6-3-1988

Bay/Delta Standards Memorandum and Exhibits

Thomas J. Graff

BAY/DELTA STANDARDS
MEMORANDUM AND EXHIBITS

Thomas J. Graff
Attorney
Environmental Defense Fund
Oakland, California

WATER QUALITY CONTROL: INTEGRATING BENEFICIAL USE AND ENVIRONMENTAL PROTECTION

Natural Resources Law Center
University of Colorado
School of Law
Boulder, Colorado

June 1-3, 1988

ENVIRONMENTAL DEFENSE FUND

Rockridge Market Hall
5655 College Avenue
Oakland, CA 94618
(415) 658-8008

December 14, 1987

TO: Interested Persons

FROM: John Krautkraemer
Thomas J. Graff

RE: Bay/Delta Standards

Introduction

Enclosed is a package of exhibits EDF presented last week at the State Water Resources Control Board (Board) hearings on the San Francisco Bay/Delta estuary. The exhibits summarize a set of standards developed by Dr. Philip Williams for EDF and others during the course of these hearings. The proposed standards on the average seek approximately 5-6 million acre feet more per year for the San Francisco Bay/Delta estuary than it now receives under current standards. The proposed standards vary in different year types (e.g., critical, dry, average, wet) and in different seasons and months. They are presented as a group, but the methodology Dr. Williams employed does allow them to be disaggregated.

EDF believes, however, that its proposed standards, taken as a group, establish a reasonable benchmark for protection of the public trust and beneficial uses of freshwater flows in the estuary. In particular, it should be noted that the standards overlap and provide multiple benefits, including for fish and wildlife and other public trust uses that may not be expressly covered by particular standards.

The burden should now shift to those who divert and export freshwater upstream and out of the estuary to justify any harm to Bay/Delta uses and to demonstrate that they have no feasible alternatives to meet their legitimate water demands, other than the diversion of water needed for the protection of the estuary.

The proposed standards cover four areas: (1) protection of the estuarine ecosystem by maintaining adequate food supply (phytoplankton); (2) protection of the managed and unmanaged wetlands of Suisun Marsh; (3) protection of salmon by providing adequate outflow for outmigrating young; and (4) striped bass survival. These, of course, are not the only resources worthy of

protection in the estuary or benefits associated with freshwater flow, but they are the ones for which EDF has proposed numerical flow standards. Each area for which standards are developed is summarized below.

Estuarine ecosystem protection (phytoplankton)

The standards would maintain phytoplankton abundance in key areas in San Francisco Bay: Suisun Bay, San Pablo Bay, and South Bay. Phytoplankton is the base of the estuarine food chain and is critical to higher level organisms. With the exception of the San Pablo Bay standard, the actual standards are set in terms of salinity, but have been converted to outflow in the enclosed exhibits.

Two of the standards would require maintaining an "entrapment zone" in Suisun Bay and San Pablo Bay during critical periods. The entrapment zone is an area of high food concentration which is optimally located downstream from the Delta adjacent to the highly productive shallow areas in San Pablo and Suisun Bays. The proposed Suisun Bay standard would require a minimum outflow of 10,000 cubic feet per second (cfs) during April through September and would apply in all but the 5% driest years. The San Pablo Bay standard would require a minimum of 20,000 cfs during April through June in all but the 30% driest years. In addition, a third standard would require outflow of 40,000 cfs for any four week period during October through April to limit intrusion of marine benthic organisms into Suisun Bay. These organisms can severely deplete phytoplankton populations important to support other species such as zooplankton and, in turn, larval fish.

A fourth set of phytoplankton standards would maintain phytoplankton abundance in the South Bay by providing springtime outflow to stratify this reach. This stratification process, which occurs during high flow and weak tide periods, "fences off" bottom benthic feeders from surface phytoplankton, allowing larger populations to develop. The required outflows range from 40,000 to 80,000 cfs for various time periods in April, depending on the water year type.

The phytoplankton standards are summarized in EDF Exh. 16-18 for various year types. These plots also show outflows with existing water development and with no development (unimpaired conditions). There currently are no outflow standards for San Francisco Bay.

A full discussion of the proposed standards is contained in reports prepared by Dr. Williams and phytoplankton expert Dr. James Hollibaugh, which they, together with U.C. Davis biology professor Peter Moyle, presented to the Board under the sponsorship of Contra Costa County Water Agency and EDF.

Suisun Marsh Standards

These standards are designed to protect both the managed wetlands of Suisun Marsh as well as the unmanaged tidal brackish marshes. For the managed wetlands, the standards would require reinstatement of the standards the Board adopted in 1978 in Decision 1485. The proposal is to meet the standards with

outflow, until it is demonstrated that the planned installation of physical facilities to meet the standards is effective. The original standards were substantially weakened by the Board in 1985.

The unmanaged wetland standards would ensure suitable salinities to maintain key areas of Suisun Marsh as brackish tidal marsh habitat and prevent their conversion to salt marsh. There currently are no standards for this purpose.

The Suisun Marsh standards are summarized in EDF Exh. 19 and are graphically represented for various year types in EDF Exh. 20-22. They are discussed in more detail in a report prepared by Dr. Williams and Dr. Michael Josselyn, which was presented to the Board by the Bay Conservation and Development Commission.

Salmon Survival Standards

These standards are derived from information presented by the U.S. Fish and Wildlife Service at the Board hearings. They are designed to protect young salmon (smolt) migrating out the Sacramento and San Joaquin Rivers. Survival of these smolt is strongly correlated with river flow. The standards are summarized in EDF Exh. 23.

The current salmon standards in D1485 provide virtually no protection for smolt survival. D1485 striped bass standards provide some incidental protection, equal to a projected index of survival of only .05 in dry years and .35 in wet years. In contrast, the proposed standards would provide an average survival index of about .75, which approximates the recent historical average. Historical levels of fish abundance were endorsed by the Board in D1485 and continue to be the management objective of the California Department of Fish and Game and U.S. Fish and Wildlife Service.

Striped Bass Survival

The failure of outflows since 1978 to provide predicted levels of striped bass survival is well publicized. The proposed standards set forth in EDF Exh. 25 are derived by determining what outflow actually is needed, based on post-1976 survival indices, to attain the striped bass survival objectives sought and predicted, but not attained, by D1485. The predicted Striped Bass Indices and Observed Indices since 1976 are plotted in EDF Exh. 24.

It should be noted that because D1485 applies only to the state and federal water projects, the proposed striped bass survival standards would not provide for historical levels of abundance, but would at best only mitigate for the effects of these two projects. Nevertheless, they would provide substantially better protection than existing standards.

The salmon and striped bass standards are graphically summarized for the various year types in EDF Exhs. 26-28.

While these standards are tied to specific life stages of specific fish, they would provide ancillary benefits to other Bay/Delta fisheries, including, for example, the Delta smelt, a native species whose population has severely declined and which is a potential candidate for threatened or endangered species status.

Overall Outflow Requirements

The total outflow requirements for the set of standards discussed above are shown graphically for various year types in EDF Exh. 29-31. As can be seen, the drier the year, the greater the extent to which existing development limits the ability to meet the needs of the Bay and Delta. This means that the standards set for dry, and particularly for critical, years are the most important.

The total outflow requirements of the standards are illustrated in EDF Exh. 32. This table was derived by adjusting DWR's 1985-level development scenario to include the proposed standards. DWR's scenario calculates what outflows would be at approximately the present level (1985) of water development with the D1485 standards in place, if there were to be a repeat of the 1922-78 hydrologic period of record. Under DWR's scenario, average annual Delta outflow is about 14 million acre feet. As can be seen, the adjusted scenario with the proposed standards shows an annual average outflow of about 19.5 million acre feet. This means that the Bay, on the average, receives about 5-6 million acre feet per year less outflow than it needs. This shortfall varies seasonally, as well as for different water year types. It is interesting to note that the actual average historical outflow for the period 1922-78 was about 22 million acre feet per year.

EDF Exhs. 33-35 show graphically how the proposed standards would alter the frequency of various outflow levels on an annual, as well as spring and summer, basis. As can be seen the standards would significantly decrease the frequency of low outflows.

Conclusion

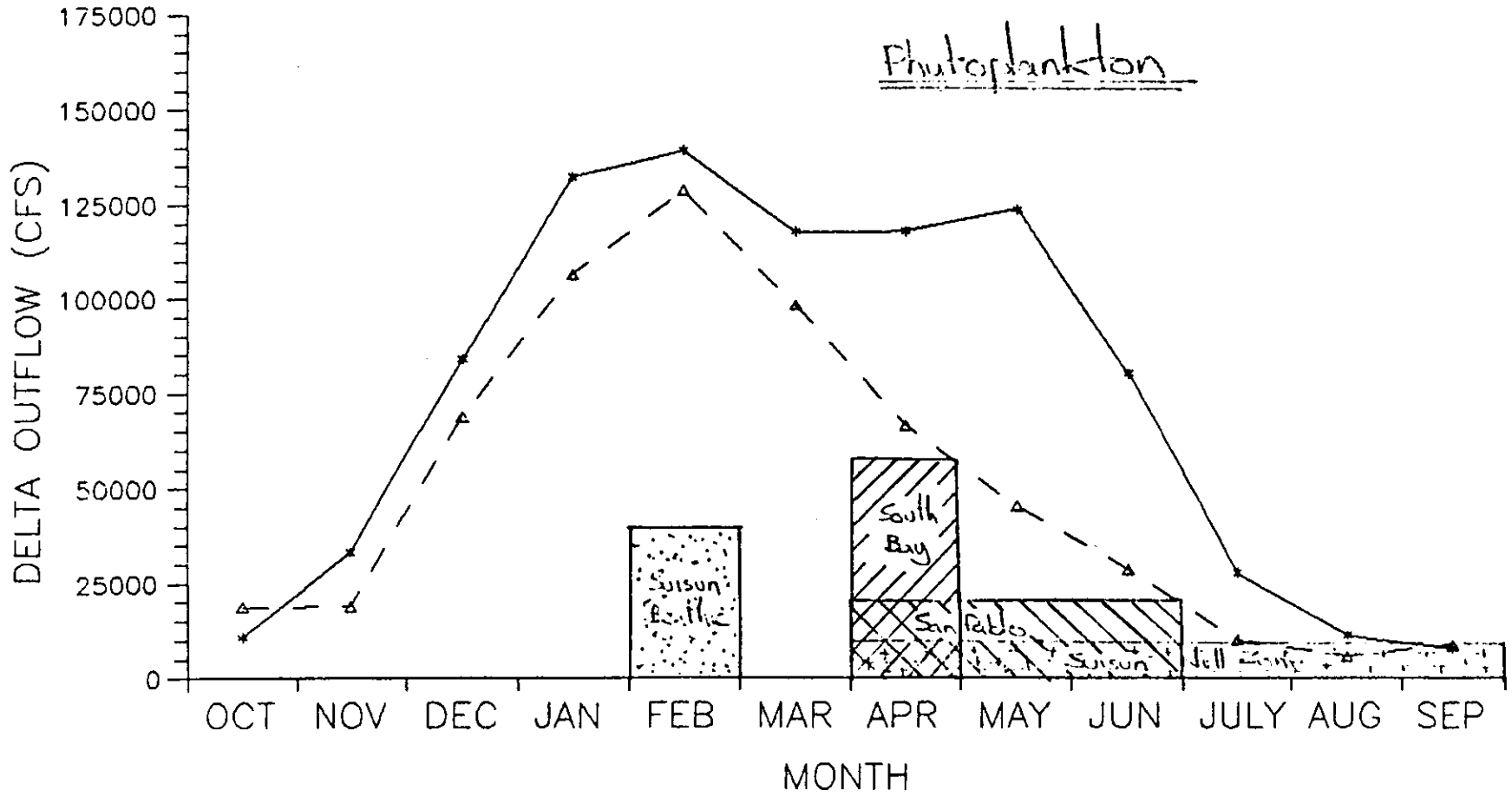
EDF believes that the current allocation of water between the Bay and Delta on the one hand and consumptive uses of water on the other is heavily out of balance, with the scales strongly tipped against the estuary. The needs of the Bay/Delta, as indicated by the proposed standards, require flows from 10,000 cfs to 80,000 cfs, depending on the year type and season. In contrast, D1485 provides flows in the range of 1,000 cfs to 14,000 cfs (although actual outflow is higher in wetter periods).

As a result, our proposed standards emphasize the need for the Board, and for water development agencies and users, aggressively to pursue alternatives which would reduce the need for withdrawals from the Bay/Delta system. First and foremost among these should be increasing the efficiency of use of already developed supplies by the aggressive promotion of freer water marketing. Richard Howitt, Professor of Agricultural Economics at U.C. Davis, presented detailed testimony for the Board on this alternative. This testimony

established the benefits of water marketing for all three major sectors engaged in competition for California's water resources: agricultural, urban and environmental. If water marketing should take hold in California, as EDF and Professor Howitt have advocated, much of the conflict between San Francisco Bay protection and the water consuming sectors of California's economy could be alleviated.

EDF Exh. 16

CHANGES IN MONTHLY DELTA OUTFLOW
1 IN 10 WET YEAR

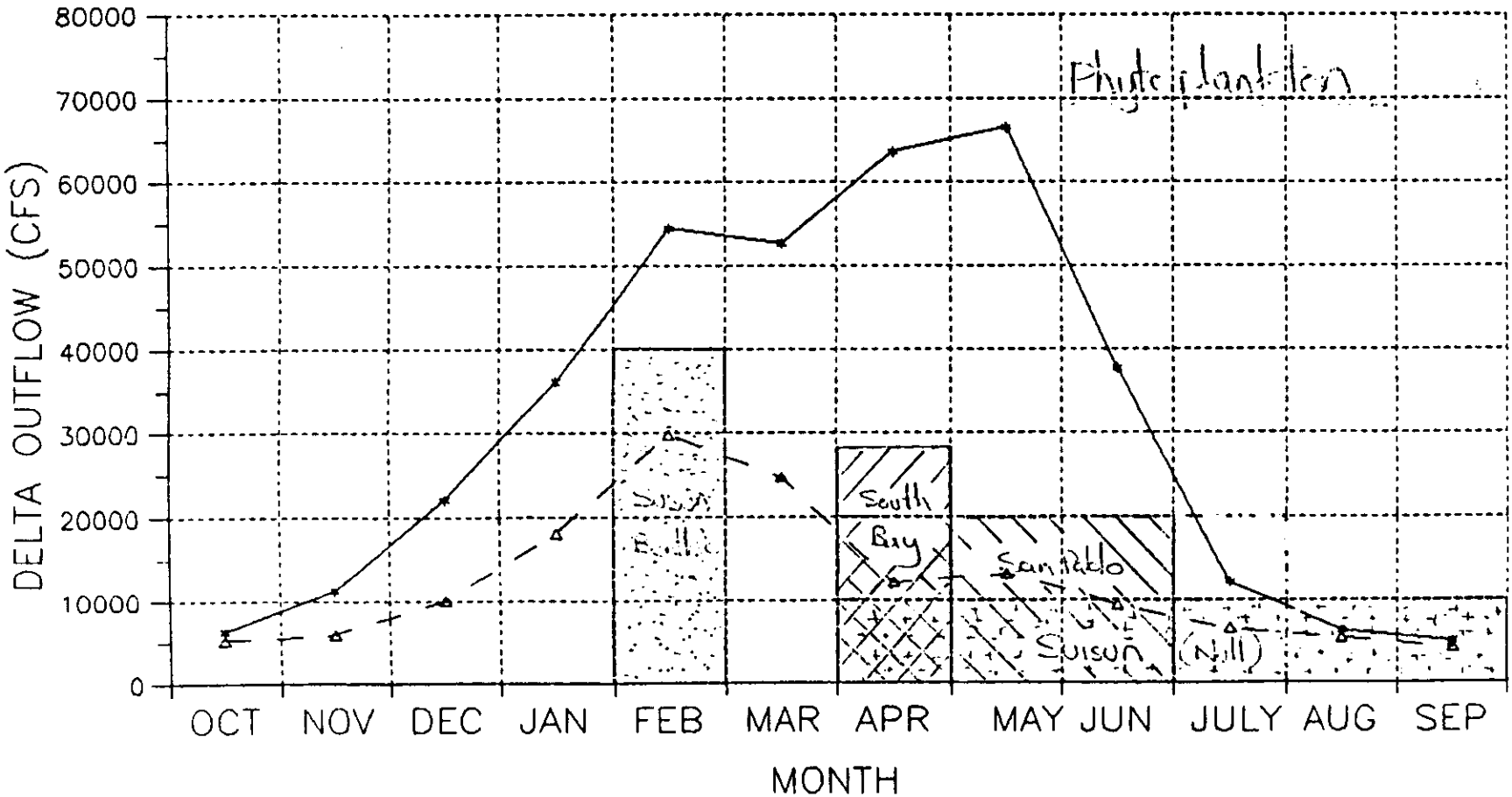


DATE: 12/07/87 BY: L. FISHBAIN	UNIMPAIRED EXISTING	Philip Williams & Associates Pier 35, The Embarcadero San Francisco, California 94111	FIGURE 17

EDF EXH. 17

CHANGES IN MONTHLY DELTA OUTFLOW

MEDIAN YEAR



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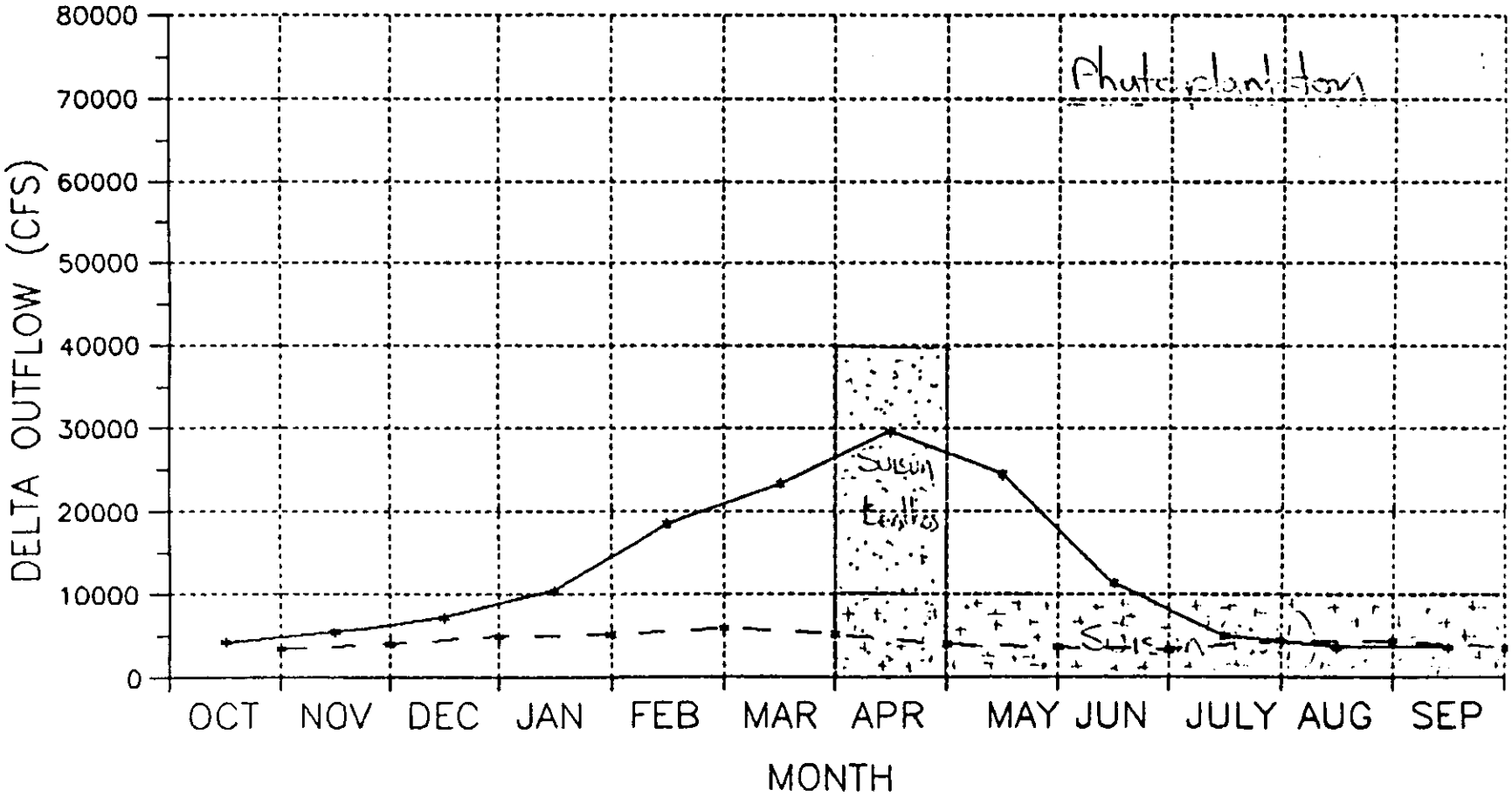
EDF EXH. 18

CHANGES IN MONTHLY DELTA OUTFLOW
1 IN 10 DRY YEAR



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EDF Exhibit 19

SUMMARY OF DELTA OUTFLOWS FOR WETLAND STANDARDS

A. Suisun Marsh - Tidal Brackish Marsh Standard

Month	28-Day Average Higher High Tide EC Standard	28-Day Average Mean Tide EC[1]	Delta Outflow (cfs)[2]	Application
February	15	7	50,000	> 1 in 10 dry
March	15	7	40,000	> 1 in 10 dry
April	18	10	25,000	All Years
May	20	12	20,000	All Years

Notes: 1. SALDIF conversion algorithm
2. Regression of DELSTAT monthly values at Martinez

B. Suisun Marsh - Managed Wetlands Standard (Original D1485 at S-36)

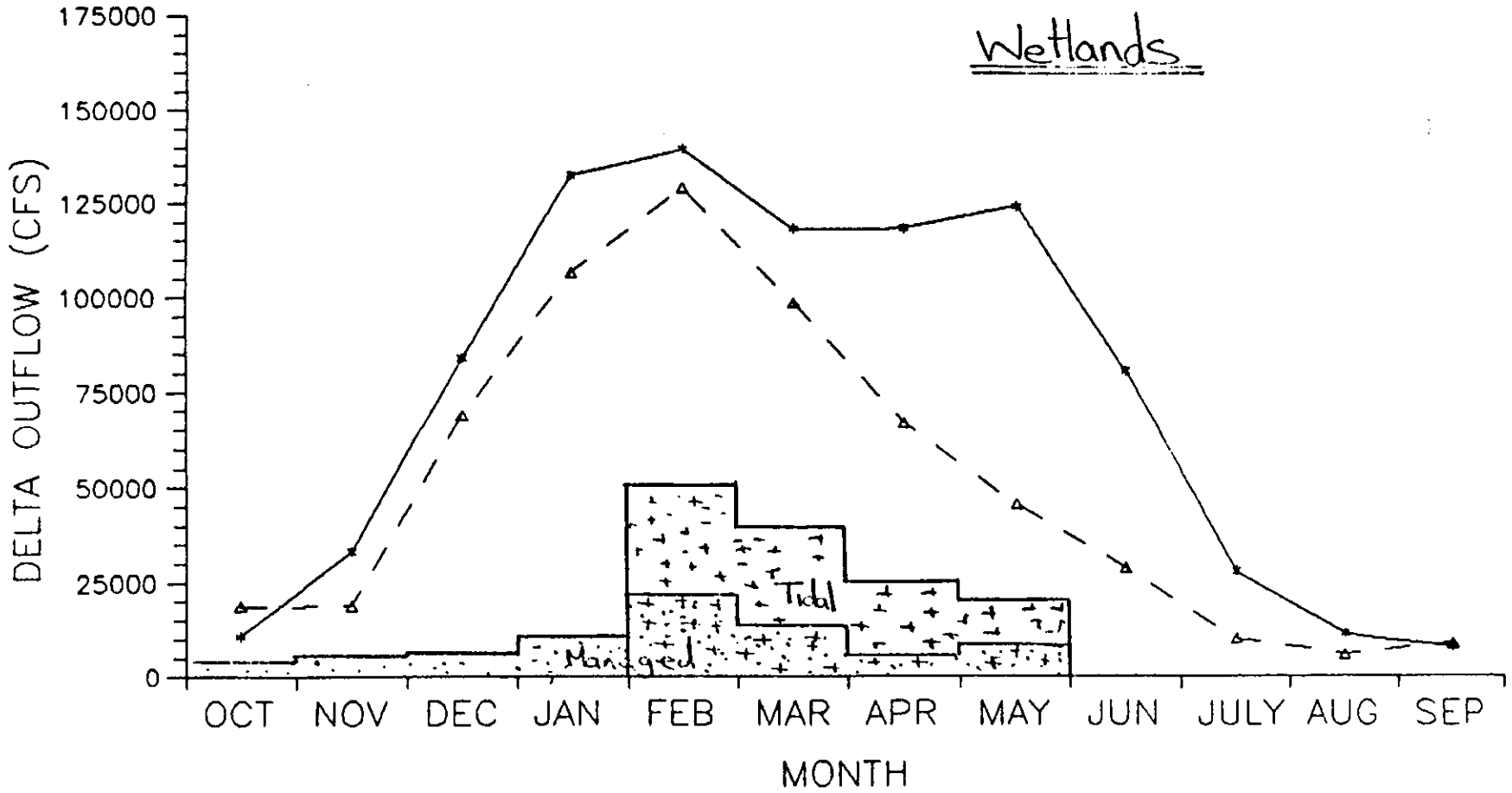
Month	Monthly Average Mean High Tide EC	Monthly Average Mean Tide EC	Delta Outflow (cfs)[2]	Application
October	19.0	17	4,000	All Years
November	15.5	13	6,000	All Years
December	15.5	13	7,000	All Years
January	12.5	10	11,000	All Years
February	8.0	6	21,000	All Years
March	8.0	6	13,000	All Years
April	11.0	9	8,000	All Years

Notes: 1. Conversion as per DWR Exhibit 61
2. Regression of DELSTAT monthly values at S36

EDF EXH. 20

CHANGES IN MONTHLY DELTA OUTFLOW

1 IN 10 WET YEAR



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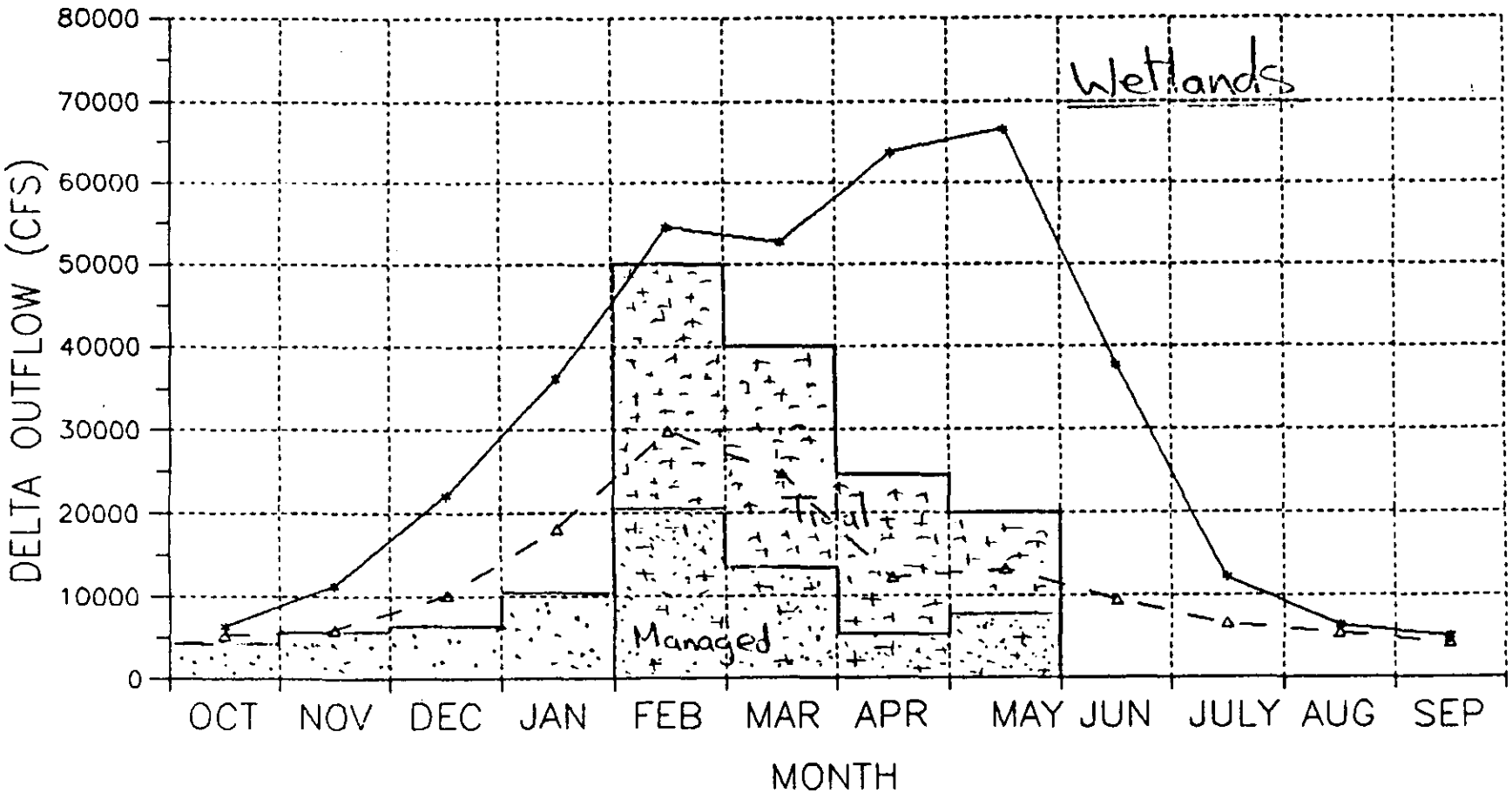
EDF EXH. 21

CHANGES IN MONTHLY DELTA OUTFLOW

MEDIAN YEAR



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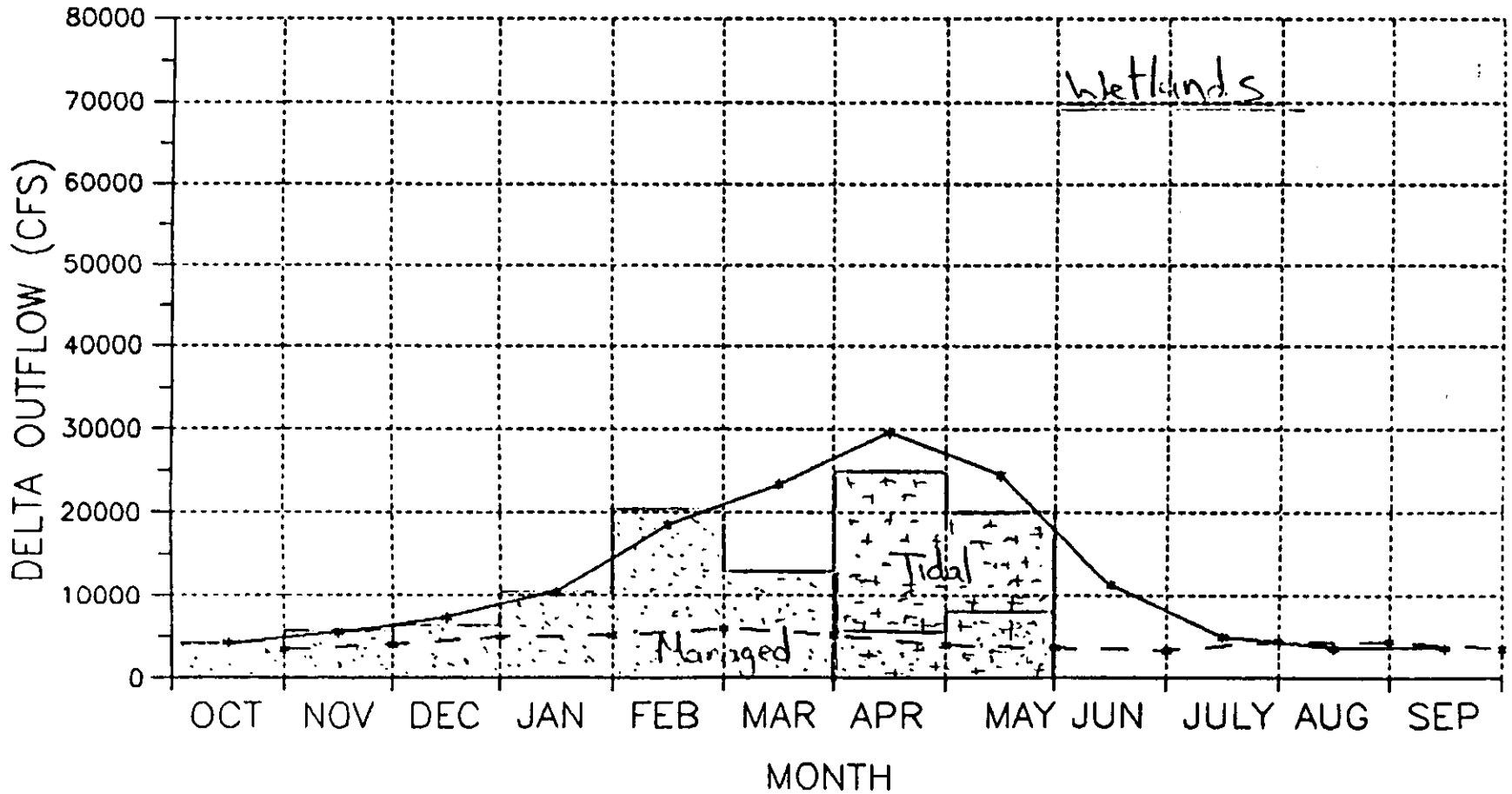
EDF EXH. 22

CHANGES IN MONTHLY DELTA OUTFLOW
1 IN 10 DRY YEAR



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SALMON SMOLT MIGRATION STANDARDS

APRIL, MAY, JUNE

Water Year Type	Annual Survival Index Goal	Sacramento R. Rio Vista cfs.	Sacramento R. Freeport cfs.	Sacramento R. Diversion[3] Above RV cfs.	S. Joaquin at Vernalis cfs.	Total River Freeport & Vernalis	Estimated[4] Export + Depl - E. Side cfs.	Estimated Delta Outflow cfs.
Wet	0.95	22,000	26,000	4,000[1]	11,000	37,000	6,000	31,000
Above N.	0.87	20,000	24,000	4,000[1]	10,000	34,000	7,000	27,000
Below N.	0.75	18,000	22,000	4,000[1]	9,000	31,000	8,000	23,000
Dry	0.65	16,000	20,000	4,000[1]	8,000	28,000	9,000	19,000
Critical	0.30	10,000	15,000	5,000[2]	5,000	20,000	10,000	10,000

Note:
1. Cross channel closed, Georgiana Slough only
2. Cross channel and Georgiana Slough
3. From DWR Exhibit 50
4. Based on recent historic DAYFLOW records

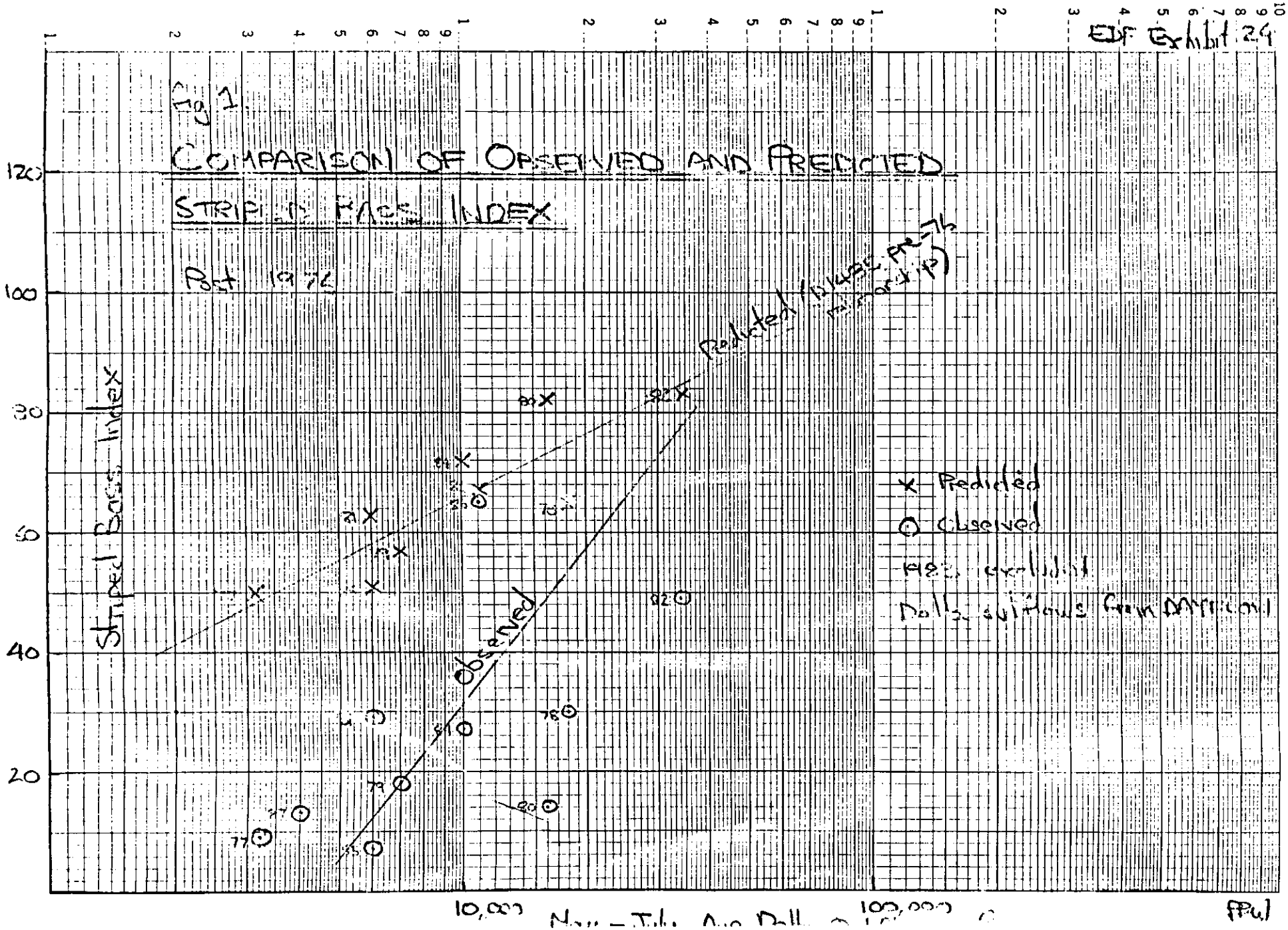
EJF Exhibit 24

Fig 1.

COMPARISON OF OBSERVED AND PREDICTED

STRIPED BASS INDEX

Post 1972

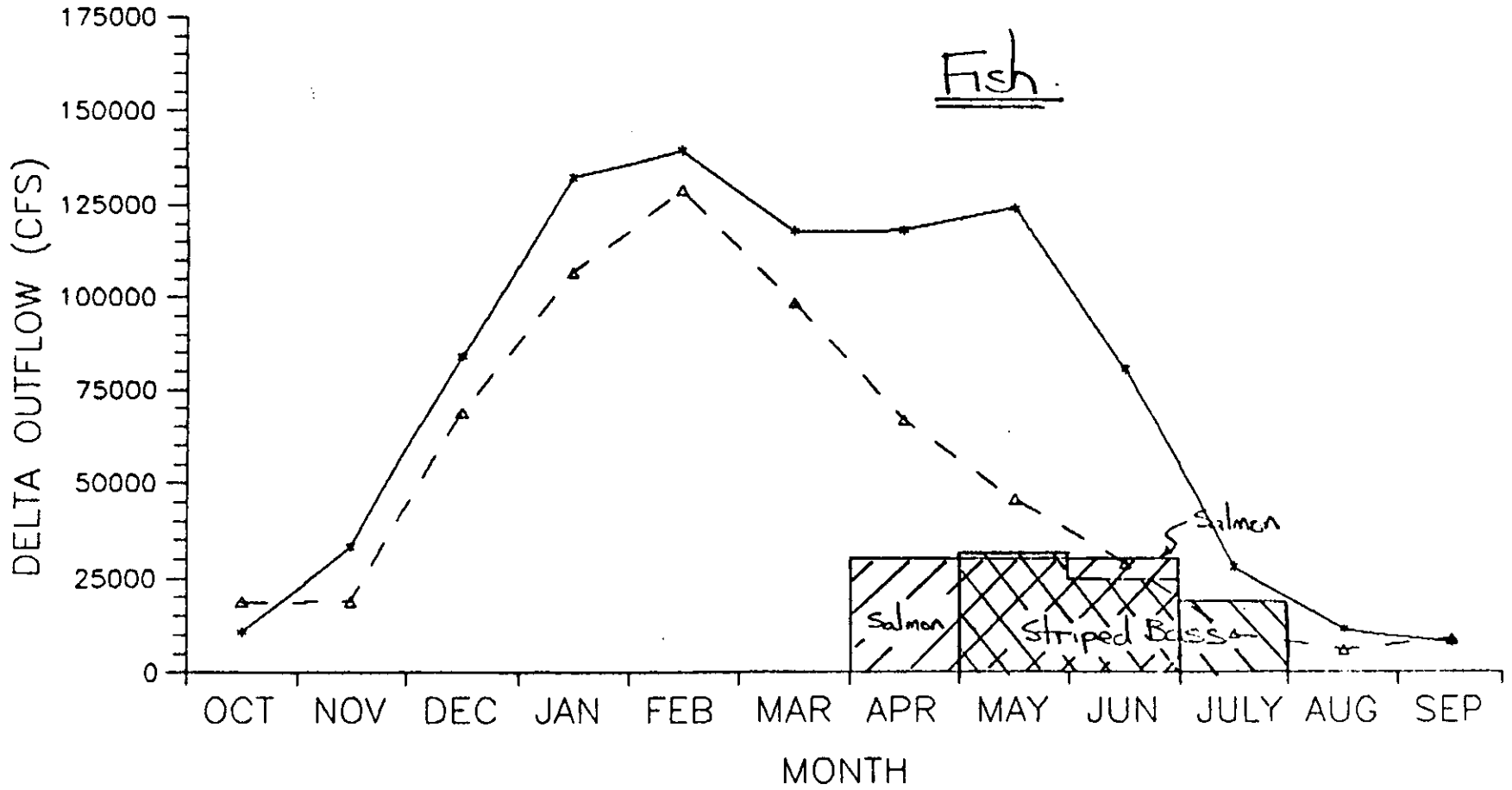


Striped Bass Survival Flow Standard

Water Year Type 4-River Index	D-1485 Standard x 1,000 cfs May 6-31	June	July	Monthly Average	Revised Standard x 1,000 cfs May 6-31	June	July	Monthly Average
Wet	14.0	14.0	10.0	12.7	38	25	18	27
Ab. N	14.0	10.7	7.7	10.8	36	24	18	26
Bl. N	11.4	9.5	6.5	9.1	34	23	15	24
Sub Snow	6.5	5.4	3.6	5.2	27	18	12	19
Dry	4.3	3.6	3.2	3.7	23	15	10	16
Dry After Dry or Crit.	3.3	3.1	2.9	3.1	21	14	10	15
Critical	3.3	3.1	2.9	3.1	21	14	10	15

EDF Exh 126

CHANGES IN MONTHLY DELTA OUTFLOW
1 IN 10 WET YEAR



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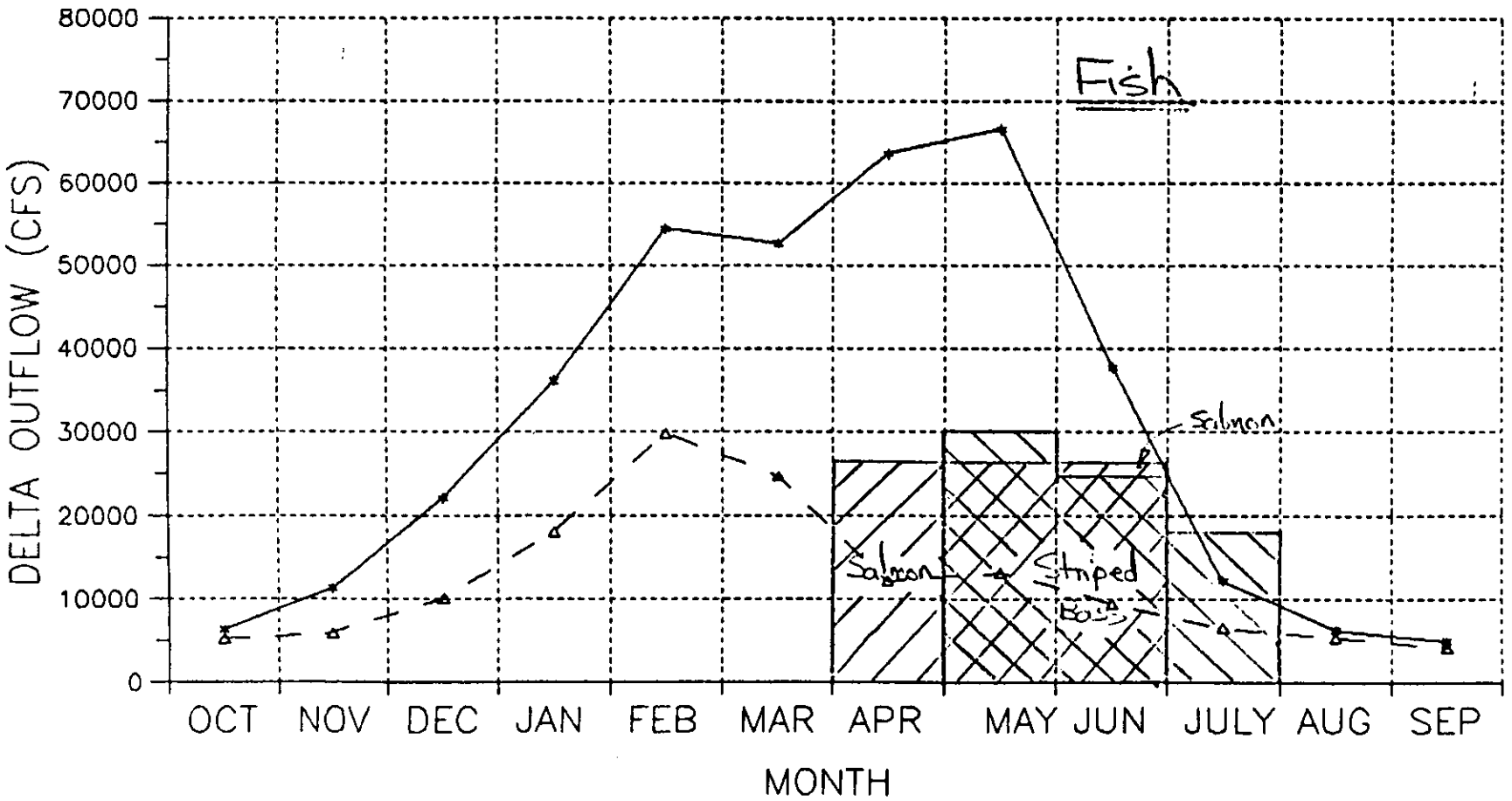
EDF Exh. 27

CHANGES IN MONTHLY DELTA OUTFLOW

MEDIAN YEAR



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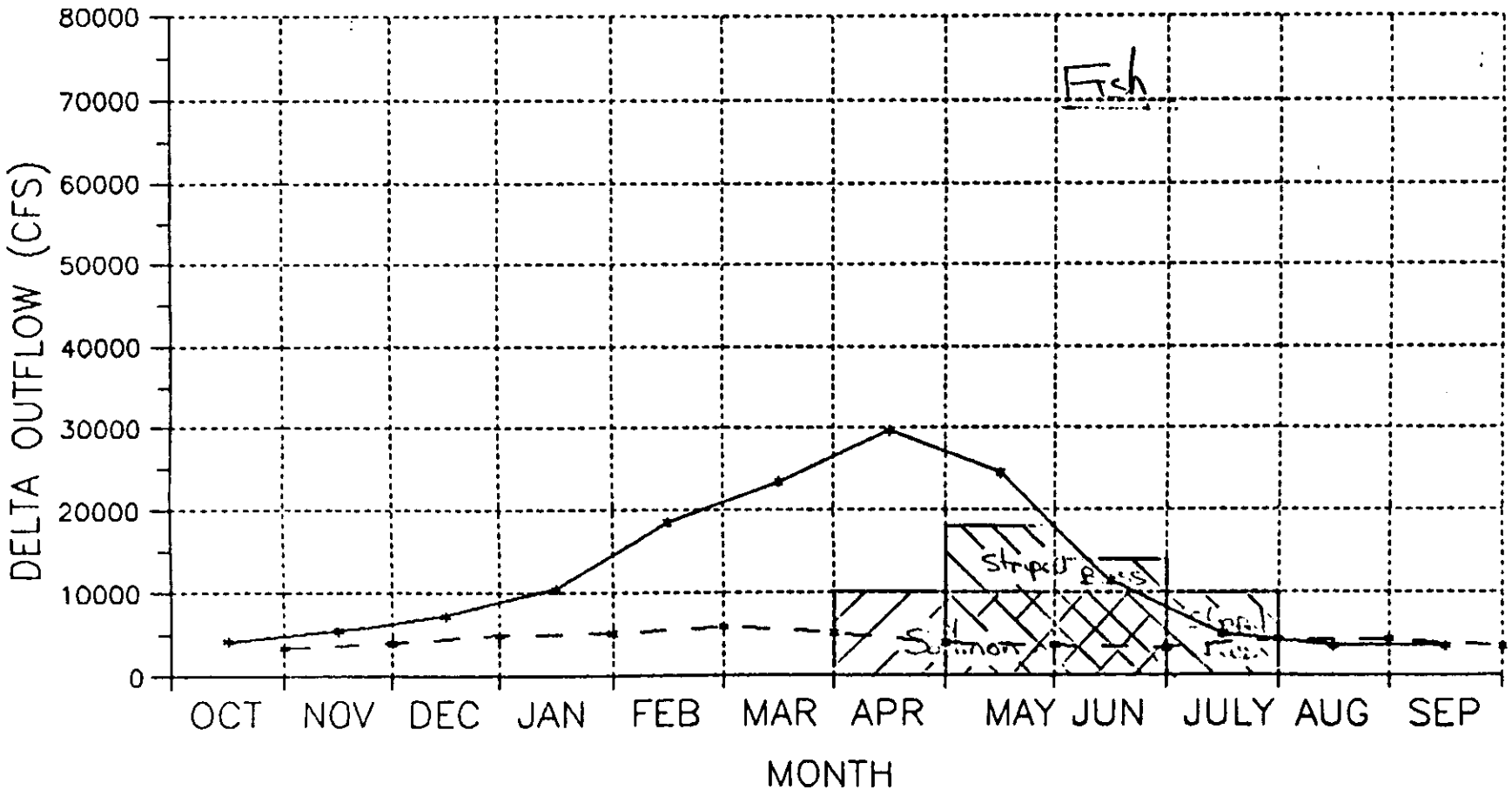
EDF Exh. 28

CHANGES IN MONTHLY DELTA OUTFLOW

1 IN 10 DRY YEAR



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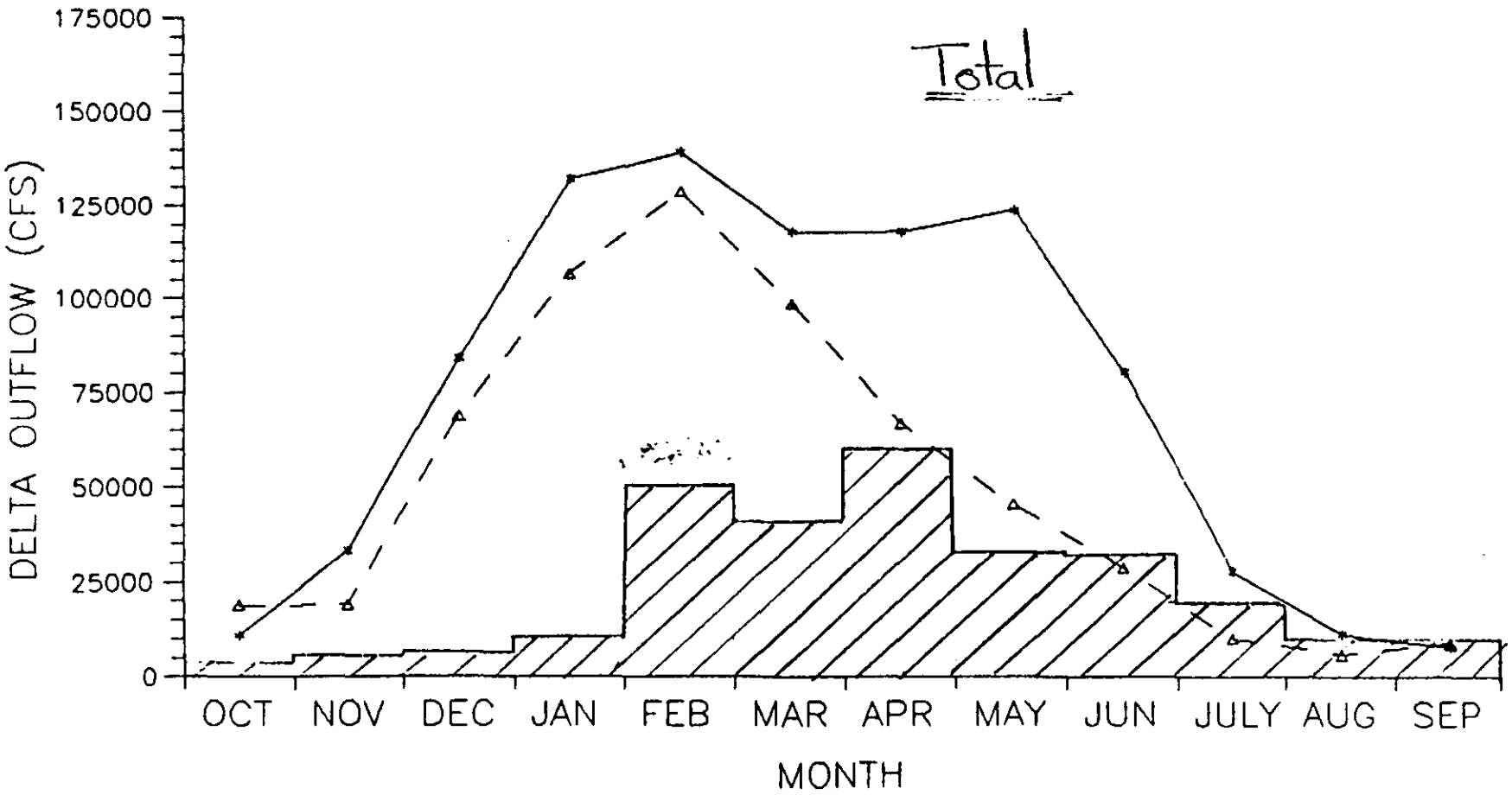
EDF Exh.29

CHANGES IN MONTHLY DELTA OUTFLOW
1 IN 10 WET YEAR



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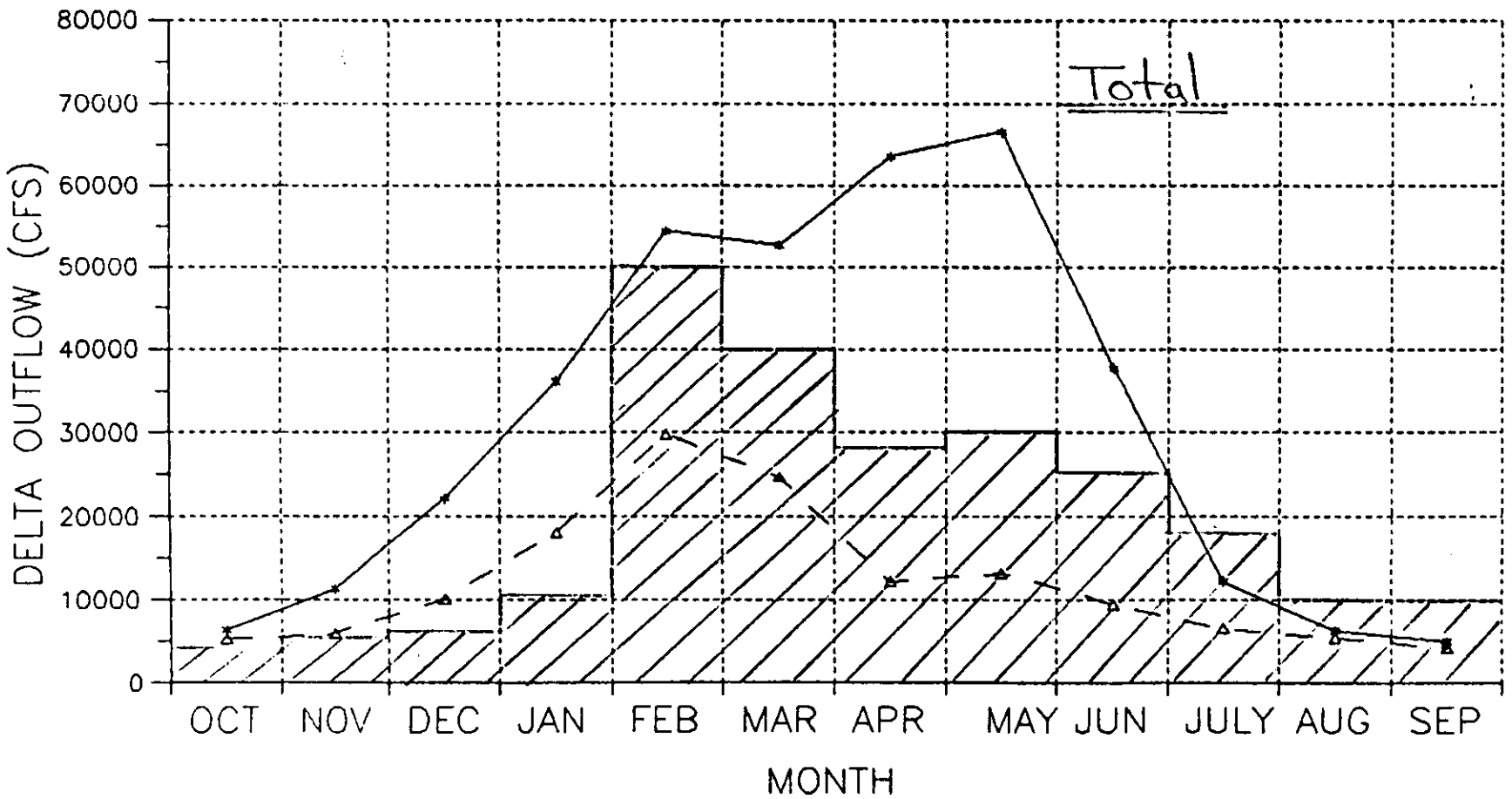
EDF Exh 30

CHANGES IN MONTHLY DELTA OUTFLOW

MEDIAN YEAR



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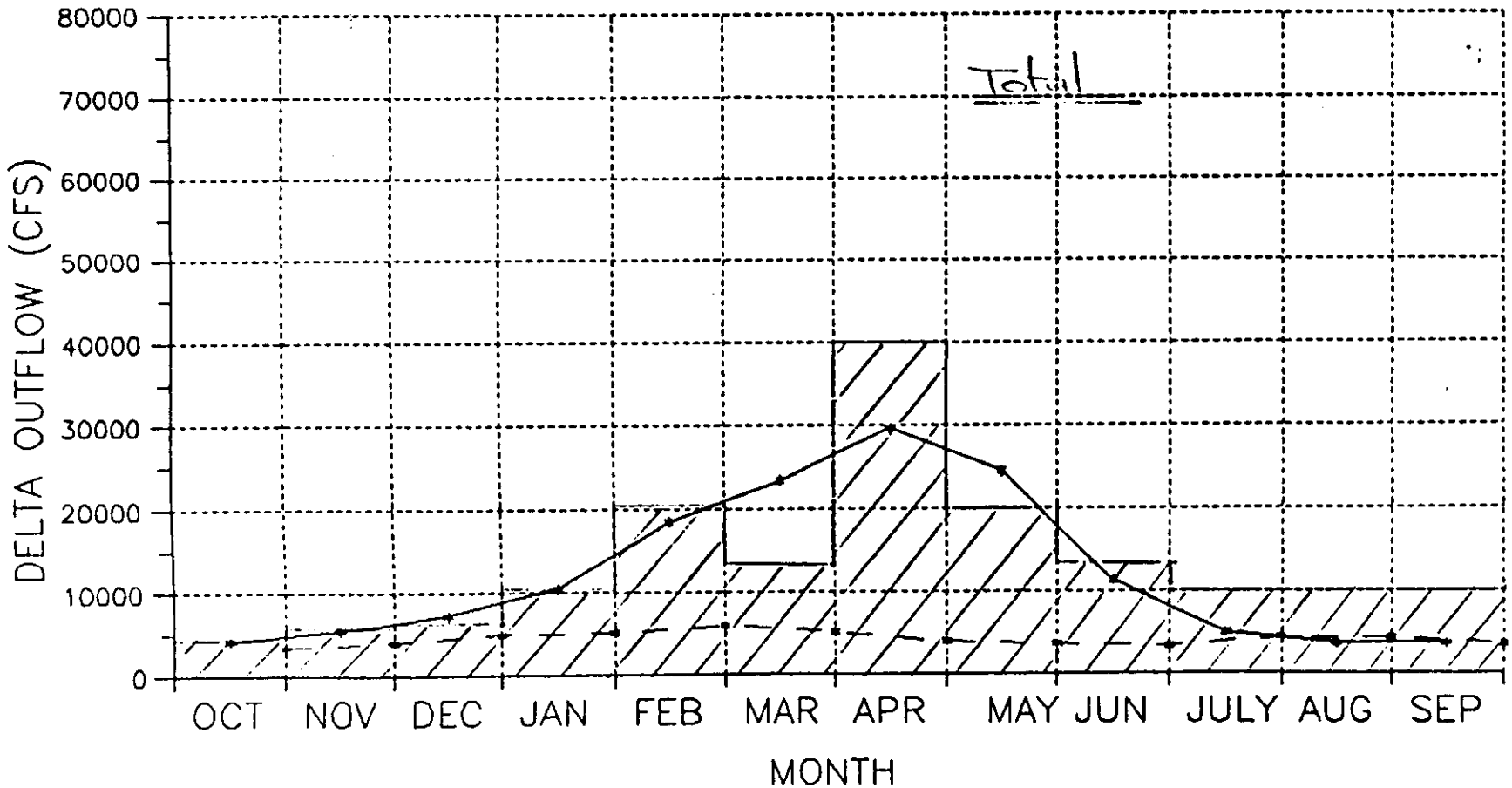
EDF Exh 31

CHANGES IN MONTHLY DELTA OUTFLOW

1 IN 10 DRY YEAR



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EDF EXHIBIT 32

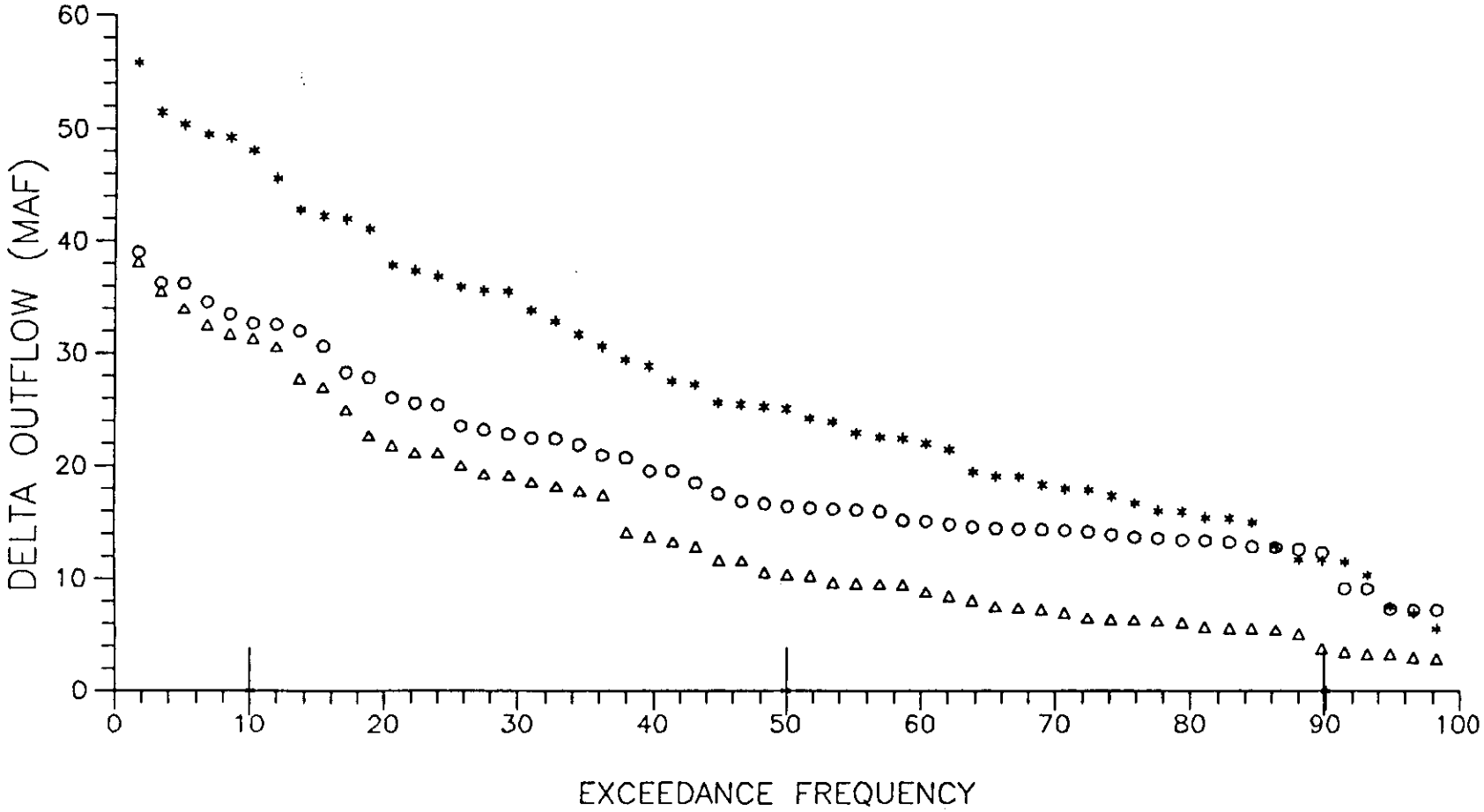
1985-LEVEL DELTA OUTFLOWS WITH SAN FRANCISCO BAY STANDARDS (TAF)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOT
1922	274.4	357.0	802.3	697.6	2776.9	2459.5	3332.2	2047.3	1606.6	1106.8	614.9	595.0	16670.5
1923	515.8	502.0	2695.2	1655.6	2776.9	2459.5	1666.1	1783.1	1368.6	922.3	614.9	595.0	17555.0
1924	272.5	357.0	430.4	676.4	1207.9	799.3	595.0	1106.8	833.1	614.9	184.5	191.0	7269.8
1925	276.2	357.0	430.4	676.4	2776.9	2459.5	3332.2	1844.6	1606.6	1106.8	614.9	595.0	16876.5
1926	246.0	357.0	430.4	676.4	2776.9	2459.5	3332.2	1229.8	1130.6	614.9	614.9	595.0	14463.5
1927	260.2	940.6	700.5	1408.9	7628.6	2459.5	3332.2	1967.6	1844.6	1106.8	614.9	595.0	22859.5
1928	558.4	996.8	646.2	899.3	2876.0	6241.4	3332.2	1660.2	1606.6	737.9	614.9	595.0	20764.9
1929	259.7	357.0	430.4	676.4	2221.5	799.3	595.0	1106.8	833.1	614.9	614.9	595.0	9104.9
1930	246.0	357.0	455.6	1079.6	2776.9	2459.5	1487.6	1414.2	1368.6	737.9	614.9	595.0	13592.7
1931	246.0	357.0	430.4	676.4	1166.3	799.3	595.0	1106.8	833.1	614.9	184.5	193.1	7202.7
1932	246.0	357.0	621.1	952.2	2876.0	2459.5	1487.6	1783.1	1368.6	922.3	614.9	595.0	14283.4
1933	246.0	357.0	430.4	676.4	2221.5	799.3	595.0	1106.8	833.1	614.9	614.9	595.0	9090.2
1934	246.0	357.0	430.4	676.4	2776.9	2459.5	1487.6	1229.8	833.1	614.9	614.9	595.0	12321.3
1935	246.0	357.0	430.4	1496.2	2776.9	2459.5	3332.2	1844.6	1606.6	1106.8	614.9	595.0	16866.1
1936	297.0	357.0	430.4	1962.0	5000.6	2459.5	3332.2	1844.6	1606.6	1106.8	614.9	595.0	19606.7
1937	398.6	357.0	430.4	676.4	2776.9	3167.4	3332.2	1783.1	1368.6	922.3	614.9	595.0	16422.9
1938	450.0	1086.5	4086.5	1596.3	8156.2	10256.0	3997.1	4320.0	2759.5	1106.8	614.9	595.0	39024.8
1939	1188.8	450.1	434.3	676.4	2776.9	2459.5	1487.6	1229.8	833.1	614.9	614.9	595.0	13361.1
1940	246.0	357.0	430.4	1380.5	3717.1	6660.6	3549.3	1967.6	1844.6	1106.8	614.9	595.0	22469.8
1941	390.0	357.0	2673.8	6446.2	7049.8	5991.7	4873.3	2674.3	1844.6	1106.8	614.9	595.0	34617.4
1942	970.8	585.8	3768.4	5043.7	8046.0	2459.5	3332.2	2289.5	1844.6	1106.8	614.9	595.0	30657.3
1943	1019.6	771.1	1428.0	5061.3	3234.0	5117.5	3332.2	1967.6	1844.6	1106.8	614.9	595.0	26092.6
1944	378.7	357.0	430.4	676.4	2876.0	2459.5	1487.6	1229.8	1130.6	614.9	614.9	595.0	12859.8
1945	266.8	509.2	659.2	676.4	3229.5	2459.5	1487.6	1783.1	1368.6	922.3	614.9	595.0	14572.1
1946	502.6	514.0	4553.5	2738.9	2776.9	2459.5	1666.1	1844.6	1606.6	1106.8	614.9	595.0	20979.4
1947	324.9	357.0	502.1	676.4	2776.9	2459.5	1487.6	1229.8	1130.6	614.9	614.9	595.0	12769.5
1948	292.1	357.0	430.4	676.4	2876.0	2459.5	3332.2	1844.6	1606.6	1106.8	614.9	595.0	16191.6
1949	345.5	357.0	430.4	676.4	2776.9	2994.5	1666.1	1229.8	1130.6	614.9	614.9	595.0	13431.9
1950	263.9	357.0	430.4	921.3	2776.9	2459.5	1666.1	1783.1	1368.6	922.3	614.9	595.0	14159.1
1951	642.6	3554.7	6139.2	3843.9	3685.6	2459.5	1844.6	1906.1	1844.6	737.9	614.9	595.0	27868.7
1952	319.5	585.8	3194.1	5544.8	4823.2	4208.0	3966.5	4470.1	2558.5	1106.8	614.9	595.0	31987.2
1953	1137.8	464.1	2613.6	6151.4	2776.9	2459.5	1844.6	1967.6	1844.6	1106.8	614.9	595.0	23576.8
1954	756.2	782.8	430.4	1519.9	3206.0	2748.4	3332.2	1844.6	1606.6	1106.8	614.9	595.0	18543.9
1955	297.5	554.4	1154.1	1019.6	2776.9	2459.5	1487.6	1229.8	1130.6	614.9	614.9	595.0	13934.7
1956	260.8	357.0	6717.7	10061.0	4923.3	2459.5	1844.6	2743.0	1844.6	1106.8	614.9	595.0	33528.3
1957	1405.5	357.0	430.4	676.4	2776.9	2739.6	1487.6	1783.1	1368.6	922.3	614.9	595.0	15157.3
1958	938.7	598.0	1265.6	2284.5	9118.4	8083.8	6391.3	2992.4	2309.5	1106.8	614.9	618.2	36322.1
1959	1192.3	357.0	430.4	1899.5	2995.1	2459.5	1487.6	1229.8	1190.1	614.9	614.9	595.0	15066.1
1960	246.0	357.0	430.4	676.4	2876.0	2459.5	1487.6	1414.2	1368.6	737.9	614.9	595.0	13263.5
1961	246.0	357.0	430.4	676.4	2776.9	2459.5	1487.6	1229.8	1130.6	614.9	614.9	595.0	12618.9
1962	246.0	357.0	456.3	676.4	3686.8	2459.5	1666.1	1783.1	1368.6	922.3	614.9	595.0	14832.0
1963	2463.4	389.4	1358.5	875.1	4301.8	2459.5	5278.2	1967.6	1844.6	1106.8	614.9	595.0	23254.8
1964	577.3	1268.3	430.4	1124.0	2876.0	2459.5	1487.6	1229.8	1130.6	614.9	614.9	595.0	14408.3
1965	260.6	399.7	5955.8	7006.5	2776.9	2459.5	3332.2	1967.6	1844.6	1106.8	614.9	595.0	28320.1
1966	606.3	1391.5	712.7	1592.5	2776.9	2459.5	1666.1	1414.2	1368.6	737.9	614.9	595.0	15936.1
1967	246.0	383.4	2475.8	3824.5	3089.9	3566.8	3332.2	3405.7	2992.9	1106.8	614.9	595.0	25633.9
1968	1147.9	520.7	775.8	1644.0	3530.3	2459.5	1487.6	1414.2	1368.6	737.9	614.9	595.0	16296.4
1969	282.3	357.0	1024.5	8083.0	7529.0	3437.7	3332.2	4212.3	2119.9	1106.8	614.9	595.0	32694.7
1970	1026.0	718.8	3322.6	12777.0	4732.6	2459.5	1844.6	1906.1	1844.6	737.9	614.9	595.0	32579.7
1971	326.4	1181.1	4638.0	2801.7	2776.9	2829.1	1844.6	1967.6	1844.6	1106.8	614.9	595.0	22526.7
1972	644.4	453.8	929.9	758.6	2876.0	2459.5	1487.6	1414.2	1368.6	737.9	614.9	595.0	14340.4
1973	355.7	1115.5	1311.4	5493.5	5570.5	3648.2	1844.6	1967.6	1844.6	1106.8	614.9	595.0	25468.3
1974	335.4	3840.9	4166.3	8031.4	2776.9	6907.1	4058.8	1967.6	1844.6	1106.8	614.9	595.0	36245.7
1975	898.2	550.1	752.3	777.3	3718.9	5440.2	1666.1	1844.6	1606.6	1106.8	614.9	615.2	19991.3
1976	1275.0	594.5	438.3	676.4	2876.0	2459.5	1487.6	1229.8	833.1	614.9	614.9	595.0	13694.9
1977	246.0	357.0	430.4	676.4	1166.3	799.3	595.0	1106.8	833.1	614.9	184.5	178.5	7188.1
1978	246.0	357.0	430.4	3752.6	2827.7	4505.1	3672.0	1967.6	1844.6	1106.8	614.9	595.0	21919.7
AVG	528.1	632.6	1461.9	2416.4	3563.3	3090.6	2373.3	1856.7	1527.4	894.3	592.2	574.4	19511.0

EDF exhibit 22

SAN FRANCISCO BAY STANDARDS

ANNUAL FLOW FREQUENCY RELATIONSHIP



DATE: 12/10/87

BY: L. FISHBAIN

* UNIMPAIRED
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○ W/STANDARDS

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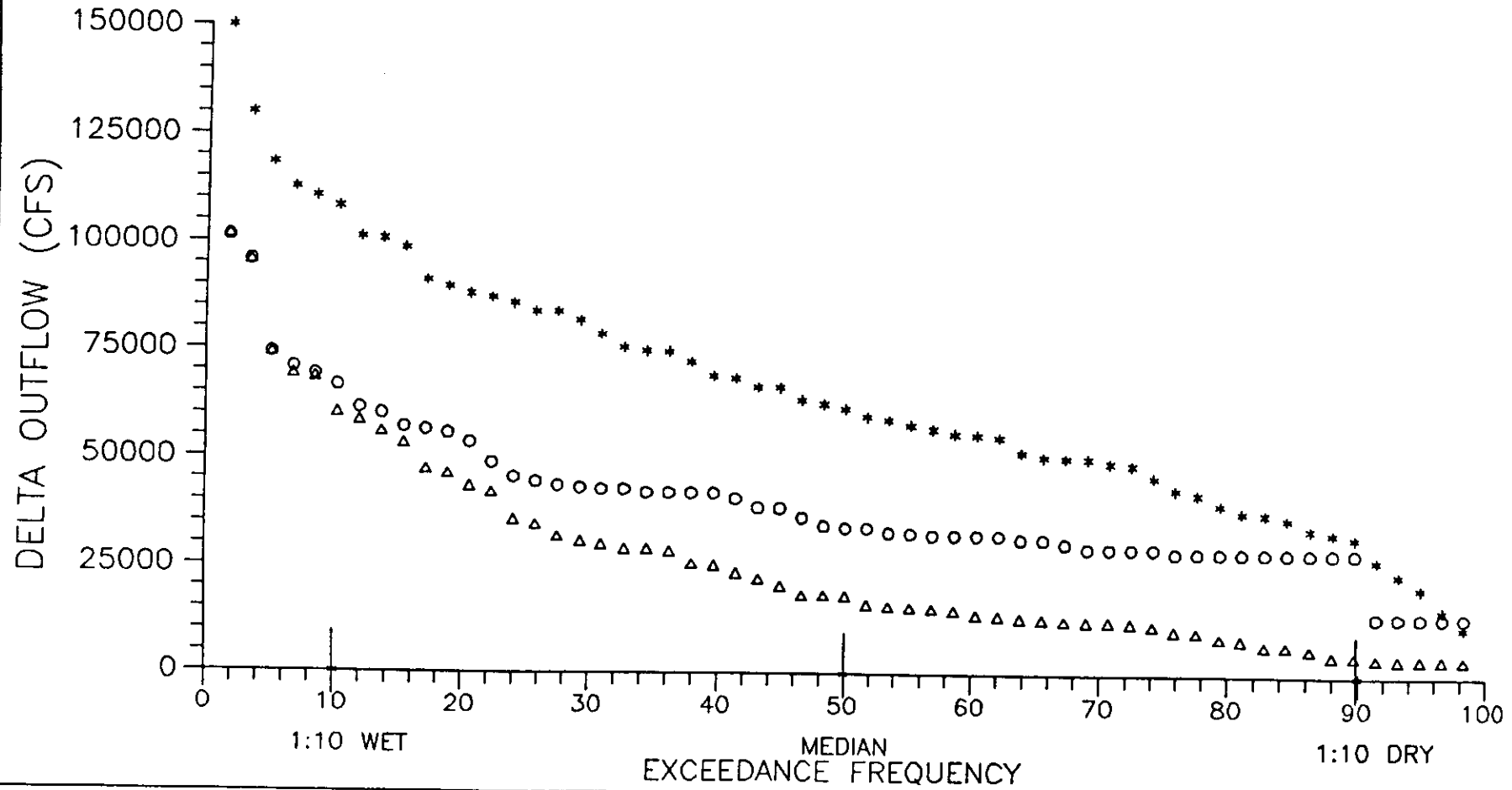
Pier 35, The Embarcadero
San Francisco, California 94111

EDF exhibit 34

SAN FRANCISCO BAY STANDARDS

SPRING FLOW FREQUENCY RELATIONSHIP



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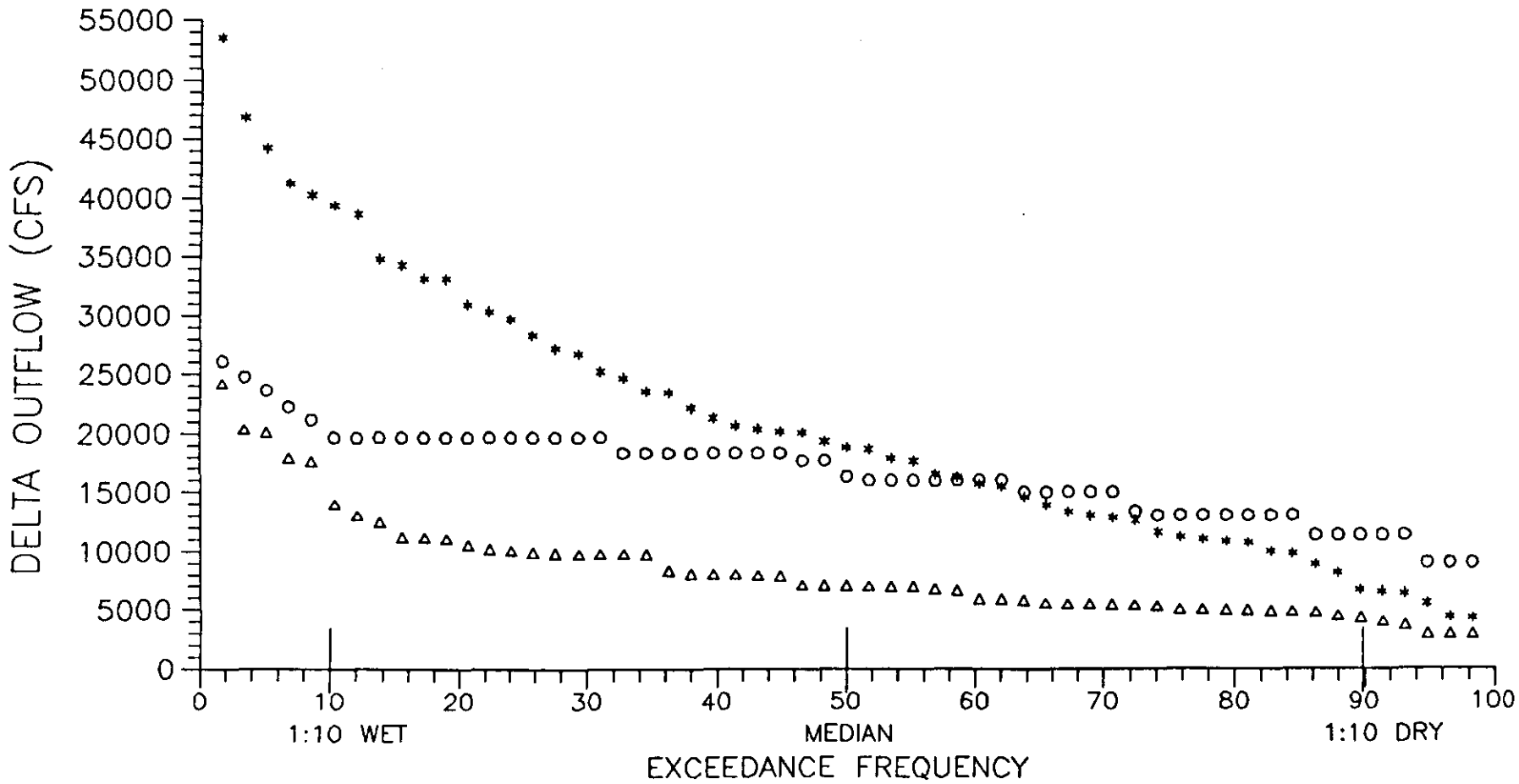
EDF exhibit 35

SAN FRANCISCO BAY STANDARDS
SUMMER FLOW FREQUENCY RELATIONSHIP



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