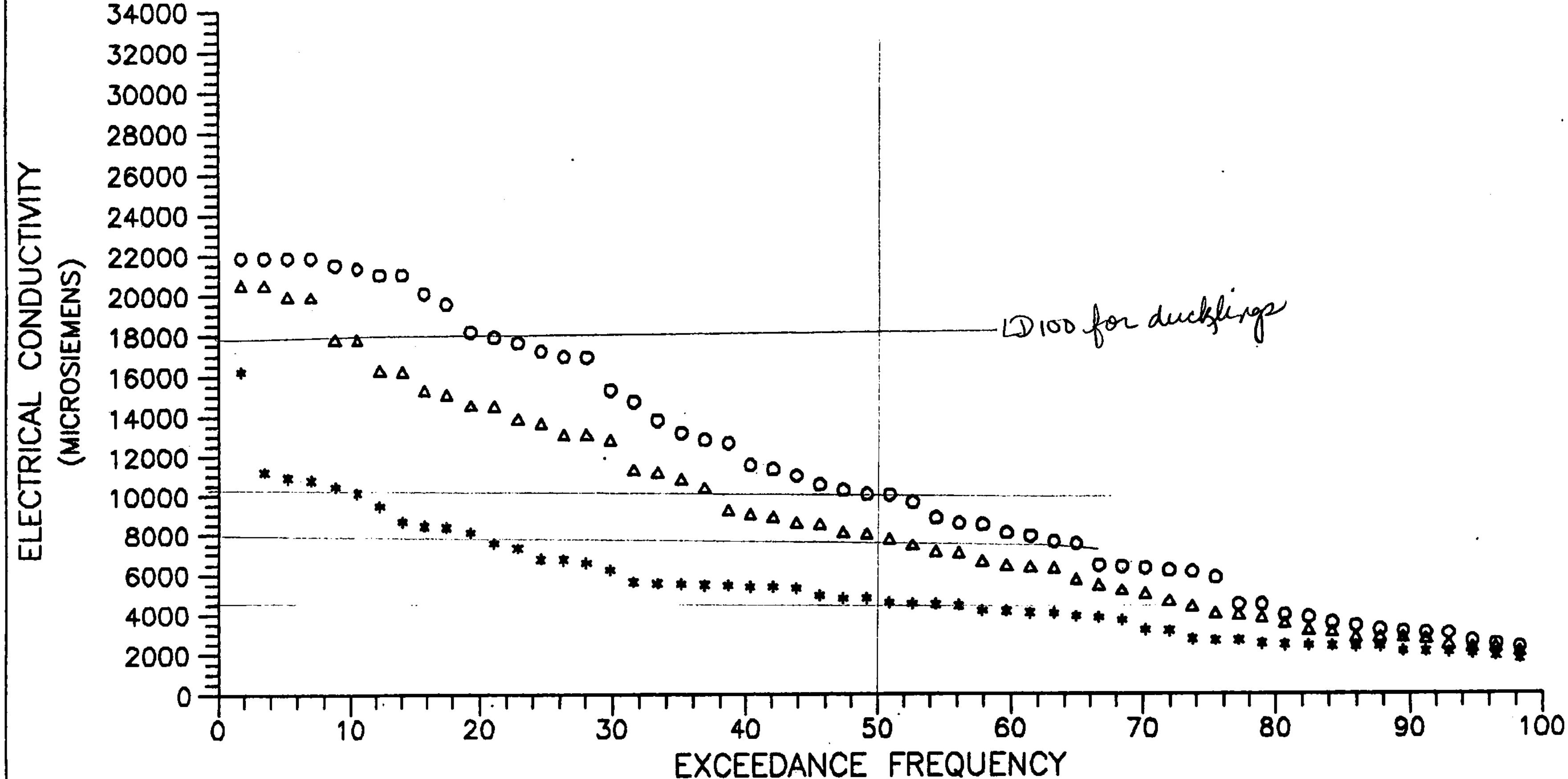


DATE: 6/10/87 BY: L. FISHBAIN	* UNIMPAIRED △ EXISTING o FUTURE	Philip Williams & Associates Pier 35, The Embarcadero San Francisco, California 94111	FIGURE A9

STATION S36

MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP

MARCH



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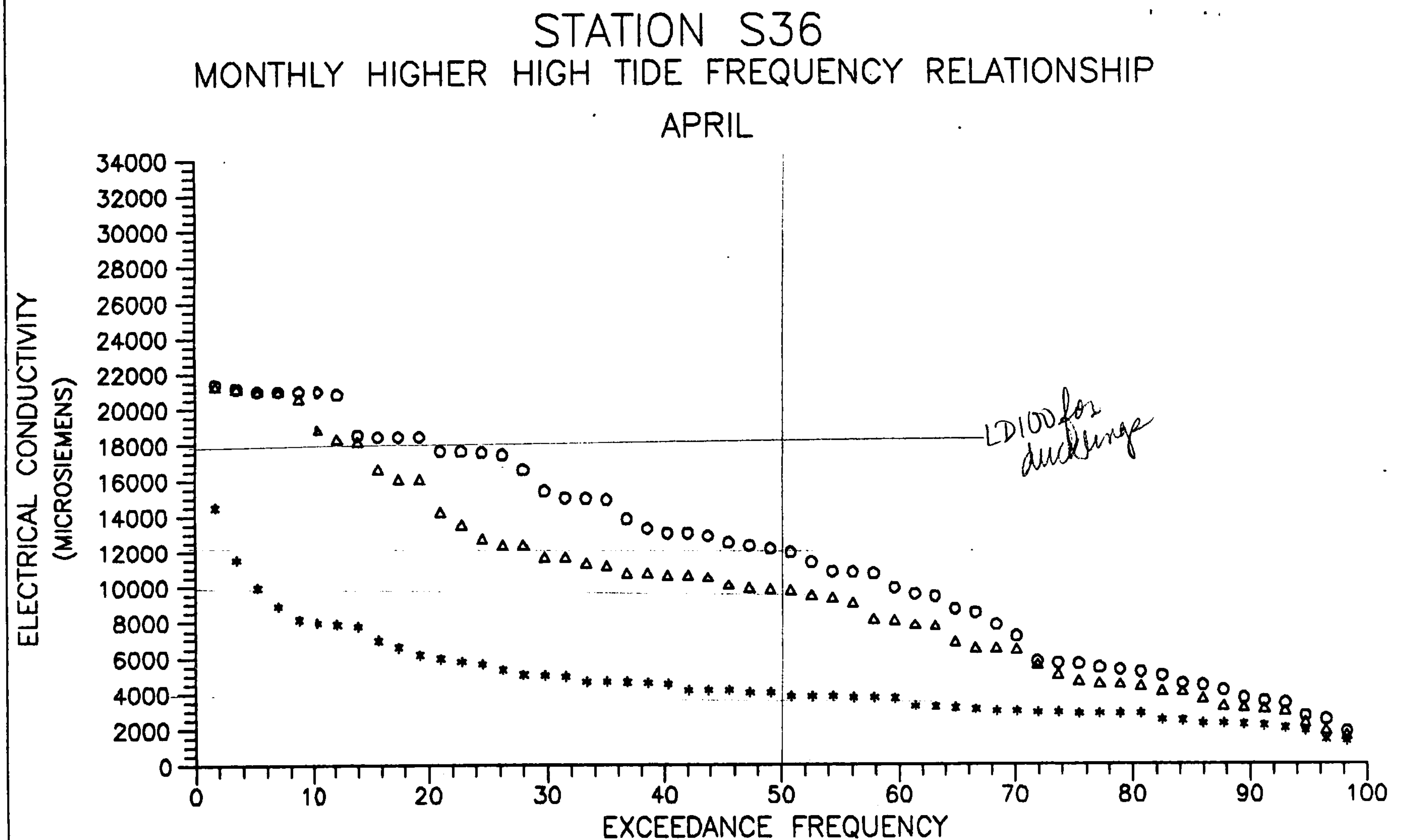

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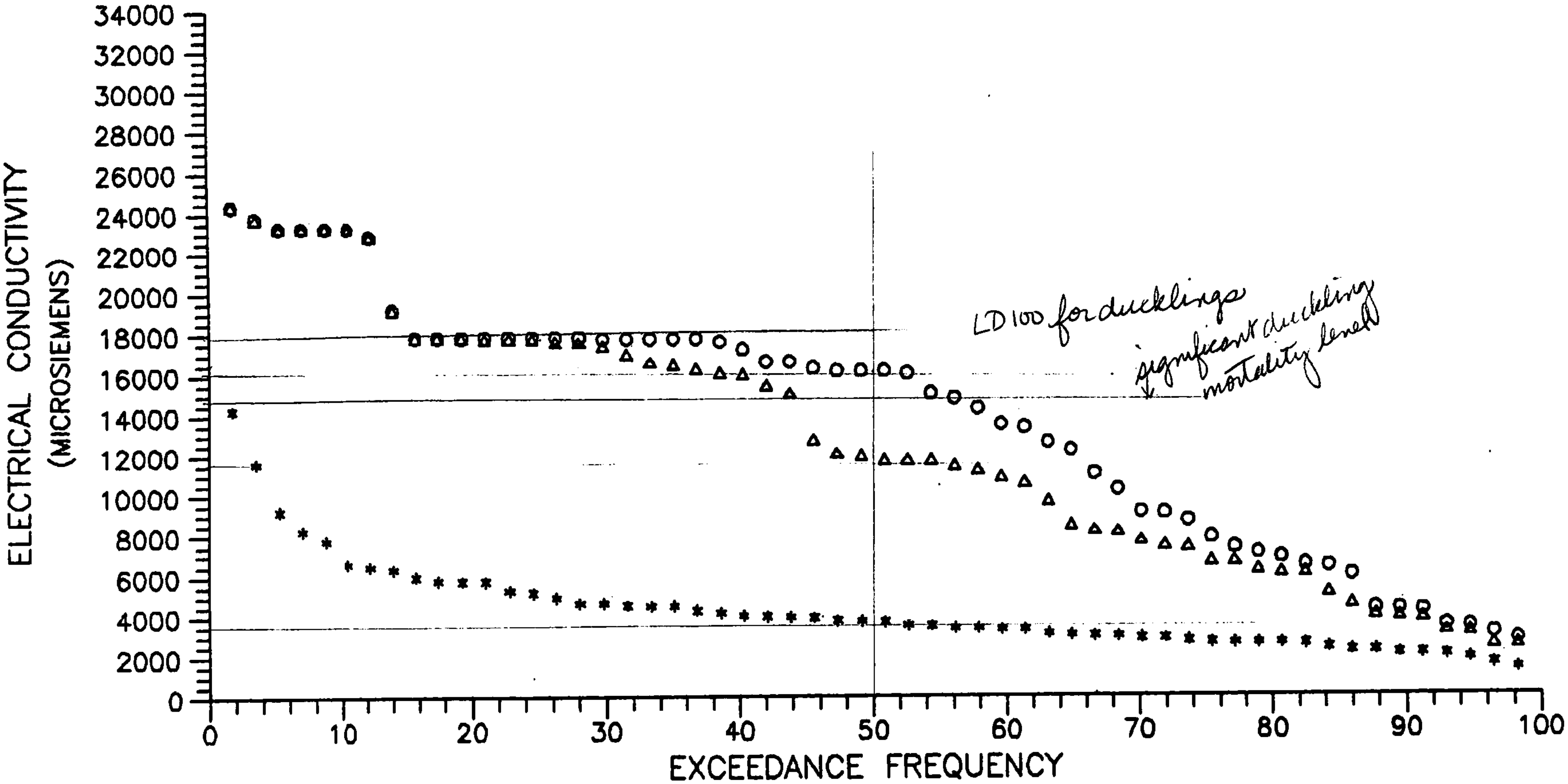
STATION S36

MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP

MAY

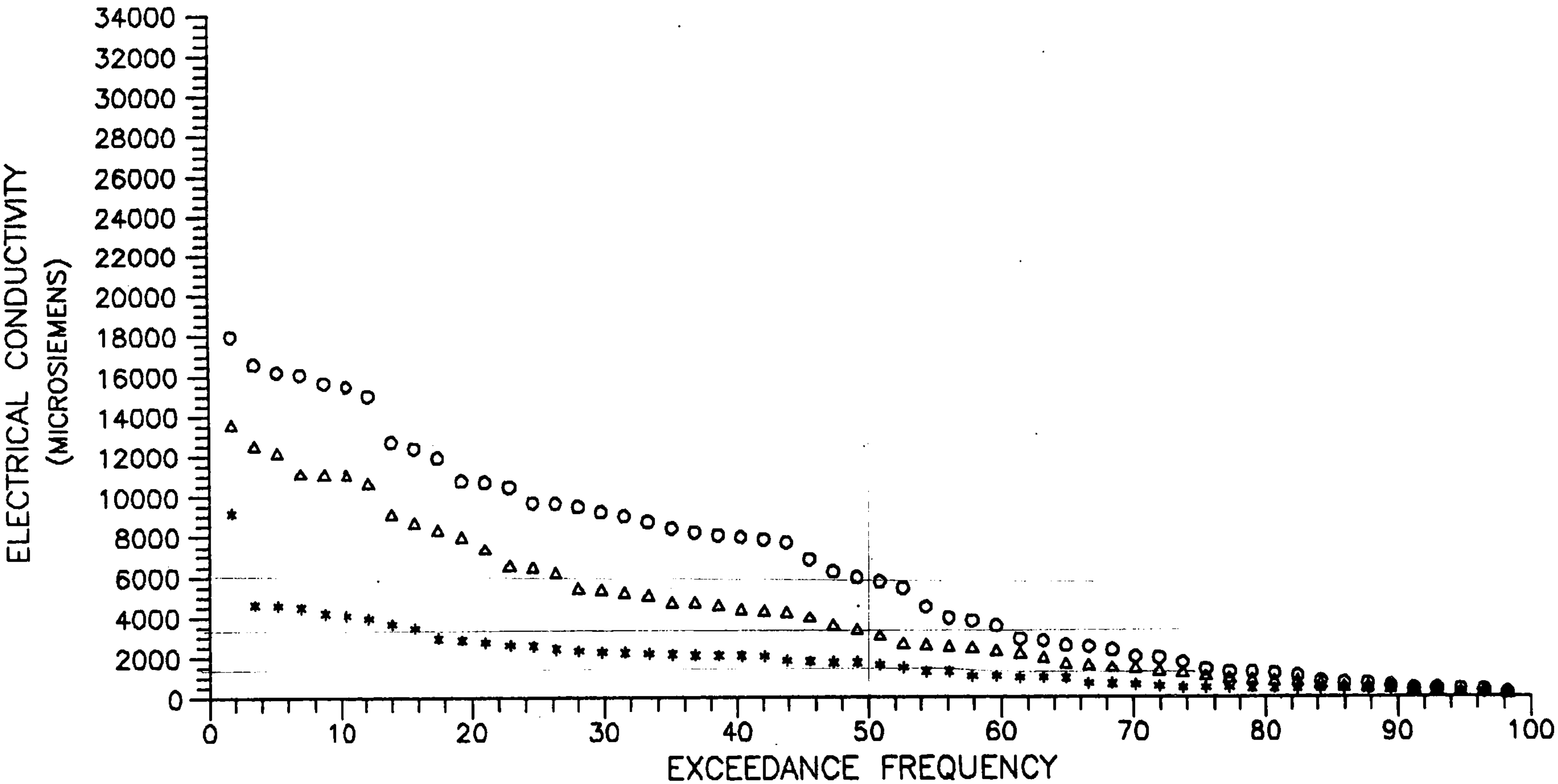


DATE: 6/10/87 BY: L. FISHBAIN	* UNIMPAIRED △ EXISTING ○ FUTURE	Philip Williams & Associates Pier 35, The Embarcadero San Francisco, California 94111	FIGURE A12

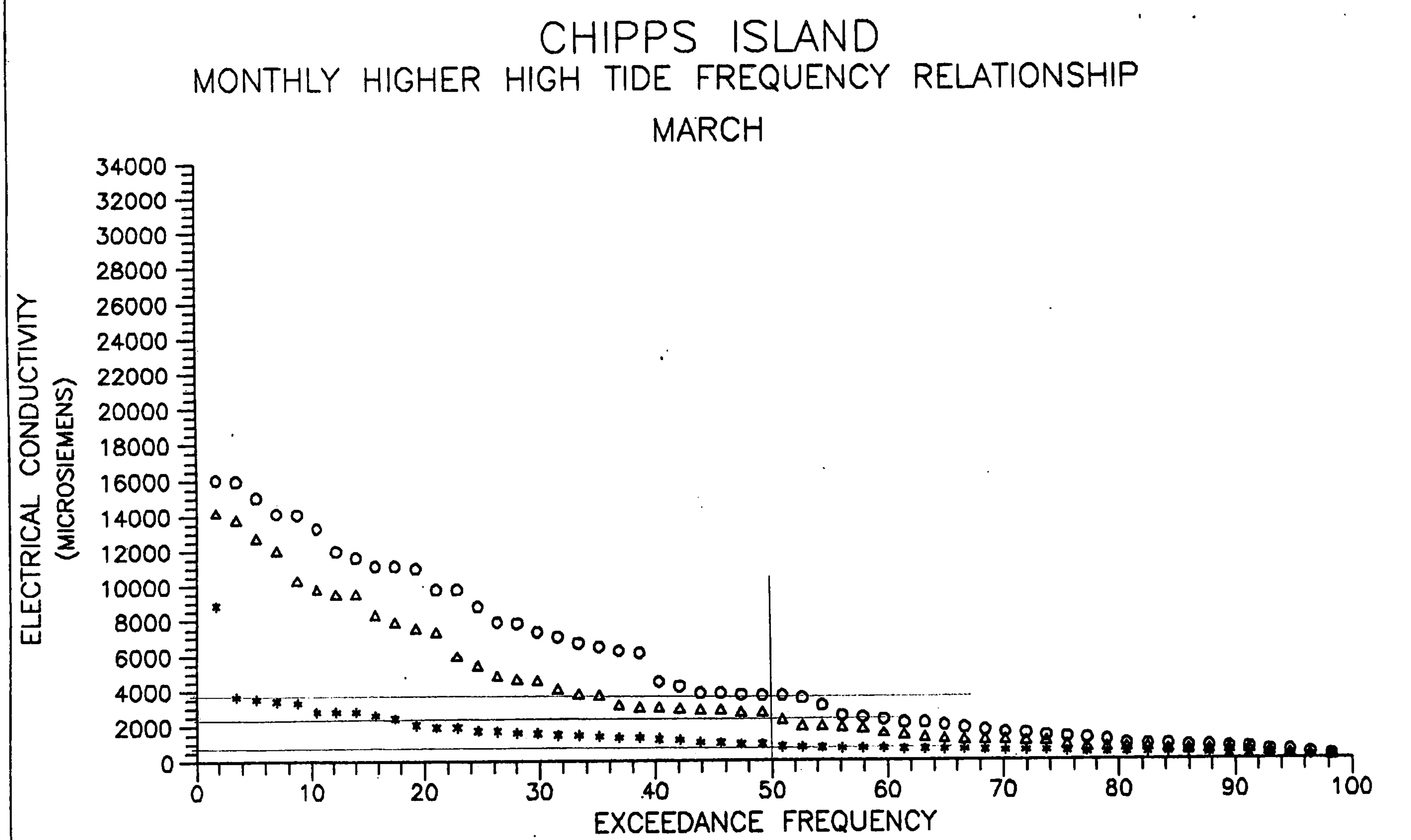
CHIPPS ISLAND

MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP

FEBRUARY



DATE: 6/10/87 BY: L. FISHBAIN	* UNIMPAIRED △ EXISTING ○ FUTURE	Philip Williams & Associates Pier 35, The Embarcadero San Francisco, California 94111	FIGURE A13



DATE: 6/10/87

BY: L. FISHBAIN

* UNIMPAIRED
△ EXISTING
o FUTURE

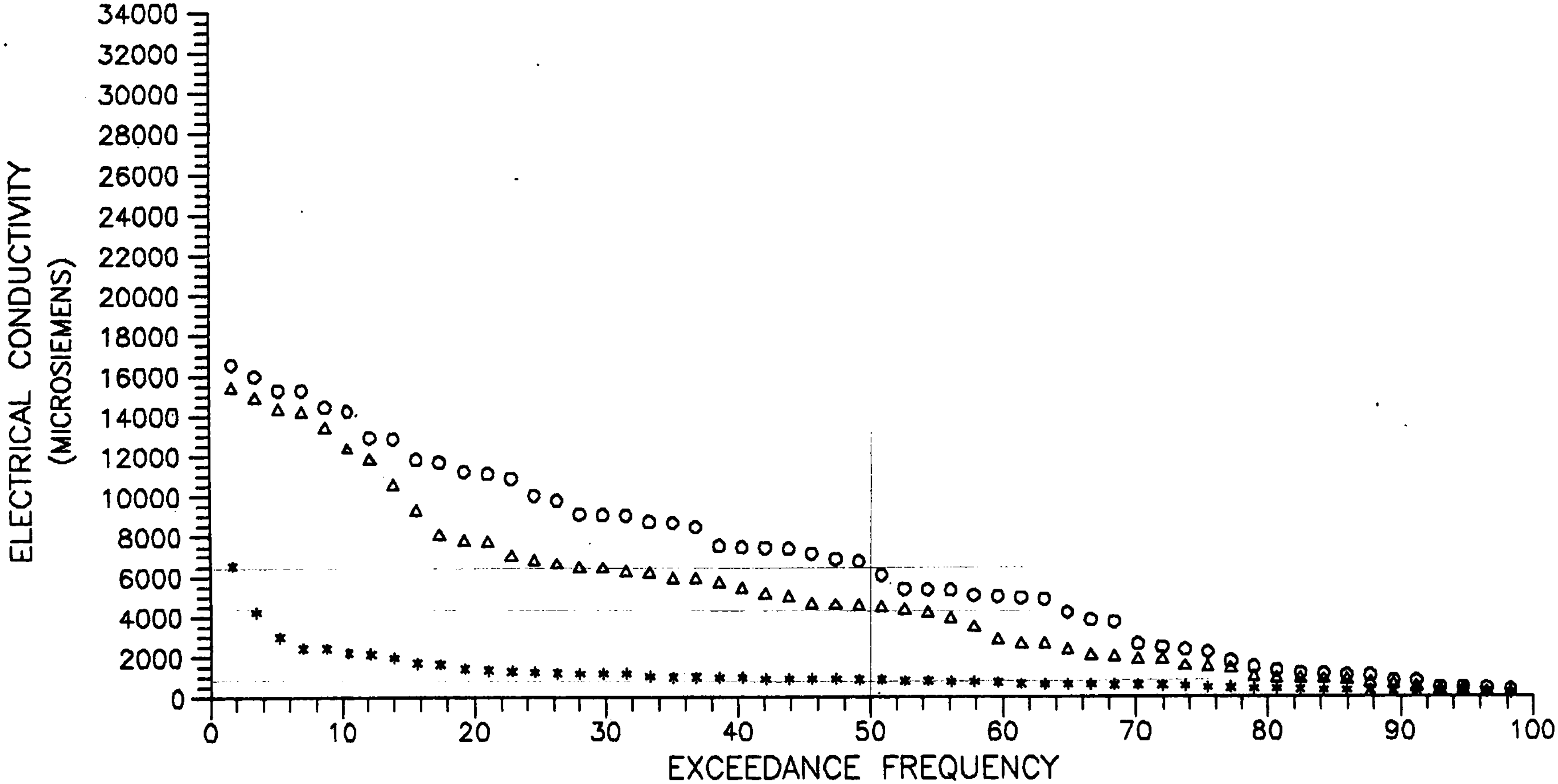
Philip Williams & Associates
Pier 35, The Embarcadero
San Francisco, California 94111

FIGURE
A14

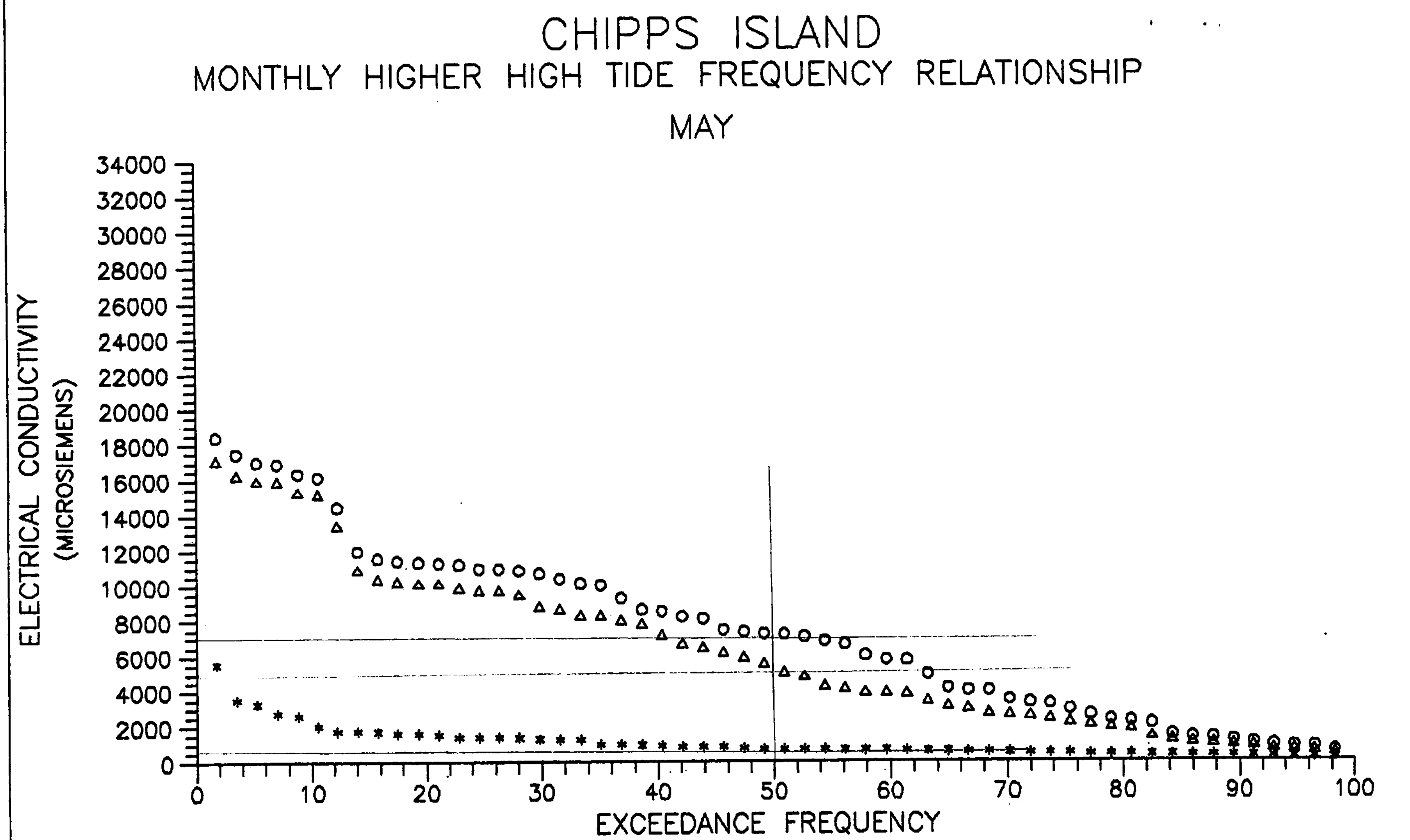
CHIPPS ISLAND

MONTHLY HIGHER HIGH TIDE FREQUENCY RELATIONSHIP

APRIL



DATE: 6/10/87 BY: L. FISHBAIN	* UNIMPAIRED △ EXISTING ○ FUTURE	Philip Williams & Associates Pier 35, The Embarcadero San Francisco, California 94111	FIGURE A15



DATE: 6/10/87 BY: L. FISHBAIN	* UNIMPAIRED △ EXISTING ○ FUTURE	Philip Williams & Associates Pier 35, The Embarcadero San Francisco, California 94111	FIGURE A16

APPENDIX B

D1485 PROVISIONS AFFECTING SUISUN MARSH AS ORIGINALLY ENACTED

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 June July 3,000 3,000 4,600
		The mean monthly diversions from the Delta by the Central Valley Project (Bureau), not to exceed the values shown	All	May June 3,000 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

APPENDIX C

D1485 AS MODIFIED DECEMBER 1985

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

ORDER

APPLICATION 5625 and 26 others (as listed on attached sheet) PERMIT 12720 and 26 others LICENSE

ORDER ALLOWING EXTENSION OF TIME TO COMPLY WITH SUISUN MARSH STANDARDS

WHEREAS:

1. Order Condition 7(b) of Decision 1485 requires the permittee to meet specific water quality standards for full protection of the Suisun Marsh by October 1, 1984, as set forth in Table II of the Decision.

2. A petition for an extension of time to comply with the water quality standards for full protection of Suisun Marsh set forth in Order Condition 7(b) and Table II of Decision 1485 was filed by the U. S. Bureau of Reclamation on August 6, 1985.

3. The permittee has proceeded with diligence and good cause has been shown for the extension of time.

NOW THEREFORE, IT IS ORDERED THAT:

1. Order Condition 7(b) of Decision 1485 is superseded in accordance with Order Conditions 2 and 3 below.

2. Permittee shall comply with the water quality standards for full protection of Suisun Marsh set forth in Order Condition 7(a) of Decision 1485 (hereinafter termed standards) in accordance with the following schedule:

   (a) Permittee shall meet the standards by October 1, 1988 at the following locations:

      (1) Sacramento River at Collinsville Road in Collinsville (C-2)
      (2) Montezuma Slough at National Steel (three miles south of Mien's Landing) (S-64)
      (3) Montezuma Slough near Beldon Landing (0.35 miles east of Grizzly Island Bridge) (S-49)

   (b) Permittee shall either meet the standards by October 1, 1991 at:

      (1) Chadbourne Slough at Chadbourne Road (S-21), and
      (2) Cordelia Slough, 500 feet west of the Southern Pacific crossing at Cygnus (S-33),

   or meet the standards by October 1, 1993 at:

      (1) Chadbourne Slough at Chadbourne Road (S-21), and
      (2) Cordelia Slough at Cordelia-Goodyear Ditch (S-97)

   (c) Permittee shall either meet the standards by October 1, 1991 at Goodyear Slough at the Morrow Island Clubhouse (S-35), or meet the standards by October 1, 1994 at Goodyear Slough, 1.3 miles south of

(d) Permittee shall meet the standards by October 1, 1997 at:

(1) Suisun Slough 300 feet south of Volanti Slough (S-42), and
(2) Water supply intake locations for waterfowl management areas on Van Sickle Island and Chipps Island.

3. Table II of Decision 1485 is amended on page 39 to replace the Suisun Marsh electrical conductivity standards that became effective October 1, 1984 with the following:

BENEFICIAL USE PROTECTED and LOCATION	PARAMETER	DESCRIPTION	YEAR TYPE	VALUES	
FISH AND WILDLIFE					
• SUISUN MARSH				Month	EC in mmhos
– To become effective on October 1, 1988 at: Sacramento River at Collinsville Road in Collinsville (C–2)	Electrical Conductivity (EC)	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	Oct.	19.0
Montezuma Slough at National Steel (3 miles south of Mein's Landing) (S–64)				Nov.	15.5
Montezuma Slough near Beldon Landing (0.35 miles east of Grizzly Island Bridge) (S–49)				Dec.	15.5
– To become effective either on October 1, 1991 at: Chadbourne Slough at Chadbourne Road (S–21) and				Jan.	12.5
Cordelia Slough, 500 feet west of the Southern Pacific crossing at Cygnus (S–33);				Feb.	8.0
or on October 1, 1993 at: Chadbourne Slough at Chadbourne Road (S–21) and				Mar.	8.0
Cordelia Slough at Cordelia–Goodyear Ditch (S–97)				Apr.	11.0
– To become effective either on October 1, 1991 at: Goodyear Slough at the Morrow Island Clubhouse (S–35);				May	11.0
or on October 1, 1994 at: Goodyear Slough, 1.3 miles south of Morrow Island Ditch (S–75)					
– To become effective on October 1, 1997 at: Suisun Slough, 300 feet south of Volanti Slough (S–42), and					
Water supply intake locations for waterfowl management areas on Van Sickle Island and Chipps Island.					

4. By January 15 of each year, permittee shall provide, either separately or jointly with California Department of Water Resources, a written report to the Board on its progress toward achieving full compliance with this order.

L. D. Johnson

Lloy D. Johnson, Interim Chief
Division of Water Rights

Dated DECEMBER 5 1985

Attachment A

Permits of the Department of Water Resources:

Permit 16477 (Application 5629)
Permit 16478 (Application 5630)
Permit 16479 (Application 14443)
Permit 16480 (Application 14444)
Permit 16481 (Application 14445A)
Permit 16482 (Application 17512)
Permit 16483 (Application 17514A)
Permit 12720 (Application 5625)