ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF ENFORCEMENT

REPORT ON

POLLUTION AFFECTING SHELLFISH HARVESTING IN SAN FRANCISCO BAY, CALIFORNIA

PARTIAL PRELIMINARY DRAFT

FEDERAL FIELD INVESTIGATIONS CENTER-DENVER

DENVER, COLORADO

AND

REGION IX, SAN FRANCISCO, CALIFORNIA

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CLEAN WATER

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT

Report on

POLLUTION AFFECTING SHELLFISH HARVESTING IN SAN FRANCISCO BAY, CALIFORNIA

National Field Investigations Center-Denver
Denver, Colorado
and
Region IX
San Francisco, California

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I. INTRODUCTION

Water quality standards were adopted for San Francisco Bay and its tributaries by the California State Water Quality Control Board in 1967, and accepted by the Secretary of the Interior in January 1969, in accordance with the Federal Water Quality Act of 1965. Pollution of these waters is subject to the provisions of Section 10, Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.). Section 10(a) of the Act provides that the pollution, of navigable waters in or adjacent to any State, that endangers the health or welfare of any persons shall be subject to abatement.

Section 10(d) of the Act further provides that a Federal-State conference shall be called whenever, on the basis of reports, surveys, or studies, there is reason to believe that substantial economic injury results from the inability to market shellfish or shellfish products in interstate commerce because of pollution of such waters, and called because of action of Federal, State, or local authorities.

This report summarizes presently available information pertaining to the water quality in the San Francisco Bay system; evaluates that information with respect to applicable standards, statutes, regulations, or criteria; and recommends a program that will lead to compliance with established water quality uses.

Specific objectives of the report are:

A. To evaluate the water quality in San Francisco Bay.

B. To determine whether a commercial shellfish industry or other beneficial uses of the bay are being impaired by pollution of the waters.

C. To determine whether shellfish or other economically important bay species are being adversely affected by water pollution.

D. To ascertain if existing and scheduled pollution abatement measures for major municipal and industrial waste sources are satisfactory in light of existing and pending federal responsibilities.

E. To ascertain if violations of water quality standards are occurring in San Francisco Bay.

F. To develop recommendations for appropriate enforcement action(s).

Sources of information contained in this report include: The California State Water Resources Control Board; the California State Department of Health; the California Department of Fish and Game; California Academy of Science; San Francisco Regional Water Quality Board; National Marine Fisheries Service; National Oceanic and Atmospheric Administration (NOAA); Marine Minerals Technical Center; U. S. Geological Survey; the University of California; the United State Public Health Service; Food and Drug Administration (FDA); and the Environmental Protection Agency (EPA). Limited field studies were also conducted by the EPA National Field Investigations Center-Denver (NFIC-D), Office of Enforcement, and by EPA Region IX personnel in San Francisco. The cooperation and contribution of the various state, local, and private organizations are gratefully appreciated.

II. SUMMARY AND CONCLUSIONS

Despite continued attempts at implementing disinfection practices in order to control coliform bacteria densities in San Francisco Bay, as well as abatement and control programs for reducing other deliterious contaminants, the EPA investigation, in the spring of 1972, indicated that bacterial and other contamination interferes with the propagation or harvest of commercially important shellfish.

Repeated bacteriological analyses of water samples from throughout the bay system reveal that, except for in Carquinez Strait and Suisun Bay, mid-channel waters contain relatively low coliform bacteria densities. In contrast, more than fifty percent of the waters directly over known shellfish beds, on the periphery of the Bay, contained coliform bacteria densities in excess of state and federal criteria for "approved" shellfish growing waters.

The occurrence of these unacceptably high concentrations of coliform bacteria were in the western and southwestern sectors of South Bay and in the vicinity of the densely populated area of Oakland and Alameda. The central area of the bay system contained two district localities of high coliform densities, one being the inner waters of Richardson Bay and the other the waters adjacent to Point Richmond on the northeastern shore. Of several shellfish areas in San Pablo Bay only Molate Point, north of the eastern side of the San Rafael-Richmond Bridge, was, surrounded by waters of an unsatisfactory bacteriological quality. One shellfish growing area in Carquinez Strait also contained overlying waters of poor quality.

Shellfish quality standards adopted by the State of California and the National Shellfish Sanitation Program were exceeded in most shellfish samples collected from the intertidal zone throughout the bay.

At one time or another, all shellfish collected from Central and South Bays showed coliform bacteria densities in excess of adopted market standards. Samples collected from four of the seven locations in San Pablo Bay were in excess of bacteriological standards, and the only obtainable sample from Carquinez Strait also proved to be of unsatisfactory bacteriological quality.

In addition to the analyses for the accepted coliform indicator organisms each shellfish sample was examined for enteric pathogens. Two species of *Salmonella* were found; *S. kentucky* was recovered from a sample collected at Burlingame (on the western side of South Bay), and *S. typhimurium* was isolated from a sample collected in San Leandro Bay. These findings indicate contamination of shellfish by inadequately treated sewage and, consequently, a severe health hazard to anyone consuming the sea food.

Shellfish from the San Francisco Bay area were found to be contaminated with heavy metals, notably cadmium, chromium, copper, mercury, lead, and zinc. At many bay locations heavy metal concentrations in the shellfish were substantially greater than the background levels. Alert levels of heavy metals that have been proposed by the FDA as indicators of municipal and industrial pollution in shellfish were exceeded in eighteen different cases. Zinc and lead were the most widespread contaminants observed during the study.

In Carquinez Strait mercury concentrations in soft clams exceeded

the FDA recommended levels for fish and shellfish.

Chlorinated insecticides and polychlorinated biphenyls were found in the shellfish and sediments sampled at most stations. Although the concentrations exceeded background levels, they were not sufficiently high at this time to warrant regulatory action according to presently accepted alert levels.

Shellfish in San Francisco Bay were found to be contaminated with petroleum related hydrocarbons of industrial origin.

The propagation and harvesting of shellfish is impaired, to a major degree, by water pollution resulting from the discharge to the bay system of inadequately treated municipal and industrial wastes and by dredging, landfill, and spoil disposal practices. The potential exists for re-establishment of a major shellfishery in the bay, should existing water quality constraints be eliminated.

A sizeable standing crop of clams and native oysters is present in the bay system. Research has shown that using modern cultural methods, Pacific and Eastern oysters can be grown.

Estimates of the oyster productive potential of the San Francisco Bay system range from 1 to 13 million pounds of oyster meats annually. At a dockside price of $0.40 per pound, this production would have an annual value of $400,000 to $5,200,000. The large supply associated with the upper limit of potential production would probably result in reduced prices, making an upper limit of $2,600,000 a more realistic potential value of the fishery.

The total economic impact, on the economy of the San Francisco area,

as the result of the loss of the oyster fishery, caused by water pollution is in the range of $820,000 to $10,200,000. This estimate considers only the economic effect of the harvested oysters. The additional economic impact produced by the importation of seed oysters to supply cultural requirements is unknown.

The San Francisco Bay system exhibits evidence of enrichment at various locations, mainly along the shores and in tidal reaches of some tributaries. Nitrogen and phosphorous concentrations in the waters of the bay system are substantially higher than traditional growth-limiting levels. Decaying of aquatic vegetation has reached nuisance proportions in the Albany tide flats, by producing hydrogen sulfide odors and by causing blackening of the lead-based paints found on surrounding shoreline homes.

Agricultural drainage from the Central Valley, entering the bay system through the Delta, is one main source of nitrogen and phosphrous. Municipal and industrial waste discharges also contribute substantial nutrient loads to the bay.

Fish kills have occurred annually in San Francisco Bay, particularly in the Suisun Bay and Carquinez Strait area. These kills have generally occurred during the spring and summer in the vicinity of municipal waste treatment plants and industrial waste discharges and involve thousands of fish [Appendix F]. More than 56 percent of the reported fish kills were from unknown causes; however, of those from known causes about 20 percent resulted from low dissolved oxygen, 7 percent from sewage, 9 percent from an industrial pollutant, and 8 percent from other causes. Most of these kills were investigated by the California Department of Fish and Game.

SUMMARY AND CONCLUSIONS ON WASTE SOURCES

TO BE ADDED HERE.

Substantial success has been achieved by the State of California in eliminating conditions of gross pollution; however, dischargers not complying with state requirements still exist. Many dischargers have delayed construction of necessary treatment facilities.

No enforcement measures against pollution of interstate or navigable waters have been taken by the Federal Government in the bay area pursuant to the provisions of the Federal Water Pollution Control Act. Refuse Act prosecutions have been limited.

III. RECOMMENDATIONS

THIS SECTION TO BE

INSERTED LATER

IV. DESCRIPTION OF THE AREA

A. PHYSICAL DESCRIPTION

San Francisco Bay is a distinctive geographical feature in the Northern California area; unusual hills, striking in appearance, lie on the outer periphery of the bay area. It covers approximately 435 square miles. San Francisco Bay ranges from 3 to 12 miles in width and is about 50 miles in length.

Westernmost of the numerous large metropolitan areas is the City of San Francisco, situated on a land mass immediately south of the strait, Golden Gate, that is the bay connection with the Pacific Ocean. The cities of Richmond, Oakland, and Berkeley are east of San Francisco across the Bay from Golden Gate. To the northeast are Martinez, Vallejo, Pittsburg, and Antioch. South of the San Francisco area lie the cities of San Mateo, Burlingame, Redwood City, San Jose, Hayward, San Leandro, and Palo Alto. North of the area are Rodeo, San Rafael, Walnut Creek, Napa, Petaluma, and Antioch.

The periphery of the bay is characterized by flatlands and tidal marshland. Approximately 80 percent of this marshland has been "reclaimed," chiefly for agricultural use and salt ponds. A great amount of these lands, or shoreline, has a flat slope. As a result, the area between mean high and low water is relatively large; it totals 64 square miles. Another result of the effect of this flat-slope topography is the shallow depth of the bay. Average depths are about 20 feet. Immediately east of the Golden Gate, which is only several miles wide, the average

depth of the bay increases to 43 feet, while at the northern and southern reaches the average depth remains 18 to 20 feet. In contrast, the scouring action of high-velocity currents through the Carquinez Strait maintains a maximum depth of 90 feet.

The San Francisco Bay estuarine system lies on a northeast-southwest orientation and consists of South, San Francisco, San Pablo, and Suisun Bays, the Carquinez Straits, and the Delta of the San Joaquin and Sacramento Rivers. Within the boundaries of San Francisco Bay there are several islands including Angel Island, Alcatraz, Yerba Buena, and the man-made Treasure Island.

For purposes of later discussion, the San Francisco Bay system has been divided into four hydrographic units. These are: South Bay, Central Bay, San Pablo Bay and Suisun Bay. South Bay is the portion of San Francisco Bay lying south of the San Francisco-Oakland Bay Bridge. Central Bay boundaries are from the Richmond-San Rafael Bridge south to the San Francisco-Oakland Bay Bridge. San Pablo Bay lies between the Richmond-San Rafael Bridge and the Carquinez Strait Bridge. Suisun Bay extends easterly from the Carquinez Strait Bridge to the west end of the Chipps Island (including Grizzly and Honker Bays) [Figure IV-1].

B. CLIMATE

The San Francisco Bay area is characterized by a mild and temperate climate. The warmest weather occurs in the late spring and early autumn. Average temperatures in the City of San Francisco are about 50°F in January and about 60°F in July. This slight variation in annual temperature in the vicinity of the ocean contrasts to much wider ranges in the inland areas.

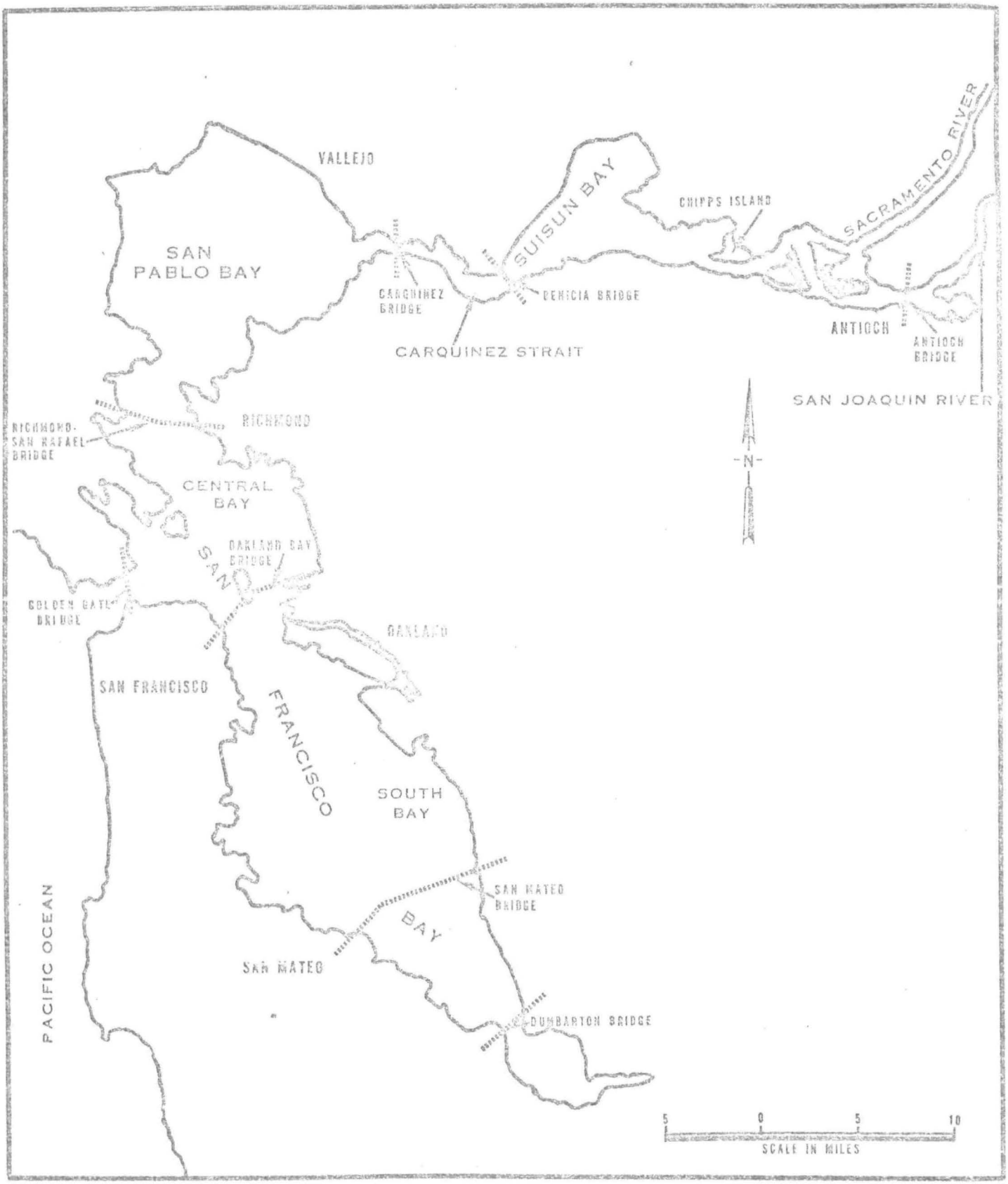

Figure IV-1 San Francisco Bay System

The rainy season extends from November through April, with maximums occurring in December and January. Mean annual rainfall varies geographically, with a high of 22 inches in the City of San Francisco to a low of about 13 inches in the southern and eastern sections of the Bay system. The average annual rainfall for the general Bay area is about 19 inches.

In contrast to precipitation, the average annual evaporation is about 48 inches which is more than twice the annual precipitation. This extensive rate of evaporation, highest in July, accounts for a loss of more than 650,000 acre feet of water annually from the Bay system.

C. HYDROLOGY

Along the Pacific Coast, including San Francisco Bay, one of the chief characteristics of the tide is diurnal inequality. Successive high or low water heights differ. The largest inequality is usually found in the low waters. The mean tidal range at Golden Gate is about 4 feet. At the Dumbarton Bridge, in South Bay, the mean tidal range increases to 7.5 feet, a noticeable change. In the northern section, the mean tidal range gradually decreases from 4.6 feet in upper San Pablo Bay to 3.1 feet at Antioch in Suisun Bay. These tidal differences in the northern section are attributed to a progressively dampened tidal surge. In addition to affecting the tidal range, this restrained tidal surge causes conspicuous variations in times of tidal peaks within the system. Tidal delays, using the Golden Gate as reference, are about 50 minutes at Dumbarton Bridge, one to two hours in eastern San Pablo Bay and nearly four hours at Antioch in Suisun Bay. Tidal velocities are variable in the Bay system and are influenced by winds and run-off from the Sacramento and San Joaquin Rivers.

Velocities exceeding five knots per hour occur in some reaches of the Bay.

Despite its shallow depths, San Francisco Bay (435 sq mi) contains a relatively large volume of water; at mean tide the volume is approximately 5.4 million acre feet. The tidal prism (the volume of water between mean high and low tides) is about 1.1 million acre feet or 21 percent of the average total volume of water in the Bay. On each tidal cycle about 4 percent of the total volume of the Bay is replaced by new ocean water, serving to remove pollutants from the Bay. However, most of this replacement occurs near Golden Gate, with progressively decreasing amount of flushing in the Bay system's interior.

Water transport within the Bay complex is controlled by tides and advective flow (flow or movement of water resulting from causes other than the tides). In the northern section of the Bay system the advective flow is basically the result of river discharge from the Delta region. However, in the southern section there is very little discharge from natural streams. The result is that the advective flow is minor and is governed by waste discharges and evaporation. In general, dominant control of Bay water transport is achieved by the effects of tides which far outweigh the effects of waste discharges, precipitation, groundwater movement, or stream flows, including even the large flow from the Delta.

D. WATER USES

The San Francisco Bay system provides a wide variety of beneficial uses, recreational and economical, to people in the area. Some of the most important ones include water supplies for industrial, agricultural, and municipal use; a natural habitat for fish and wildlife; a vast,

water-oriented recreational area; accessibility to ocean-going water transport; and an aesthetically pleasing environment.

In order to protect these beneficial uses the California State Water Quality Control Board has established water quality standards that have been subsequently approved by the United States Environmental Protection Agency. (These different uses and the water quality criteria will be discussed more thoroughly later in the text.)

V. WATER QUALITY CONDITIONS

A. APPLICABLE WATER QUALITY REGULATIONS

Federal-State Water Quality Standards

The waters of the San Francisco Bay system and tributary streams are contained entirely within California. The tidal portions, affected by the ebb and flow of the tides, are subject to the provisions of the Federal Water Pollution Control Act as amended by the Water Quality Act of 1965. In 1967, the California State Water Quality Control Board established Standards for the tidal waters of the Bay system pursuant to the 1965 amendments of the Act.[1/] These Standards subsequently were approved as Federal Standards, except for the temperature criteria, in January, 1969.

The Standards consist of three components: 1) a designation of beneficial water uses to be protected, 2) water quality objectives (criteria) which specify limits on various water quality parameters, and 3) an implementation plan that sets forth enforcement procedures and time schedules for abatement of pollution.

Waters of the San Francisco Bay system are used for a wide variety of purposes. The standards designate that the following beneficial uses are to be protected:

1. Whole or limited body water-contact recreation.
2. The historic usability of domestic, industrial and agricultural water supplies, east of the westerly end of Chipps Island, to the extent that it is reasonably practicable until alternate supplies are provided.

3. Industrial water supplies, westerly of Chipps Island at the times with respect to all water quality factors except salinity incursion.
4. Fishing, hunting, fish and wildlife propagation and sustenance (as shown in Figures V-1 and V-2).
5. Shellfish
6. Pleasure boating, marinas and navigation.
7. Esthetic appeal.
8. Dispersion and assimilation of wastes.

Water quality criteria were established to protect the designated beneficial uses. These criteria [Appendix A] specify numerical or narrative limits for important water quality parameters. Criteria of special interest are discussed in the following sections.

B. BACTERIOLOGICAL CONDITIONS

The Standards established in 1967 did not designate specific areas to be protected for shellfish harvesting but indicated such areas would be designated when studies by the State Department of Fish and Game and Public Health had been completed. A total of 42 potential shellfish harvesting areas were subsequently indentified in 1968 by the Department of Fish and Game [Figure V-3]. Bacteriological quality of waters overlying these shellfish beds was found to be unacceptable for safe consumption of shellfish when evaluated by the Department of Public Health during the period 1966 to 1970. These waters failed to meet the requirements based upon criteria contained in the U. S. Public Health Service manual, "Sanitation of Shellfish Growing Areas," 1965, revised. The

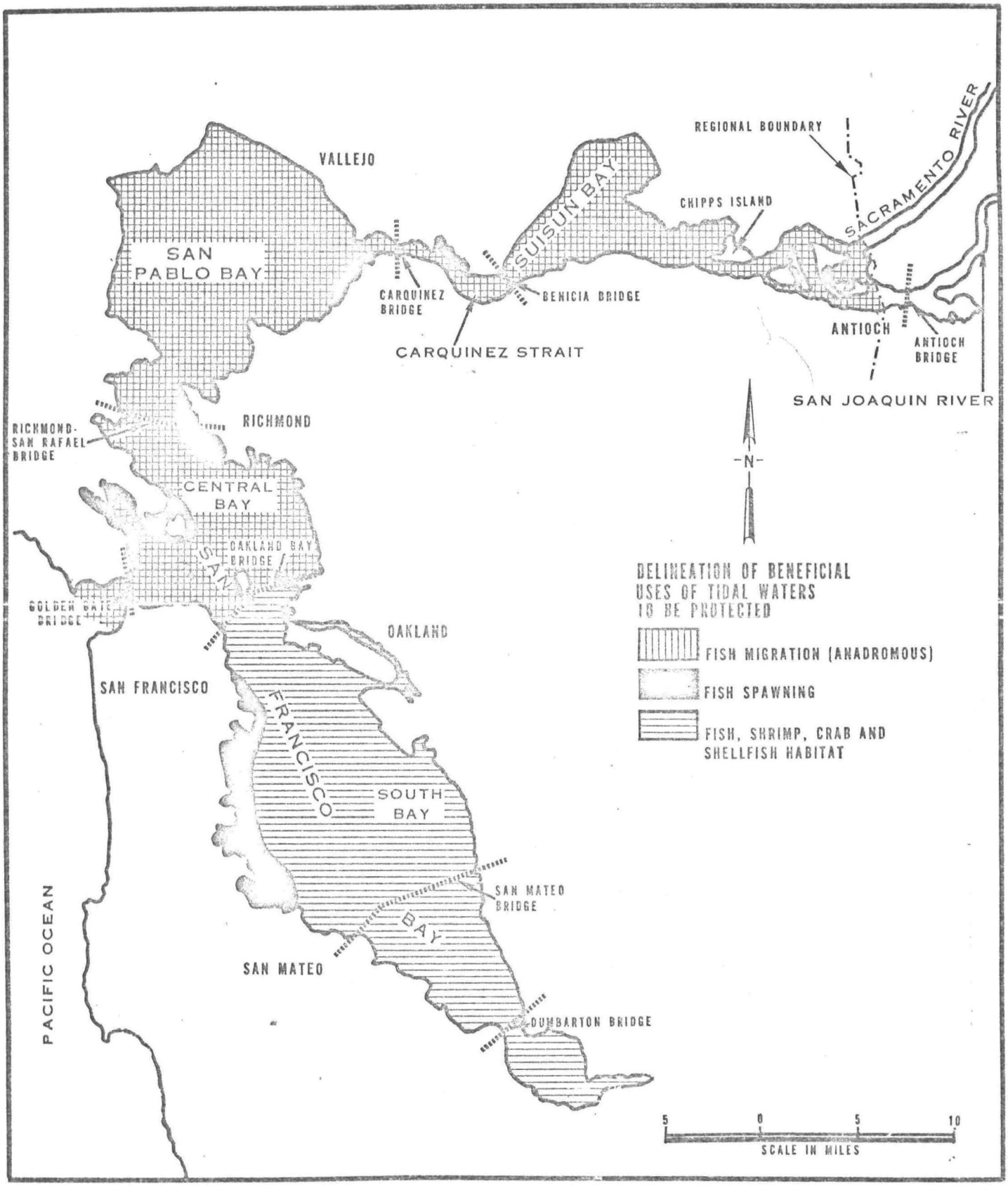

Figure V-1 Beneficial Uses of Tidal Waters to be Protected-Fish Migration; Fish Spawning; Fish, Shrimp, Crab and Shellfish Habitat

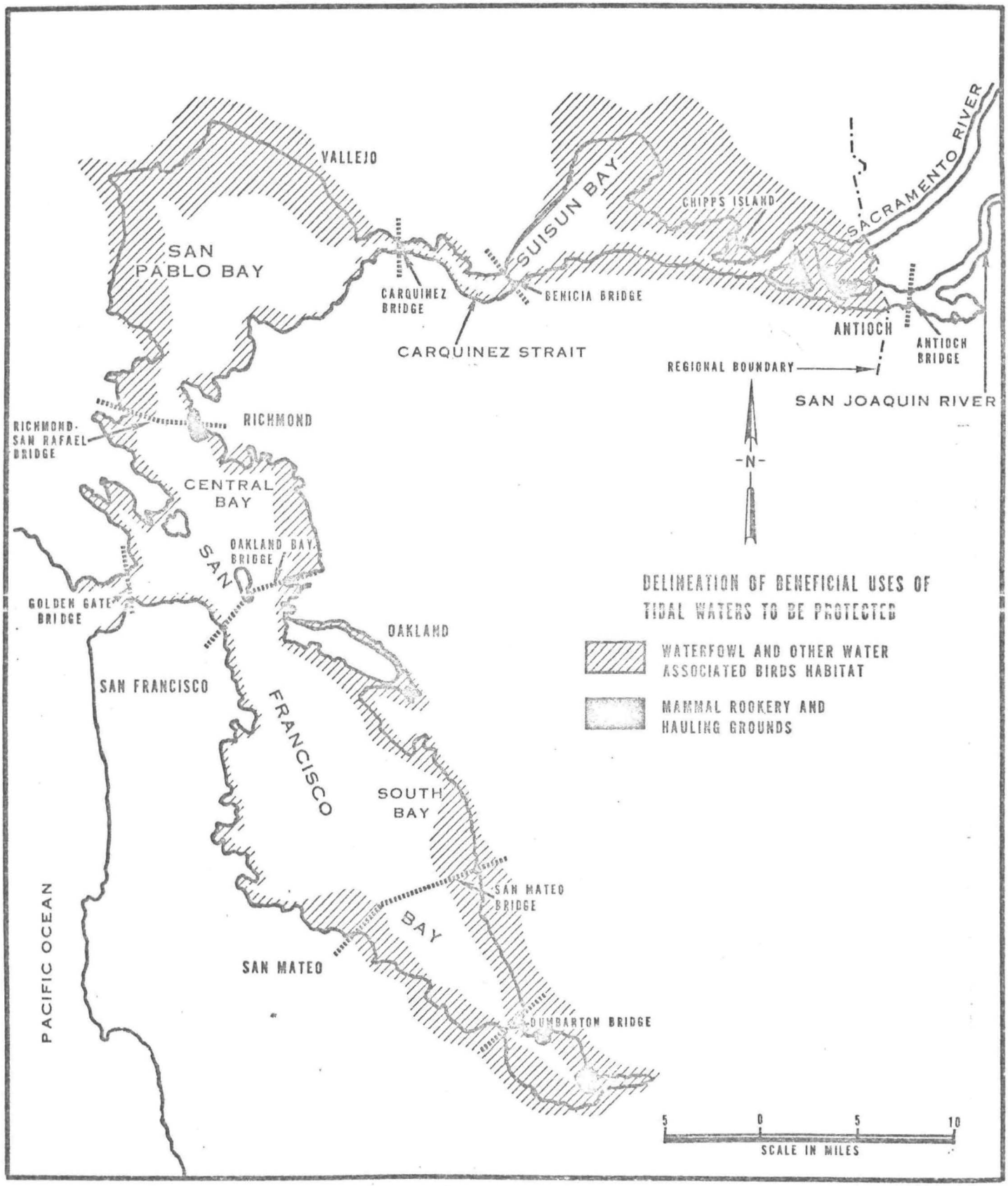

Figure V-2 Beneficial Uses of Tidal Waters to be Protected-Waterfowl and Other Water Associated Birds Habitat; Mammal Rookery and Hauling Grounds

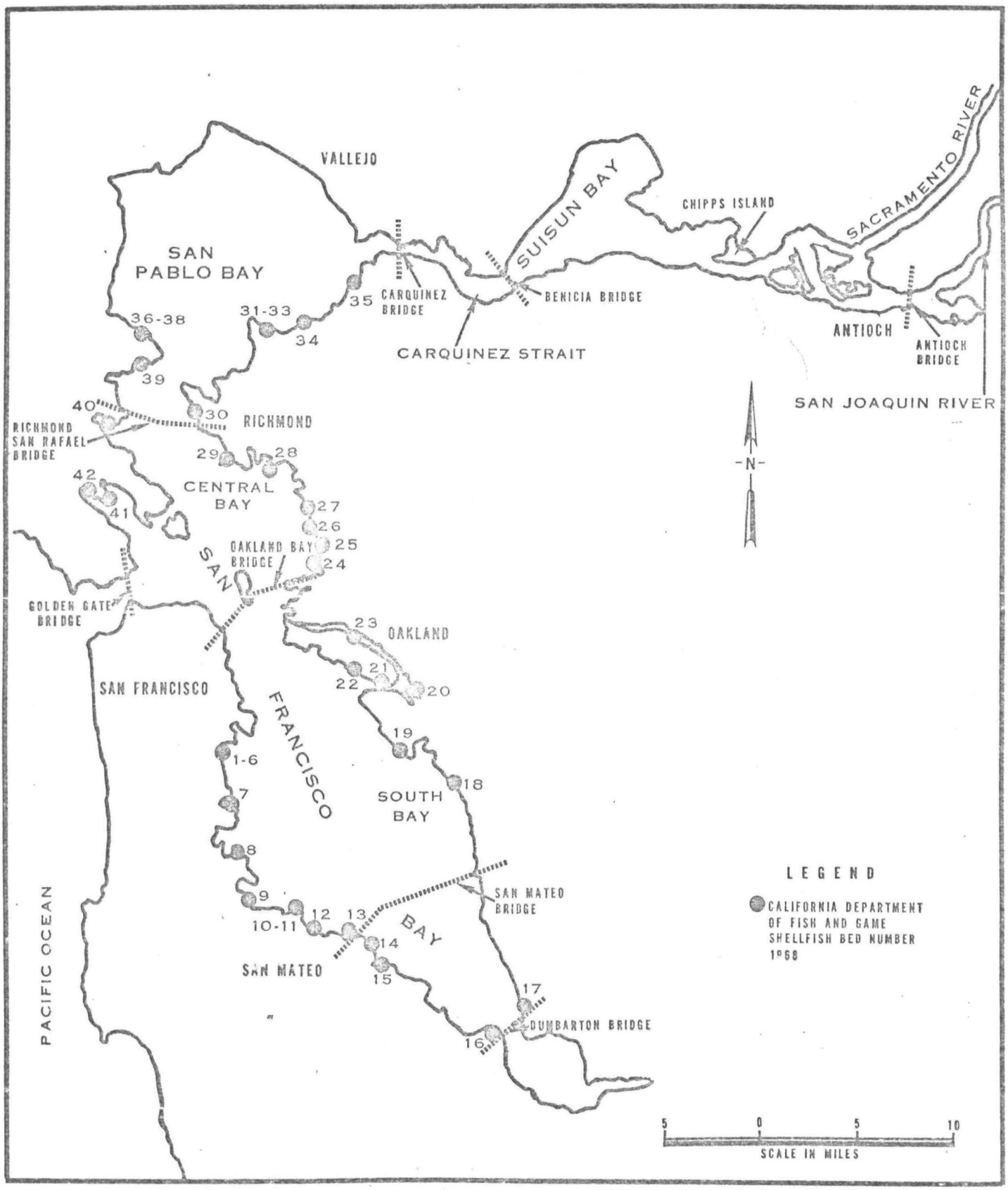

Figure V-3 Shellfish Bed Locations, San Francisco Bay System

criteria for approved shellfish areas are, in summary form:

1. The area is not so contaminated with fecal material that consumption of shellfish might be hazardous.
2. The area is not so contaminated with radionuclides or industrial wastes that the consumption of the shellfish might be hazardous.
3. The coliform median MPN of the water does not exceed 70/100 ml, and not more than 10 percent of the samples ordinarily exceed an MPN of 230/100 ml (5 tube decimal dilution test) measured under the most unfavorable hydrographic and pollution conditions.

In addition to the above criteria, which were formulated to safely classify shellfish growing waters, the State of California also complies with standards adopted by the National Shellfish Sanitation Program for all species of fresh and frozen oysters (includes all shellfish within the Program) at the wholesale market level. Shellfish at the wholesale market level are considered "satisfactory" when a fecal coliform density of not more than 230 MPN per 100 grams of meat or a 35°C plate count of not more than 500,000 per gram is exceeded.

Prior to the 1972 EPA investigations, the most recent comprehensive water quality study covering the entire San Francisco Bay system was conducted from 1960 to 1964 by the University of California.[2/] During this earlier study, samples were collected from a total of 51 stations distributed among six main areas of the Bay system. Coliform density characteristics observed during the study are summarized below, Table V-1, according to the areas of the Bay designated by the University as shown in Figure V-4.

TABLE V-1

AVERAGE COLIFORM BACTERIA

(MPN/100 ml)

IN SAN FRANCISCO BAY, CALIFORNIA

1960-1961

South Bay	Lower Bay	Central Bay	North Bay	San Pablo Bay	Suisun Bay
20,000	500	1,000	500	1,000	2,000

Source: Extracts from Final Report, A Comprehensive Study of San Francisco Bay, Volume V, SERL Report No. 67-2.

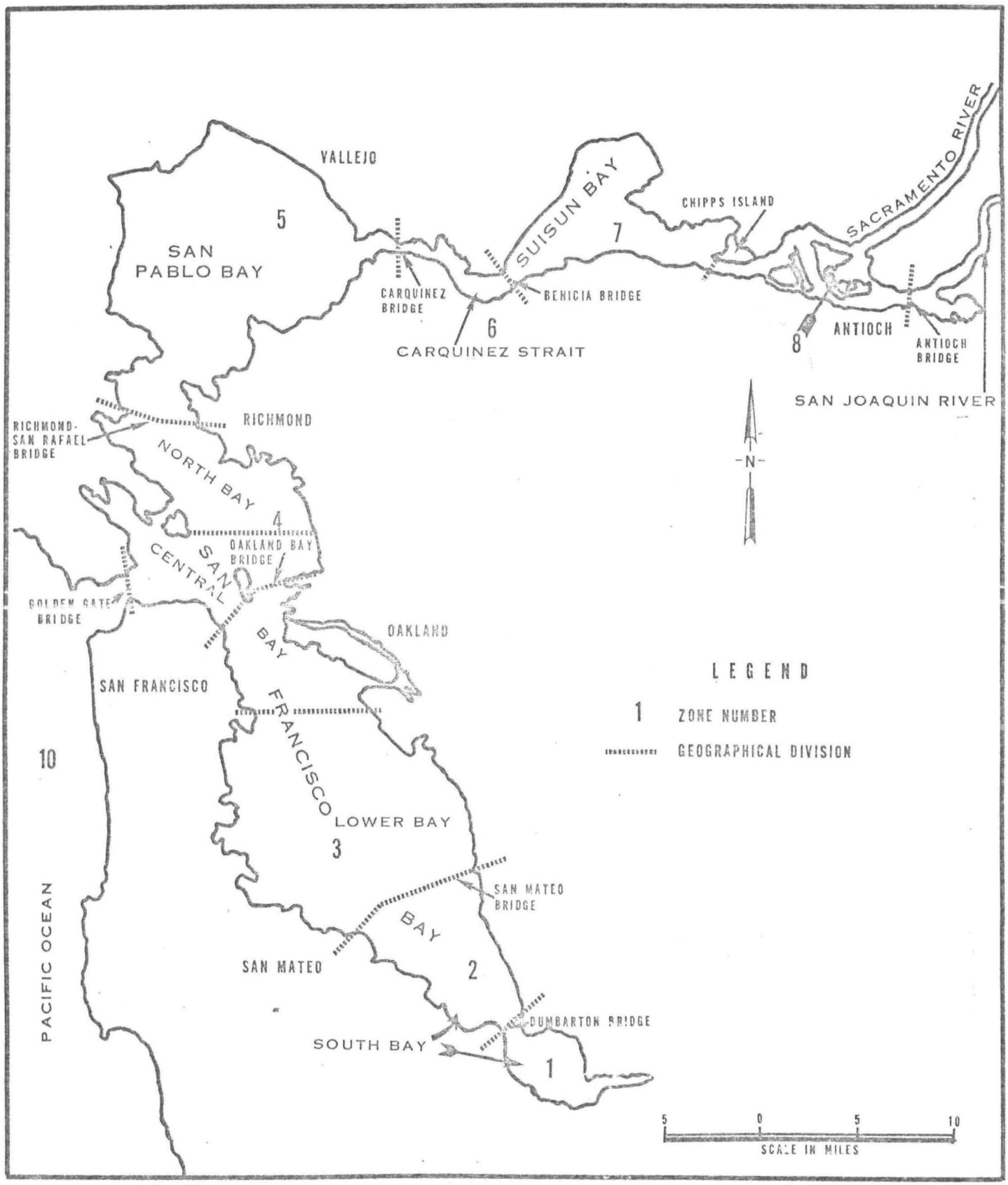

Figure V-4 Geographical and Zone Divisions of the San Francisco Bay System

Improvements in waste treatment practices since the 1960-1964 University of California study period (installation of secondary treatment facilities by several municipal waste sources, including the large City of San Jose facility, and disinfection of essentially all municipal wastes) have resulted in some water quality enhancement.

Prior to the implementation of these disinfection practices by all municipal waste treatment facilities, bacterial concentrations throughout the Bay system were generally in excess of acceptable limits for water-contact recreation and far in excess of allowable levels for shellfish harvesting. Improved disinfection has resulted in a major reduction in average bacterial levels in open water areas. Water quality at several bathing beaches is now acceptable for water-contact sports during much of the recreation season.[3/] Sanitary surveys of a number of shellfish beds during 1969 and 1970 by the State of California Department of Health showed that water overlying several beds was of suitable bacterial quality to meet the U. S. Public Health Service limits for "Approved or Conditionally Approved" shellfish harvesting areas.[4/] However, bacterial levels near most shellfish beds still posed a health hazard to human consumption of shellfish. Also, shellfish from beds with acceptable water quality were found to have unacceptably high bacterial levels in their meat.[4/] Proximity to waste outfalls, unreliability of disinfection facilities at waste treatment plants, and uncontrolled sources of bacterial contamination were factors contributing to unacceptable levels of bacteria near shellfish beds during this survey period.

Despite continued attempts at implementing disinfection practices

to control coliform bacterial densities in San Francisco Bay as well as abatement and control programs to reduce other deleterious contaminants, investigations by the Environmental Protection Agency indicates that bacterial and other contamination interferes with the propagation or harvest of commercially important shellfish.

These recent bacteriological studies were conducted in the spring of 1972 and included all of the waters of the San Francisco Bay system as well as shellfish from certain sections of the surrounding shoreline.

To determine bacteriological quality, water samples were collected for examinations twice daily during the peak of each tidal phase for the open waters and once a day, for a ten-day period, for water immediately over shellfish beds. All coliform analyses were performed according to methods prescribed in the 13th Edition, Standard Methods for the Examination of Water and Wastewater, 1971, using the Most Probable Number technique.[5/] Results of these bacteriological determinations are presented in Tables V-2 through V-5. Isolation of pathogenic (*Salmonella*) bacteria from shellfish meats was attempted at 33 locations.

South Bay

At 12 of the 24 samples stations in this section of the Bay, violations of the National Shellfish Sanitation Program bacteriological criteria for shellfish harvesting waters occurred [Table V-2, Figure V-5a]. At station 1 20 percent of the samples were greater than 230 during high tide and 38 percent were greater than 230 for the low tide period. Station 2 had 50 percent of the samples greater than 230 during high tide and 62 percent for the low tide period, the median value was 240 coliforms per 100 ml. Stations 11 and 15 also showed violations during both

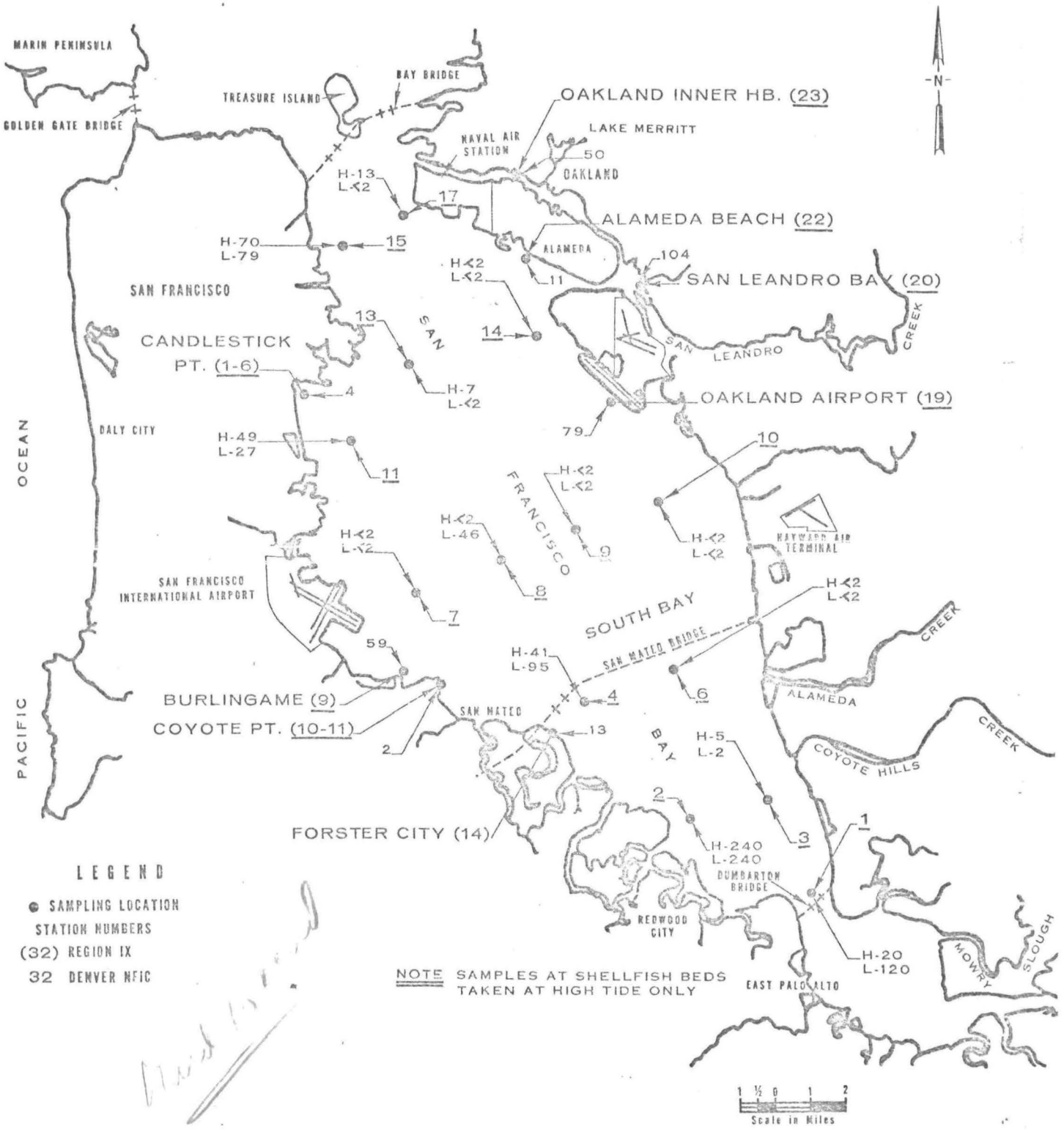

Figure V-5a Water Sampling Locations and Total Coliform Concentrations-South Bay-Spring 1972

tidal phases with more than 10 percent of the samples greater than 230 coliforms per 100 ml. Stations 4 and 8 showed violations during low tide only. Of the waters directly overlying known shellfish beds violations occurred at 6 of the 10 sampling stations [Table V-4]. The majority of these stations are located on the western shoreline in the vicinity of major sewage discharges. All shellfish samples (13) collected in the South Bay were in violation of sanitary quality criteria (fecal coliforms in excess of 230/100 gm shellfish meat with values as high as 46,000 fecal coliforms per 100 gm [Tables V-3, V-5, Figure V-6a]. In contrast, shellfish samples collected from Drakes Estero, for control purposes, were not in violation of sanitary quality criteria.

Pathogenic bacteria were isolated from shellfish meats at two locations in South Bay. *Salmonella kentucky* was isolated from shellfish taken from the Burlingame (9) beds and *S. typhimurium* from samples taken at San Leandro Bay (20) [Table V-5]. The presence of pathogenic *Salmonella* constitutes a severe health hazard to anyone consuming or even contacting the shellfish. The lack of recovery of similar organisms from other shellfish beds does not necessarily mean that the organisms are absent but that the recovery technique used was unsuccessful [Appendix B].

Central Bay

Five sampling stations located in this section of San Francisco Bay did not meet the N.S.S.P. bacteriological requirements for waters overlying shellfish growing areas [Table V-2, Figure V-5b]. Stations 19 and 24, located near the San Francisco North Point plant, had bacterial counts which were in violation duirng high tide only, both with 25 percent

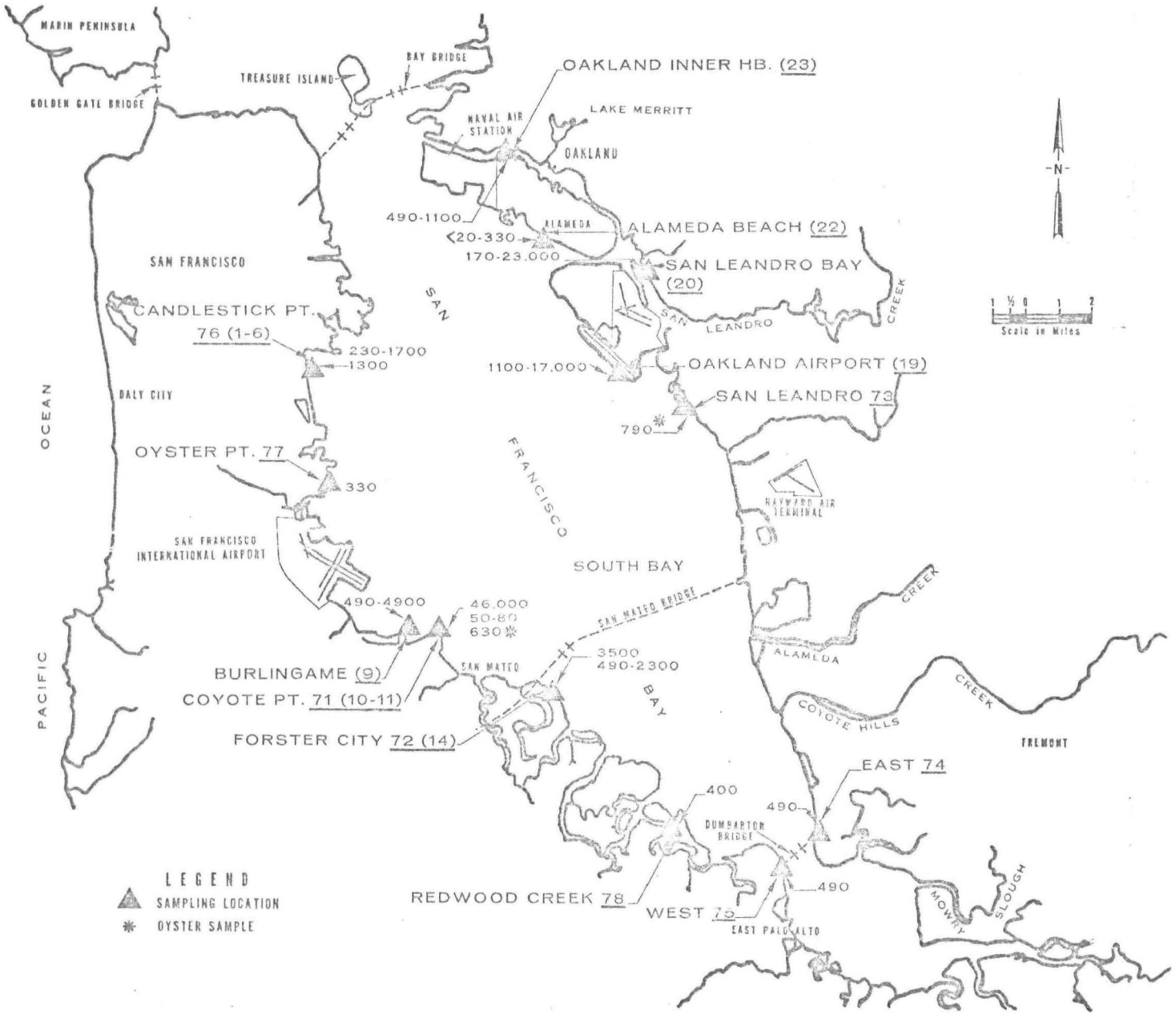

Figure V-6a Shellfish Sampling Locations and Fecal Coliform Concentrations-South Bay-Spring 1972

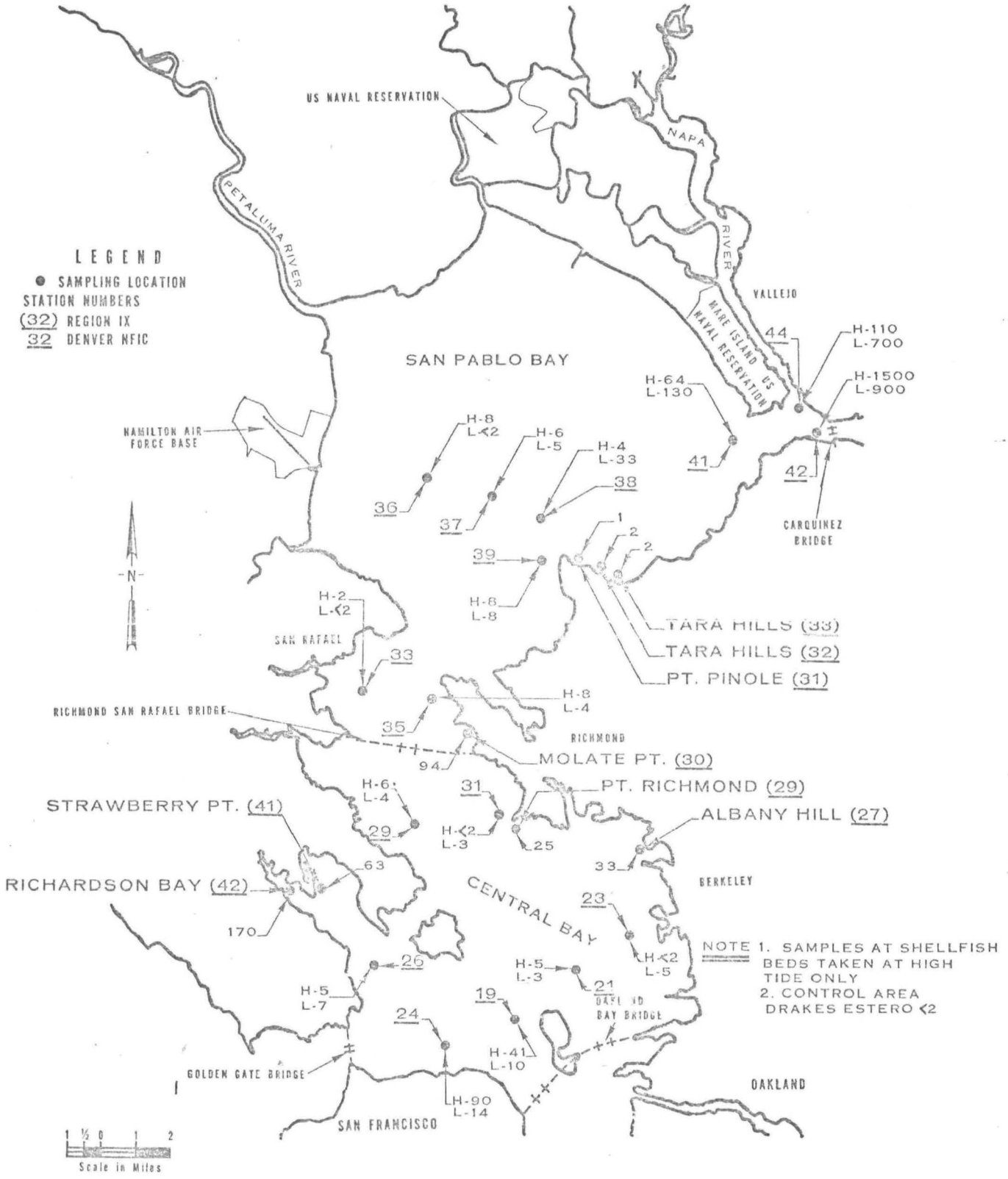

Figure V-5b Water Sampling Locations and Total Coliform Concentrations-
Central Bay-San Pablo Bay-Spring 1972

of the samples greater than 230 coliforms per 100 ml. Station 24 had a median value of 90 coliforms per 100 ml. Also, waters in the vicinity of Point Richmond, Strawberry Point, and Richardson Bay contained excessive amounts of coliform bacteria [Table V-4]. Shellfish samples collected from the intertidal zone near Richmond, Albany Hill, Strawberry Point, and Richardson Bay [Table V-5] had bacterial densities which were in violation of the established market standard for shellfish meats [Figure V-6b].

San Pablo Bay

Results of bacteriological analyses of water samples from San Pablo Bay show that sampling stations 42 and 44 had bacterial counts which were in violation during both tidal phases. During the low tide periods 100 percent of the water samples from both stations were greater than 230 coliforms per 100 ml. with median values of 900 and 700 coliforms respectively. Station 42, at high tide, had a median value of 1,500 with 75 percent of the samples greater than 230 coliforms per 100 ml. Station 44, at high tide, had a median value of 100. Water samples from station 41 were in violation during low tide only having 28.6 percent greater than 230 coliforms per 100 ml. Stations 33 and 35 through 39 were of good quality [Table V-2, Figure V-5b].

Shellfish samples collected at China Camp, Tara Hills (33), and Pinole in San Pablo Bay were within the U. S. Public Health Service bacteriological requirements [Table V-3, V-5, Figure V-6b]. Samples from Point Pinole, Tara Hills (32) and Molate Point were in excess of

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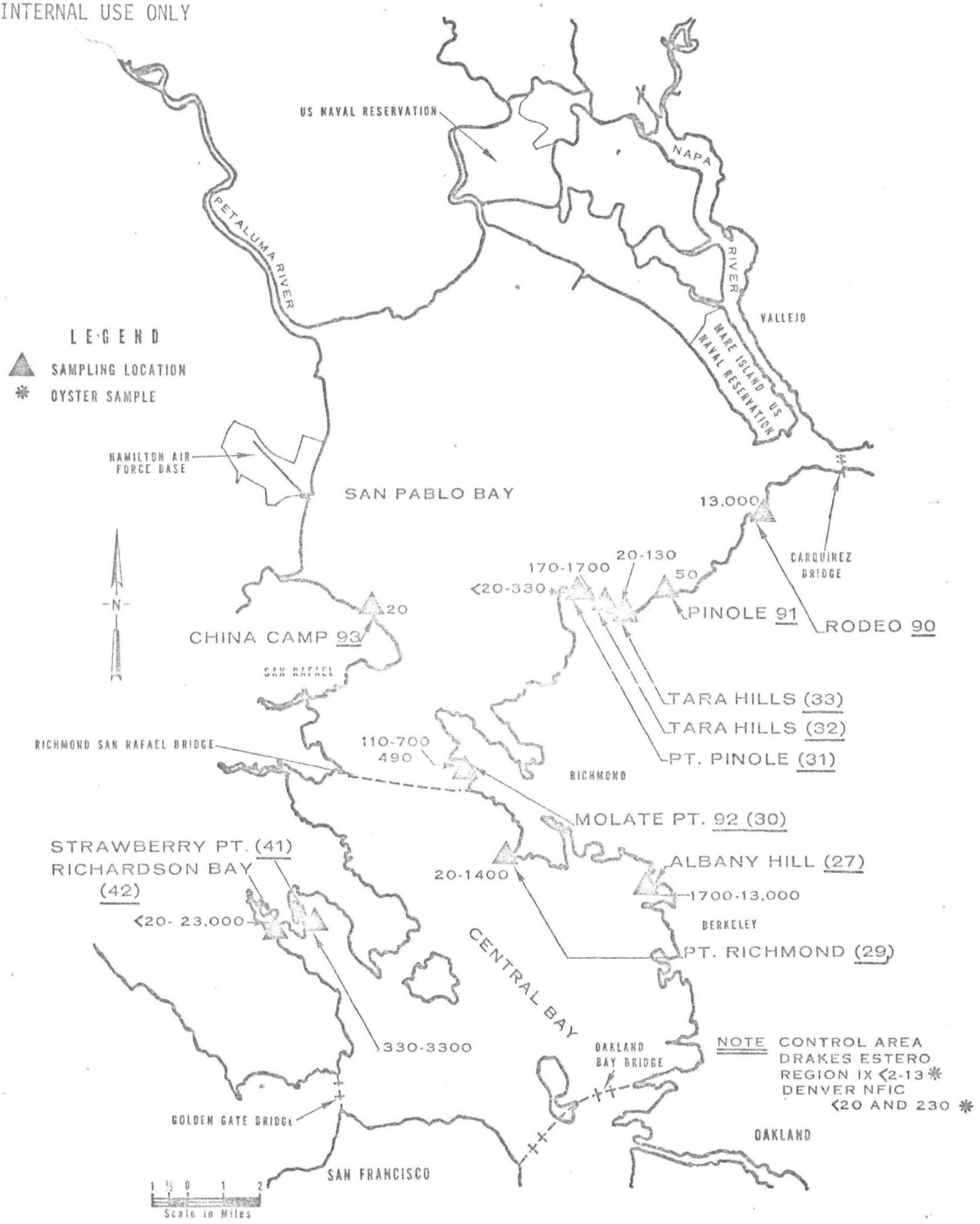

Figure V-6b Shellfish Sampling Locations and Fecal Coliform Concentrations-

Central Bay-San Pablo Bay-Spring 1972

required standards. A shellfish sample collected near Rodeo (13,000 fecal coliforms/100 gms of meat) greatly exceeded the U. S. Public Health Service bacteriological standards as did water from sampling stations 41, 42, and 44 located nearby. High coliform counts in all of the water samples collected at low tide from stations 42 and 44 demonstrate the poor water quality flowing into San Pablo Bay from Suisun Bay and Carquinez Strait. Contributing sources of pollution to these areas include several sewage outfalls such as the Maritime Academy, Mare Island Naval Ship Yard, Vallejo County Sanitation Plant, and numerous commercial vessels which periodically dock in the area.

Carquinez Strait, Suisun Bay and the Sacramento-San Joaquin Delta

All sampling stations from Carquinez Strait and Suisun Bay exceeded N.S.S.P. bacteriological requirements for shellfish harvesting areas [Table V-2, Figure V-5c]. The shellfish sample collected from the shoreline of Carquinez Strait near Benicia exceeded N.S.S.P. bacteriological requirements for market shellfish [Table V-3 and Figure V-6c]. High coliform bacterial densities in the Delta and Suisun Bay are attributable to agricultural wastewaters, inadequately treated effluents from municipal sewage treatment plants and industrial complexes, and untreated sewage from U. S. Naval ships, freighters, and pleasure boats. In addition, lower salinities in these locations are less toxic to bacteria.

Bacterial densities in water samples from stations located in the Sacramento-San Joaquin Delta (No.'s 51 and 52); San Pablo Bay (No.'s 42

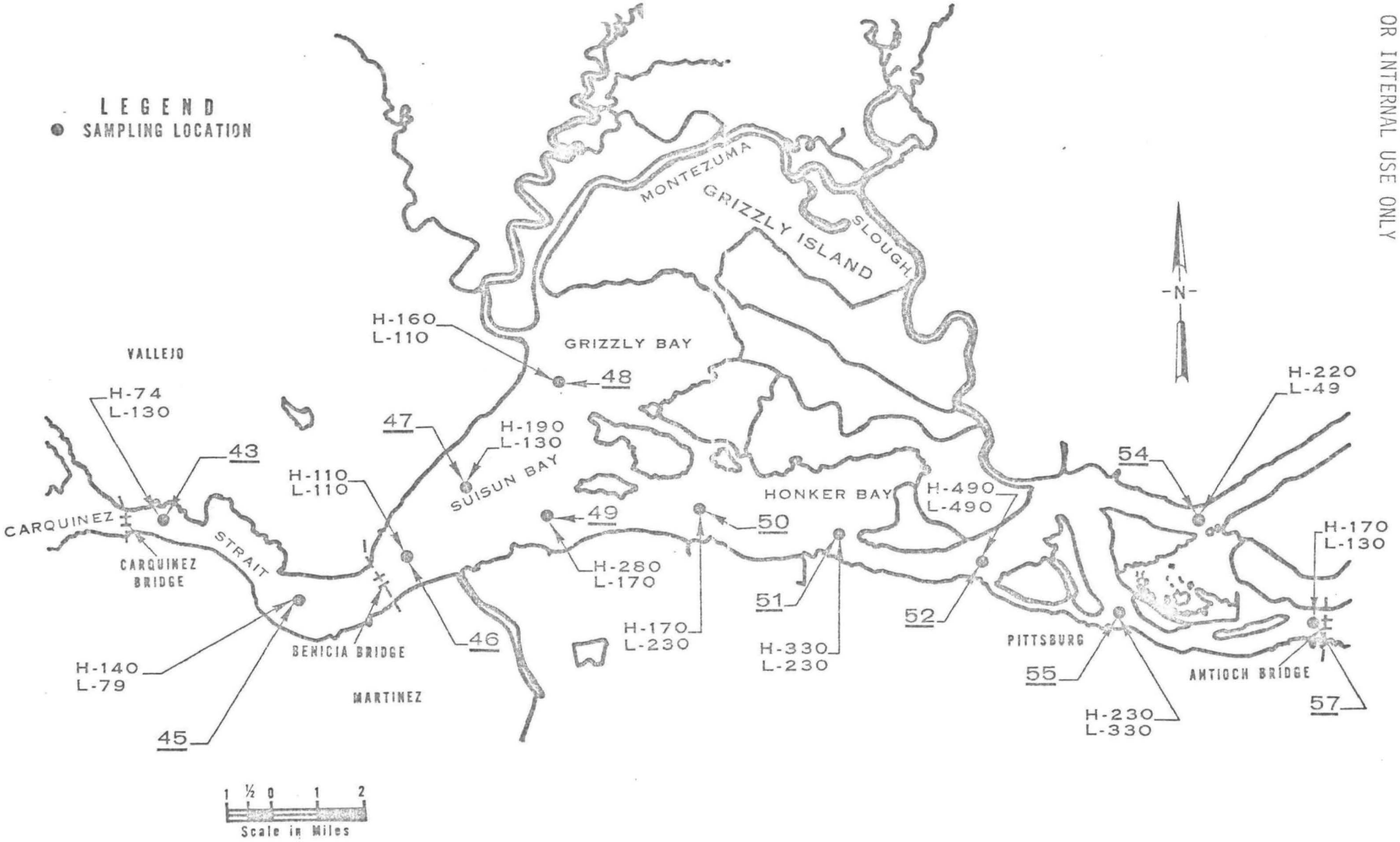

Figure V-5c Water Sampling Locations and Total Coliform Concentrations-Carquinez Strait, Suisun Bay, and Sacramento-San Joaquin Delta-Spring 1972

Figure V-6c Shellfish Sampling Locations and Fecal Coliform Concentrations-Carquinez Strait, Suisun Bay, and Sacramento-San Joaquin Delta-Spring 1972

and 44); South Bay (No.'s 1 and 2, Oakland Airport-19, and San Leandro Bay-20) exceeded California Water Quality Standards for water-contact sports areas which state that, "20 percent of samples not to exceed an MPN of 1,000 total coliforms/100 ml in any 30-day sampling period [Tables V-2, V-4].

C. CHEMICAL CONDITIONS

Selected samples of bay water, bottom sediment, and of shellfish were collected, during the spring of 1972, in an effort to determine whether or not shellfish in San Francisco Bay were being exposed to the effects of chemical pollution. The EPA laboratory staff analyzed these samples for the presence of heavy metals, chlorinated insecticides, polychlorinated biphenyls, petroleum hydrocarbons, and hexane-extractable materials. [Sampling locations are shown in Figures V-7, 8, and 9.] Results of these analyses are discussed in the following sections.

Heavy Metals

During this investigation, samples were analyzed for the heavy metals, cadmium, chromium, copper, lead, zinc, and mercury. Individual results are summarized by sample type: water [Table V-6]; bottom sediment [Table V-7]; and shellfish [Table V-8, V-8a]. As noted [Table V-6], water samples were collected and analyzed from each station during ebb (parameters No. 01 and No. 03) and flood tides (parameters No. 02 and No. 04).

Contamination by heavy metals can be a serious pollution problem in an estuarine environment. Heavy metals are persistent and can often be accumulated by living organisms to levels that are may times greater than those in the surrounding environment. The metals identified in this investigation are all relatively toxic to aquatic life. Combinations of these elements, notably copper and zinc or cadmium and copper, etc., can produce synergistic effects which greatly increase the toxicity of the individual elements. [Toxicological effects of metals and other pollutants are discussed in more detail in Appendix E.]

Figure V-7 Sampling Stations, San Francisco Bay South Bay-Spring 1972

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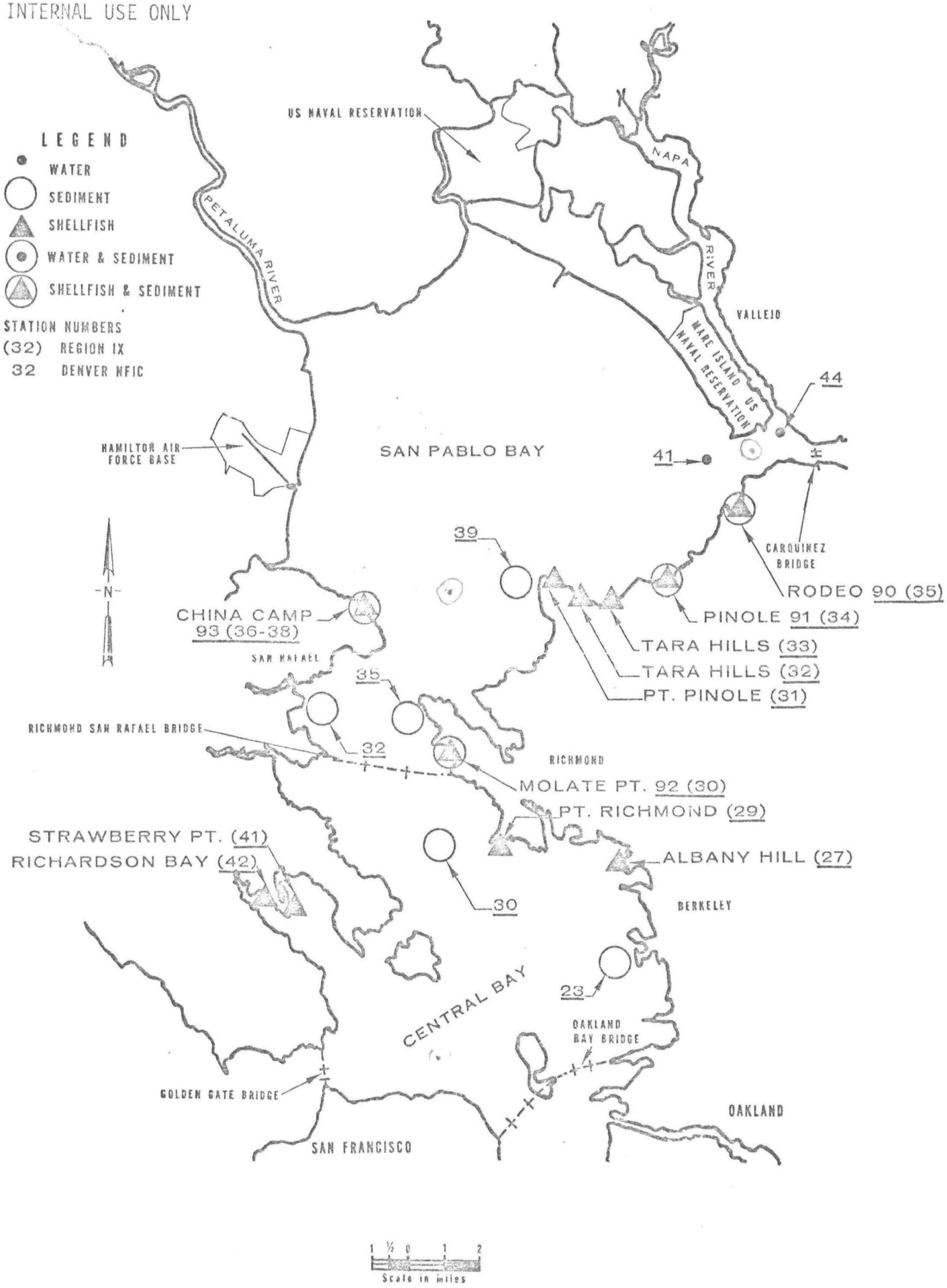

Figure V-8 Sampling Stations, San Francisco Bay Central Bay-San Pablo Bay-Spring 1972

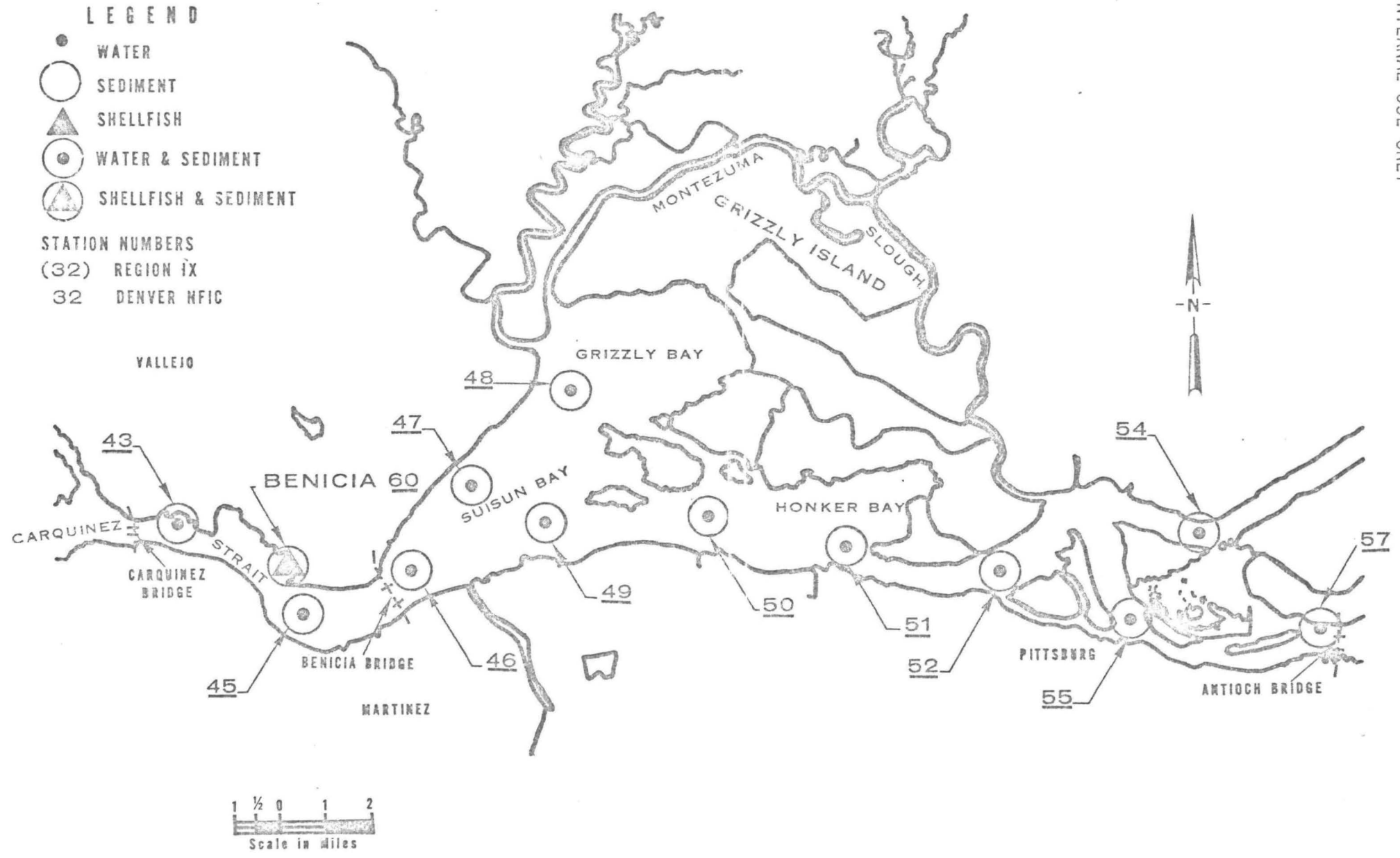

Figure V-9 Sampling Stations, San Francisco Bay Carquinez Strait-Suisun Bay-Spring 1972

In San Francisco Bay the concentrations of cadmium in the water and in bottom sediments were found to be below detectable concentrations. Only trace amounts were observed in clams throughout the bay; however, oysters collected near Redwood City (Station No. 78) and San Leandro (Station No. 73) contained from 2.0 to 4.5 mg/kg of cadmium. These concentrations are in excess of the alert levels [Appendix J] for heavy metals proposed by the FDA in 1968, as well as of the levels proposed in 1971 which recommended that cadmium not exceed the range 1.5 to 3.5 mg/kg in oysters.[6/] The source of these high concentrations of cadmium are presently unknown and warrant further investigation.

Chromium concentrations in the waters of San Francisco Bay were below detectable levels (0.01 mg/l) at all but one station (located at the far end of South Bay) where a concentration of 0.05 mg/l was observed. In the bottom sediments the chromium concentrations ranged from less than 1 to 90 mg/kg. In general, the highest levels of chromium were found in the upper end of South Bay. Oysters from both San Francisco and Drake's Bays (Control Station No. 79) contained less-than-detectable concentrations. Several of the clam samples contained low levels of chromium (0.9 to 1.5 mg/kg); however, a sample from Oyster Point (Station No. 77) contained 20 mg/kg, a value that is four times greater than the proposed FDA alert level (5 mg/kg) for chromium in soft clams. Although bottom sediments at this station did not contain excessive chromium (25 mg/kg), contamination of the shellfish by soluble chromium salts may occur. One other sample in San Pablo Bay, Tara Hills (No. 32), was also in excess of the FDA alert level with a concentration of 6.65 mg/kg.

The State of California has set a threshold limit of 0.05 mg/l for the concentration of copper in fresh water but does not have a standard value applicable to saline waters. Levels in excess of 0.1 mg/l are considered sufficient for oysters to accumulate excessive amounts, while copper concentrations above 0.5 mg/l become toxic to shellfish upon chronic exposure.[7,8]

In most of the San Francisco Bay waters tested copper concentrations were below detectable levels (<0.01 mg/l). In South Bay measurable concentrations ranged from 0.01 to 0.60 mg/l. With the exception of the highest value (0.60 mg/l), observed just northwest of the San Mateo Bridge (Station No. 4), little variation was detected between high and low tide, and into the south end of the bay the values generally increased. The significantly higher concentration of Station No. 4 is likely caused by a point-source discharge.

Concentrations of copper in the bottom sediments ranged widely, from less than 1 to 88 mg/kg, but showed no apparent trends nor appeared to have any direct relationship to the concentration observed in shellfish.

Oysters collected near Redwood City (Station No. 78) and San Leandro (Station No. 73) contained copper concentrations from 60 to 140 times greater than in those from uncontaminated locations in Drakes Bay (Station No. 79). These greater concentrations approached the proposed FDA alert level of 100 mg/kg. Soft clams from near Redwood City (Station No. 78) did not contain detectable copper (<0.5 mg/kg). Gross copper contamination was observed near Molate Point (Station No. 92) where clams contained 34 mg/kg and observed to a lesser extent near the Dumbarton Bridge

No. 71). The proposed FDA alert level for soft clams is 25 mg/kg.

Previous work by the U. S. Geological Survey had shown that mercury contamination was not a serious problem in the bottom sediments from San Francisco Bay.[9/] During this study EPA investigators detected concentrations of mercury in edible tissue samples for shellfish collected at various parts of the Bay [Table V-8, 8a]. Although most of the mercury levels were low, one sample of soft calms from Carquinez Strait (Station No. 60) contained 0.79 mg/kg, or significantly more than the FDA recommended limit (0.5 mg/kg) of mercury in fish and shellfish.[10/] Another sample of soft clams from San Pablo Bay (Station No. 91) contained mercury concentrations of 0.42 mg/kg the value that is approaching the recommended limit. The sources of this contamination are not known but may be from industrial discharges within the area.

Concentrations of lead in San Francisco Bay waters were found to be very low. Samples of water collected south of the Bay Bridge all contained less than 0.1 mg/l of lead. Water samples collected further north, in Suisun Bay, contained less than 0.01 mg/l of lead. Bottom sediment samples contained variable amounts of lead, ranging from less than 5 mg/kg (at all open water sampling stations south of San Leandro (Stations No. 1 to No. 10) to 97 mg/kg (at the mouth of Carquinez Strait (Station No. 43)). Sediment samples collected along the periphery of the bay were found to contain significantly higher levels of lead than samples collected from deeper waters. Sediments from many of the shellfish sampling stations were found to contain high concentrations of lead in the sediments, notably Stations No. 71 and No. 75.

At a number of shellfish sampling stations the concentration of lead in soft clams exceeded the proposed FDA alert levels that call for less than 2.0 mg/kg lead, cadmium, chromium, and mercury combined. The most seriously contaminated stations were: Albany Hills, No. 27 with 19 mg/kg; Bay View Park, No. 3 with 11 mg/kg; No. 91 with 4.2 mg/kg; Oakland Inner Harbor, No. 23 with 3.8 mg/kg; Richardson Bay, No. 42 with 2.9 mg/kg; Tara Hills, No. 33 with 2.2 mg/kg; and Molate Point, No. 92 with 2.0 mg/kg of lead. At stations No. 91 and No. 92 the sediment concentrations of lead were relatively low (18 and 25 mg/kg, respectively); even greater shellfish contamination may occur at stations with greater lead concentrations in the bottom sediments. Unfortunately, the detection limit of lead in many shellfish samples was not sufficiently low to determine whether significant uptaken of this toxic element was occurring.

During this investigation of the waters of San Francisco Bay the levels of zinc found [Table V-6] were low. Concentrations in the bay south of the City of San Francisco ranged from 0.02 to 0.15 mg/l. In general, the amounts of zinc tended to increase in concentration toward the south end of the bay. North of the City zinc concentrations in the water were lower. In Suisun Bay all but one water sample contained less than 0.01 mg/l which is the zinc concentration normally found in the open ocean.[7/]

Measurable quantities of zinc were found in all bottom sediments collected from the bay. Acid-extractable zinc ranged, in the sediments, from 18 to 152 mg/kg. For comparison, a control station in Drake's Bay (Station No. 79) contained 18 mg/kg of zinc in the sediments. Such an

abundance of zinc throughout the Bay indicates multiple sources of contamination. In addition, it is evident that zinc is readily incorporated into the sediments and is therefore transported primarily in the particulate phase.

Oysters tend to concentrate zinc from the environment in their tissues to a greater extent than do clams. Eastern and Pacific oysters collected at Station No. 78, near Redwood City, contained 608 and 336 mg/kg zinc, respectively, while clams contained only 25 mg/kg. At the Control Station (No. 79) Pacific oysters contained 111 mg/kg, or one-third the concentration found in the bay. The proposed FDA alert levels of zinc in oysters in 1500 mg/kg which is three times greater than the highest concentration found.

Although the zinc concentrations were lower in clams, these organisms were apparently exposed to more zinc contamination than were the oysters. Most clam samples in the bay contained more zinc than the 14 mg/kg in soft clams observed at Control Station No. 79. Serious contamination was evident near Foster City (Station No. 71) where clams contained 59 mg/kg zinc and, to a lesser extent, near Carqinez Strait (Station No. 60), Palo Alto (Station No. 75), and Oakland Inner Harbor (No. 23) where zinc concentrations in soft calms were 35, 30, and 35 mg/kg, respectively. Each of these samples contained more zinc than recommended by the proposed FDA alert levels (30 mg/kg) in soft clams. Therefore, this finding demonstrates that zinc contamination of shellfish is definitely a problem in San Francisco Bay.

Chlorinated Insecticides and Polychlorinated Biphenyls

During this investigation samples of bottom sediment, shellfish tissue, and plankton were tested for the more common chlorinated insecticides, as well as for the polychlorinated biphenyl (PCB) mixtures (known by their Monsanto trade name of Aroclor). [Results of these analyses are summarized in Table V-9, 9a.]

Chlorinated pesticides are highly toxic chemicals. Typically, they are persistent compounds, though some may be degraded by living systems into less toxic metabolities. As residues in the aquatic environment they may persist unchanged for many years and, consequently, present a continuing threat to animal communities. Shellfish have the ability to accumulate these residues in their body fats when only minute amounts exist in the surrounding environment. As a general rule, the acute toxicity of these pesticides increases with metabolic activity, being two or three times more toxic in the summer than in the winter.[7/] More subtle changes, such as reduced growth, reproduction changes, altered physiology, and induced abnormal behavior patterns, can occur at much lower levels of exposure than those which cause acute toxicity. [See Appendix E for a more detailed discussion.]

Polychlorinated biphenyls (PCB's) are also very stable compounds which have only recently (1968) been found to be widespread in the environment. The higher levels of contamination can usually be traced directly to industrial activity where they are used for a variety of purposes. These materials are similar to the chlorinated insecticides in their impact on the environment. To many organisms, they are nearly as toxic as the

chlorinated insecticides, and, through food chain magnification can rapidly reach acute levels.

All samples collected in San Francisco Bay contained some chlorinated hydrocarbon residues; the exception is plankton, for too little sample was available for analysis. Of the more common chlorinated insecticides only chlordane, dieldrin, DDT, DDD, and DDE were detected. Four different polychlorinated biphenyls were observed: namely, Aroclors 1242, 1248, 1254, and 1260, which differ primarily by the degree of chlorination.

The bottom sediments contained only very low concentrations of chlorinated insecticides. Because of biological magnification the shellfish contained greater concentrations.

Oysters in samples from San Leandro (Station No. 73) and Redwood City (Station No. 78) contained the highest levels of insecticides, even though sediments at the same location contained no detectable residues. The observed concentrations were from one to two orders of magnitude less than those reported in past years for the Bay system.[7/] However, while the current levels do not presently require regulatory action, they do indicate that contamination levels are at borderline values with regard to the onset of deleterious effects on growth, reproduction, and behavior to aquatic life. Thus, they represent a cause of concern.

In general, concentrations of PCB were higher than those of the insecticides. Sediment samples contained from less than one to 275 ng/g of Aroclor 1254, as observed at Redwood City (Station No. 78). Again, the shellfish contained more PCB than did the sediments. Oysters at Redwood City (Station No. 78), San Leandro (Station No. 73), and Coyote Pt.

(No. 10) were the most grossly contaminated. These levels of PCBs, while below levels necessitating regulatory action, are of sufficient magnitude to demonstrate definite industrial contamination.

Oil and Petrochemical Residues

Samples of soft-shell clams, *Mya arenaria*, were tested for petroleum contamination by analyzing each sample for aliphatic hydrocarbons. Using gas chromatography, hydrocarbons of petroleum origin can be easily differentiated from the small amount of aliphatic hydrocarbons that occur naturally in most aquatic organisms.

The clam samples (6 to 10 organisms/sample) were collected along the eastern short of Central and San Pablo Bays between the Oakland Bay Bridge and Carquinez Bridge. All of the samples tested contained measurable amounts of petroleum contamination. Hydrocarbons residues in the shellfish ranged from 14 to 29 µg/g [Table V-10].

Although the levels of petroleum contamination appear low as compared to values found in oyster samples from Galveston Bay, Texas, the deficiency of information relative to petroleum uptake by softshell clams is such that the degree of contamination is undeterminable. However, the lack of a clearly defined, homologous series of n-alkanes, as determined by gas chromatographic analysis, suggests that petroleum contamination of the samples is not of recent origin.

Still presently unknown is the magnitude of health hazard of these petroleum residues for the consumption of shellfish; however, it is clear that shellfish in San Francisco Bay are definitely contaminated by petroleum that originates from industrial sources, such as discharges from petrochemical and related industries, leakage or spills from oil carrying transport vessels, etc.

D. BIOSTIMULANTS AND ALGAL POPULATIONS

In 1954 in order to protect water quality throughout the San Joaquin Valley the U. S. Bureau of Reclamation recommended that an agricultural waste drainage system be constructed throughout this California valley. With the enactment, in 1960, of the Burns-Porter Act and Public Law 86-488 construction of a "Master Drain" was authorized as part of the California State Water Facilities. A feasibility study, conducted by the California Department of Water Resources, concluded, among other things, that the most practicable and economical method of agricultural waste disposal was, by way of the western Sacramento-San Joaquin Delta, into San Francisco Bay.[11/]

Preliminary data compiled in 1968 by the Federal Water Pollution Control Administration (FWPCA, now part of EPA) indicated that the drainage water would be high in nitrogen (30 mg/l $N\text{-}NO_3$), and in 1967, the agency, conducted further studies to determine the effect (on biostimulation) of discharging such water into the Bay-Delta system.[12/] In summary, the investigation revealed that "untreated" drainage water could have significant adverse effects upon the fish and recreation benefits of the receiving waters.

Subsequent studies by various State, Federal, and private agencies have substantiated earlier findings. A 1969 study concluded that nitrate-rich agricultural drainage, when mixed with San Joaquin River Delta water, stimulated algal growth and recommended nitrogen removal from wastewater.[13/] Also, another study in 1969 found that nitrogen and phosphorus were 10 to 100 times greater in the Delta than those reported necessary for a

substantial growth of algae. This same study found that these two nutrients have increased significantly over the past 4 to 6 years and that algal blooms were occurring in certain areas. The blooms are both highly undesirable and indicative of excessive enrichment of Delta waters.[14]

Further investigations of algal growths found that certain of these excessive blooms occur along the shore and sloughs in South Bay receiving wastewater dischargers.[15] Highest measurements of algal growth are being consistently found in Suisun Bay.[18,19]

In contrast to the stimulatory effects of agricultural wastewaters there appears to be acting, in the bay waters, both industrial-municipal and natural inhibatory variables that have a locally limiting effect on excessive algal growth. Past studies have shown that effluents from municipal treatment plants and industrial complexes containing high concentrations of ammonia and chlorine convey a toxic effect on algae by limiting their growth and reproduction.[16,18] Productivity measurements throughout San Francisco Bay have shown that the natural phenomona of high turbidity or low concentrations of silica may also be important factors limiting algal growth.[18]

Extensive studies, conducted for water quality management purposes, have recommended that waste discharges be removed from tidal sloughs and from the southern and eastern extremities of the Bay system as a means of reducing the adverse effects of biostimulants in these areas of limited tidal interchange.[]

E. RELATIVE TOXICITY

A parameter that has come into common usage is describing the water quality condition of the San Francisco Bay system is relative toxicity. This parameter takes into account both the amount and strength of the waste and, thus, allows comparison of the relative effects of many discharges. The relative toxicity of a wastewater discharge is defined as the volumetric flow of the discharge divided by the 48-hour median tolerance limit (expressed as a decimal fraction) determined from a bioassay using fish.

In the University of California Comprehensive Study of San Francisco Bay it was concluded that the most significant pollutant discharged to the bay appeared to be acute toxicity.—/ The occurrence of toxicity may be found to a greater or lesser degree in selected areas throughout the Bay system. Relative toxicity has been of particular concern in the South Bay south of Dumbarton Bridge and in Suisun Bay and the Sacramento, San Joaquin delta upstream from Carquinez Bridge.

The source of toxicity in the San Francisco Bay system has been shown, by one study, to be approximately 56 percent from municipal sources and 44 percent from industrial sources.1/ Evaluation of the toxicity of many municipal and industrial sources has shown that almost all of these wastes are toxic in varying degrees to fish. Moreover, the toxicity of wastewater has been shown to vary with the degree of treatment provided. Municipal and industrial discharges receiving only primary or marginal-secondary treatment are the major sources of toxicity. Many of the

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_/ Bay Delta manual.

constituents of wastewaters are toxic to aquatic life either occurring alone or as a result of synergistic effects with other compounds. [Some of these constituents exhibiting toxicity are tabulated in Appendix F.]

Studies on the San Francisco Bay system have shown a direct relation between relative toxicity and serious reductions of the variety of bottom-dwelling organisms which are an essential link in the natural food chain. The benthic animals in the food chain represent about 85 percent of the total protein in the bay waters. The effect of toxicity on fish may be far more serious than what the value, measured by the relative toxicity test, would indicate. Problems of long-term, chronic damage (occurring at low toxicant concentrations) cannot be measured by the relative toxicity determination.

Therefore, it is evident that the solution to the toxicity problem in San Francisco Bay is not a simple one. Three aspects of the problem should be attacked. First, higher levels of treatment should be provided to those waste discharges that are high in relative toxicity. Secondly, waste effluents which discharge in areas of minimal tidal water interchange should be removed to areas where rapid dilution is possible. Thirdly, because certain toxic materials are not amenable to treatment, source control should be required.

F. DISSOLVED OXYGEN

Throughout most of the San Francisco Bay system dissolved oxygen concentrations are consistently about 80 percent of saturation; however, significant dissolved-oxygen depletions occur in several critical areas of the bay. Depression of dissolved-oxygen levels to below acceptable

limits occur in tidal streams and sloughs along the westerly shore of South Bay south of Dumbarton Bridge and the northerly shore of San Pablo and Suisun Bays. This problem is most severe in Coyote Creek, Guadalupe River, Mountain View Slough, Redwood Creek, Petaluma River, and Sonoma and Suisun Sloughs.

The primary factor contributing to dissolved-oxygen depletions is the discharge of organic materials from municipal waste sources. Waste sources discharging to somewhat confined areas where dilution water, and thus assimilative capacity, is limited result in the largest dissolved oxygen deficits. These discharges are the most damaging during the canning season in late summer and early fall, when a number of plants receive large loads of organic wastes from food processing plants.

The low dissolved oxygen levels have resulted in the elimination or reduction of fish and other aquatic life populations in several areas of the bay, especially the South Bay. Some of this exhaustion of aquatic life may be caused by toxic materials as well as by dissolved-oxygen depletions.

Dissolved-oxygen depletions are expected to continue and increase in magnitude as waste volumes increase. This trend could be reversed by removal of these discharges from areas of minimal tidal water interchange to areas where large volumes of dilution water are available.

TABLE V-2
BACTERIOLOGICAL DENSITIES - SAN FRANCISCO BAY SURVEY
WATER SAMPLES
SPRING, 1972

Station Number	Station Description	Tide	No. of Samples	Total Coliforms, MPN/100 ml				% Samples >230	% Samples >1,000	Fecal Coliforms, MPN/100ml			
				Maximum	Minimum	Median	Log Mean			Maximum	Minimum	Median	Log Mean
1	Towers Opposite Beards Creek	High	10	920	8	20	37	20*	0	700	2	8	12
		Low	8	3,500	33	120*	210	38*	25**	1,700	8	79	94
2	Buoy FIR 4	High	10	3,500	14	240*	250	50*	30**	350	2	31	29
		Low	8	540	7	210*	140	62*	0	130	7	41	36
3	Northeast of Mouth of Redwood Creek	High	10	1,100	2	5	6	10	10	170	<2	2	4
		Low	8	5	<2	2	<2	0	0	5	<2	2	<2
4	Buoy FI 2.5 Sec	High	10	920	<2	41	<33	10	0	49	<2	<2	<4
		Low	8	350	14	95*	72	25*	0	170	2	13	10
6	Just South of San Mateo Bridge	High	9	49	<2	<2	<4	0	0	13	<2	<2	<2
		Low	8	5	<2	<2	<2	0	0	2	<2	<2	<2
7	Buoy FI 4.0 Sec #3	High	9	2	<2	<2	<2	0	0	<2	<2	<2	<2
		Low	9	70	<2	<2	<4	0	0	5	<2	<2	<2
8	Buoy FI 4.0 Sec #5	High	9	8	<2	<2	<3	0	0	<2	<2	<2	<2
		Low	9	240	5	46	54	22*	0	13	<2	4	<5
9	West of Point San Bruno	High	6	2	<2	<2	<2	0	0	<2	<2	<2	<2
		Low	6	<2	<2	2	<2	0	0	<2	<2	<2	<2
10	Buoy F14 Sec #1	High	9	110	<2	<2	<3	0	0	110	<2	<2	<3
		Low	9	8	<2	2	<2	0	0	2	<2	<2	<2
11	Half Point Off Sierra Point	High	9	540	2	49	27	11*	0	14	<2	<2	<4
		Low	7	350	<2	47	<23	14*	0	23	<2	<17	<8
13	Buoy FI 6 Sec Ex-A	High	9	17	<2	7	<6	0	0	11	<2	<2	<3
		Low	8	33	<2	<2	<3	0	0	5	<2	<2	<2
14	West of Grounded Hulks	High	8	5	<2	2	<2	0	0	<2	<2	<2	<2
		Low	8	2	<2	<2	<2	0	0	2	<2	<2	<2

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BACTERIOLOGICAL DENSITIES - SAN FRANCISCO BAY SURVEY
WATER SAMPLES
SPRING, 1972

Station Number	Station Description	Tide	No. of Samples	Total Coliforms, MPN/100 ml Maximum	Minimum	Median	Log Mean	% Samples >230	% Samples >1,000	Fecal Coliforms, MPN/100 ml Maximum	Minimum	Median	Log Mean
15	Half Mile East of Potrero Point	High	9	1,600	22	70	75	11*	11.1	79	2	17	13
		Low	8	1,100	8	79*	75	12.5*	12.5	140	<2	8	<12
17	Buoy FIR 4 Sec #2	High	9	27	2	13	8	0	0	8	<2	2	<3
		Low	8	23	<2	<2	<3	0	0	2	<2	<2	<2
19	Mid-channel Off North Point Buoy ?BR	High	8	330	<2	41	<47	25*	0	22	<2	13	<8
		Low	8	33	4	10	9	0	0	8	<2	2	<3
21	End of Berkeley Pier	High	8	33	<2	5	<4	0	0	5	<2	<2	<2
		Low	8	49	<2	3	<6	0	0	33	2	2	3
23	Off Berkeley Pier Near Yacht Harbor	High	8	79	<2	<2	<3						<3
		Low	8	49	<2	5	<6	0	0	5	<2	<2	<3
24	Black Point Buoy A	High	8	490	17	90*	89	25*	0	27	5	12	12
		Low	8	34	2	14	12	0	0	13	<2	4	<4
26	Richardson Bay Buoy 6	High	8	70	<2	5	<7	0	0	8	<2	2	<3
		Low	8	49	2	7	8	0	0	17	<2	4	<4
29	Off Pt Richmond Mid-channel Buoy #2	High	8	23	<2	6	<6	0	0	5	<2	3	<3
		Low	8	49	<2	4	<4	0	0	5	<2	2	<2
31	Buoy FIR #6 Richmond Channel	High	8	23	<2	<2	<3	0	0	8	<2	<2	<2
		Low	8	13	<2	3	<4	0	0	4	<2	2	<2
33	27 Ft. White Marker, Left Side of Channel	High	8	5	<2	2	<3	0	0	5	<2	<2	<2
		Low	8	11	<2	<2	<3	0	0	5	<2	<2	<2
35	Off Pier at Pt. Orient	High	8	79	<2	8	<6	0	0	33	<2	2	<4
		Low	8	17	<2	4	<4	0	0	5	<2	<2	<2
36	Buoy FIG 4, Sec #3 Petaluma River Channel	High	8	23	2	8	6	0	0	8	<2	2	<3
		Low	7	2	<2	<2	<2	0	0	<2	<2	<2	<2
37	Mid-San Pablo Bay Off Pinole Point	High	8	49	<2	6	<8	0	0	11	<2	<2	<3
		Low	7	23	2	5	6	0	0	8	<2	<2	<2
38	Off Pinole Point Channel Buoy #5	High	8	49	<2	4	<6	0	0	8	<2	<2	<3
		Low	8	110	7	33	32	0	0	33	2	10	9
39	Off Pier at Pinole Point	High	8	33	<2	8	<7	0	0	8	<2	2	<3
		Low	8	13	2	8	9	0	0	8	2	4	3

TABLE V-2 (CONTINUED)
BACTERIOLOGICAL DENSITIES - SAN FRANCISCO BAY SURVEY
WATER SAMPLES
SPRING, 1972

Station Number	Station Description	Tide	No. of Samples	Total Coliforms, MPN/100 ml				% Samples	% Samples	Fecal Coliforms, MPN/100 ml			
				Maximum	Minimum	Median	Log Mean	> 230	>1,000	Maximum	Minimum	Median	Log Mean
41	Off Lone Tree Point Mid-Channel	High	6	130	11	64	54	0	0	23	5	18	14
		Low	7	330	79	130*	150	28 6	0	79	22	33	33
42	Marina Right Side of Carquinez Strait	High	8	13,000	130	1,500*	1,400	75*	75**	2,300	33	570	330
		Low	8	3,500	330	900*	930	100*	50**	330	8	150	95
43	Mid-Channel I-80 Bridge	High	6	110	33	74*	69	0	0	49	2	17	14
		Low	7	490	49	130*	150	42.8*	0	84	22	33	40
44	Dike Nine Entrance to Napa River	High	6	130	33	110*	78	0	0	70	17	46	37
		Low	7	2,200	330	700*	850	100*	42.9**	330	63	220	170
45	Buoy FIG 4, Sec #7 Off Benicia	High	6	490	33	140	130	16.7*	0	220	22	54	54
		Low	7	130	70	79*	90	0	0	79	13	33	38
46	Mid-Channel Benicia Bridge Buoy 2	High	6	330	49	110*	130	33*	0	79	17	48	45
		Low	7	330	33	110*	110	14.3*	0	110	33	49	58
47	Buoy #4 Suisun Bay	High	6	330	33	190*	150	33*	0	79	33	60	53
		Low	7	220	70	130*	120	0	0	140	23	49	61
48	Buoy FI 4 Sec #1	High	6	230	70	160*	140	0	0	130	23	48	53
		Low	7	130	70	110*	100	0	0	94	22	79	54
49	Buoy FIR 4 Sec #8 Off Point Edith	High	6	790	70	280*	260	50*	0	230	33	79	71
		Low	7	490	79	170*	150	14.3*	0	130	23	49	52
50	Buoy FIG 4 Sec #17 Off Middle Point	High	7	790	79	170*	180	14.3*	0	330	46	49	77
		Low	7	1,300	79	230*	300	42.8*	14.3	700	33	49	99

TABLE V-2 (CONTINUED)
BACTERIOLOGICAL DENSITIES - SAN FRANCISCO BAY SURVEY
WATER SAMPLES
SPRING, 1972

Station Number	Station Description	Tide	No. of Samples	Total Coliforms, MPN/100 ml				% Samples > 1,000	Fecal Coliforms, MPN/100 ml			
				Maximum	Minimum	Median	Log Mean		Maximum	Minimum	Median	Log Mean
51	Buoy FIG 4, Sec #25 Off Simmons Point	High	7	2,300	79	330	440	42.8**	490	17	49	70
		Low	7	700	79	230	240		110	13	49	48
52	Buoy NY Off New York Point	High	7	2,300	49	490	390	14.3	490	8	49	47
		Low	7	1,300	70	490	350	28.6**	330	13	110	80
54	Buoy #16, Sacramento Ship Channel	High	7	1,300	33	220	160	14.3	70	4	13	12
		Low	7	110	27	49	55		11	<2	5	5
55	Off Antioch Point, Buoy #4	High	7	2,300	79	230	290	14.3	1,300	13	17	36
		Low	7	1,700	220	330	470	14.3	330	17	46	44
57	Mid-Channel Antioch Bridge Buoy #12	High	7	1,700	49	170	220	14.3	94	2	13	14
		Low	7	230	110	130	140		33	5	13	12

*Violation of U. S. Public Health Water Quality Recommendations for Shellfish Growing Areas (Median MPN of water not to exceed 70 Total Coliforms/100 ml and not more than 10 percent of samples to ordinarily exceed an MPN of 230/100 ml)

**Violation of California Water Quality Bacterial Standards for Water-Contact Sports Area (20 percent of samples not to exceed 1,000 Coliforms/100 ml).

TABLE V-3

BACTERIOLOGICAL DENSITIES-SAN FRANCISCO BAY SURVEY

SHELLFISH SAMPLES

SPRING, 1972

Station	Number(s)	Date	Shellfish	Total Coliforms MPN/100 gms	Fecal Coliforms MPN/100 gms
Coyote Point	10-11	3/30/72	Soft-shell Clam	63,000	46,000*
Coyote Point	10-11	3/30/72	Olympia Oyster	1,800	630*
Forster City	14	3/30/72	Soft-shell Clam	5,400	3,500*
San Leandro	18	3/31/72	Olympia Oyster	3,500	790*
Dumbarton Bridge(East Side)	17	3/31/72	Soft-shell Clam	3,500	490*
Dumbarton Bridge(West Side)	16	3/31/72	Soft-shell Clam	1,300	490*
Candlestick	1-6	4/2/72	Soft-shell Clam	160,000	1,300*
Oyster Point	7	4/2/72	Soft-shell Clam	3,500	330*
Redwood Creek	15	4/3/72	Soft-shell Clam	2,200	400*
Pinole Point	34	4/29/72	Soft-shell Clam	330	50
Molate Point	30	4/29/72	Soft-shell Clam	790	490*
Rodeo	35	4/29/72	Soft-shell Clam	49,000	13,000*
China Camp	36-38	4/30/72	Soft-shell Clam	170	20
Benicia	43	4/23/72	Soft-shell Clam	3,300	1,100*
Drakes Estero Control		4/3/72	Pacific Oyster	50	<20
Drakes Estero Control		4/3/72	Eastern Oyster	230	230

*Violation of Federal Shellfish Standard "Not to exceed 230 Fecal Coliforms/100 gms".

TABLE V-4
TOTAL COLIFORMS IN WATER OVERLAYING SHELLFISH BEDS:
MEDIAN VALUES PER 100 ml AND PERCENT EXCEEDING
230 PER 100 ml, BY STATION

Station Number	Station Description	Number of Observations	Total Coliforms		
			Median per 100 ml	Percent Above 230 per 100 ml	Percent Above 1,000 per 100 ml
3	Bayview Park	27	4	7	3.7
9	Burlingame	29	59	21	6.9
10	Coyote Point (north of)	27	2	11	7.4
14	Foster City	27	13	15	0
19	Oakland Airport	24	79	29	25*
20	San Leandro Bay	30	104	40	36.7*
22	Alameda Beach	27	11	0	0
23	Oakland Inner Harbor	30	50	17	0
27	Albany Hill	30	33	0	0
29	Point Richmond	30	25	13	0
30	Malate Point	30	94	37	13
31	Tara Hills, Left	30	1	0	0
32	Tara Hills, Middle	30	2	0	0
33	Tara Hills, Right	30	2	0	0
41	Strawberry Point West Side	30	63	10	0

TABLE V-4 (CONTINUED)
TOTAL COLIFORMS IN WATER OVERLAYING SHELLFISH BEDS:
MEDIAN VALUES PER 100 ml AND PERCENT EXCEEDING
230 PER 100 ml, BY STATION

Station Number	Station Description	Number of Observations	Total Coliforms		
			Median per 100 ml	Percent Above 230 per 100 ml	Percent Above 1,000 per 100 ml
42	Richardson Bay, North End	30	170	40	16.7
Control	Drake's Estero	3	<2	0	0

*Violation of California Water Quality Bacterial Standards for Water-Contact Sports Area (20 percent of samples not to exceed 1,000 Coliforms/100 ml).

TABLE V-5
FECAL COLIFORMS PER 100 gm SHELLFISH MEAT:
RANGE OF VALUES AND COMPARISON TO STANDARD, BY STATION

Station Number	Station Location	No. Times Sampled	Fecal Coliforms per 100 gm Range	Sample Exceeds 230 FC per 100 gm	
				No. Times	Percent
3	Bayview Park	3	230- 1,700	2	67
9	Burlingame	3	490- 4,900	3	100*
10	Coyote Point (north of)	3	50- 80	0	0
14	Foster City	3	490- 2,300	3	100
19	Oakland Airport	3	1,100-17,000	3	100
20	San Leandro Bay	3	170-23,000	2	67**
22	Alameda Beach	3	<20- 330	1	33
23	Oakland Inner Harbor	3	490- 1,100	3	100
27	Albany Hill	3	1,700-13,000	3	100
29	Point Richmond	3	<20- 1,400	2	67
30	Malate Point	3	110- 700	2	67
31	Tara Hills, Left	3	20- 330	1	33
32	Tara Hills, Middle	3	170- 1,700	1	33
33	Tara Hills, Right	3	20- 130	0	0
41	Strawberry Point West Side	3	330- 3,300	3	100

TABLE V-5 (CONTINUED)
FECAL COLIFORMS PER 100 gm SHELLFISH MEAT:
RANGE OF VALUES AND COMPARISON TO STANDARD, BY STATION

Station Number	Station Location	No. Times Sampled	Fecal Coliforms per 100 gm Range	Sample Exceeds 230 FC per 100 gm	
				No. Times	Percent
42	Richardson Bay, North End	3	<20-23,000	2	67
Control	Drake's Estero	3	<2- 13	0	0

Salmonella kentucky isolated

**Salmonella typhimurium* isolated

TABLE V-6

Results of Metals Analysis of San Francisco Bay Area Water Samples

Sample Number*	Concentration (mg/l) Cadmium	Chromium	Copper	Lead	Zinc
01-01-03-0327	<0.02	<0.01	0.17	<0.1	0.09
01-01-04-0327	<0.02	0.05	0.18	<0.1	0.15
01-02-03-0327	<0.02	<0.01	0.16	<0.1	0.06
01-02-04-0327	<0.02	<0.01	0.14	<0.1	0.07
01-03-03-0327	<0.02	<0.01	0.12	<0.1	0.04
01-03-04-0327	<0.02	<0.01	0.12	<0.1	0.06
01-04-03-0327	<0.02	<0.01	0.11	<0.1	0.04
01-04-04-0327	<0.02	<0.01	0.60	<0.1	0.05
01-06-03-0327	<0.02	<0.01	0.05	<0.1	0.04
01-06-04-0327	<0.02	<0.01	0.05	<0.1	0.04
01-07-03-0327	<0.02	<0.01	0.04	<0.1	0.06
01-07-04-0327	<0.02	<0.01	0.01	<0.1	0.04
01-08-04-0327	<0.02	<0.01	0.03	<0.1	0.04
01-08-04-0327	<0.02	<0.01	0.02	<0.1	0.05
01-10-03-0327	<0.02	<0.01	0.02	<0.1	0.04
01-10-04-0327	<0.02	<0.01	0.01	<0.1	0.07
01-11-03-0327	<0.02	<0.01	<0.01	<0.1	0.05
01-11-04-0327	<0.02	<0.01	<0.01	<0.1	0.04
01-12-03-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-12-04-0327	<0.02	<0.01	<0.01	<0.1	0.04
01-13-03-0327	<0.02	<0.01	<0.01	<0.1	0.03

TABLE V-6

Results of Metals Analysis of San Francisco Bay Area Water Samples (continued)

Sample Number*	Concentration (mg/l) Cadmium	Chromium	Copper	Lead	Zinc
01-13-04-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-14-03-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-14-04-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-15-03-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-15-04-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-16-03-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-16-04-0327	<0.02	<0.01	<0.01	<0.1	0.03
01-17-03-0327	<0.02	<0.01	<0.01	<0.1	0.02
01-17-04-0327	<0.02	<0.01	<0.01	<0.1	0.02
01-18-03-0327	<0.02	<0.01	<0.01	<0.1	0.04
01-18-04-0327	<0.02	<0.01	<0.01	<0.1	0.02
01-41-01-0423	<0.01	<0.01	<0.01	<0.01	0.05
01-41-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-43-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-43-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-44-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-44-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-45-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-45-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-46-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-46-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-47-01-0423	<0.01	<0.01	<0.01	<0.01	0.02

TABLE V-6

Results of Metals Analysis of San Francisco Bay Area Water Samples
(continued)

Sample Number*	Concentration (mg/l) Cadmium	Chromium	Copper	Lead	Zinc
01-47-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-48-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-48-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-49-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-49-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-50-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-50-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-51-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-51-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-52-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-52-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-54-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-54-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-55-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-55-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-57-01-0423	<0.01	<0.01	<0.01	<0.01	<0.01
01-57-02-0423	<0.01	<0.01	<0.01	<0.01	<0.01

*Sample Number = Survey Number - Station Number - Parameter Number - Date

TABLE V-7

Results of Metals Analysis of San Francisco Bay
Bottom Sediment Samples

Sample Number*	Concentration (mg/kg, dry weight) Cadmium	Chromium	Copper	Lead	Zinc
01-01-03-0326	<1	<1	36	<5	98
01-02-03-0326	<1	31	31	<5	87
01-03-03-0326	<1	26	NR	NR	73
01-04-03-0326	<1	40	NR	NR	66
01-05-03-0326	<1	31	26	<5	71
01-06-03-0326	<1	36	31	<5	82
01-07-03-0326	<1	47	37	<5	105
01-08-03-0326	<1	51	24	<5	92
01-09-03-0326	<1	27	22	<5	71
01-10-03-0326	<1	40	33	<5	119
01-11-03-0326	<1	90	44	29	137
01-12-03-0326	<1	77	39	23	127
01-13-03-0326	<1	72	41	<10	129
01-14-03-0326	<1	82	43	<11	144
01-15-03-0326	1	83	47	<10	140
01-17-03-0326	<1	55	26	25	97
01-18-03-0326	<1	39	15	<7	94
01-23-05-0501	<1	58	45	38	121
01-30-05-0501	<1	33	20	19	72
01-32-05-0501	1	71	68	41	140
01-35-05-0501	1	51	45	39	115

TABLE V-7

Results of Metals Analysis of San Francisco Bay
Bottom Sediment Samples
(continued)

Sample Number*	Concentration (mg/kg, dry weight) Cadmium	Chromium	Copper	Lead	Zinc
01-39-05-0501	<1	54	32	20	70
01-43-05-0423	<1	12	59	87	134
01-45-05-0423	<1	<1	88	45	141
01-46-05-0423	<1	27	54	28	111
01-47-05-0423	<1	26	38	18	69
01-48-05-0423	<1	<1	59	29	58
01-49-05-0423	<1	17	11	11	32
01-50-05-0423	<1	18	60	34	89
01-51-05-0423	<1	19	9	7	38
01-52-05-0423	<1	16	18	14	47
01-54-05-0423	<1	22	21	13	62
01-55-05-0423	1	<1	55	21	152
01-57-05-0423	<1	<1	10	13	41
01-60-10-0423	<1	28	31	37	88
01-71-09-0330	<1	55	17	<13	72
01-72-09-0330	<1	23	27	42	102
01-73-08-0331	<1	12	12	<5	27
01-74-08-0331	<1	36	13	47	88
01-75-08-0331	<1	83	14	81	63
01-76-09-0402	<1	33	13	<9	49
01-77-15-0402	<1	25	59	<6	44
01-78-08-0403	<1	49	33	38	78

TABLE V-7

Results of Metals Analysis of San Francisco Bay
Bottom Sediment Samples
(continued)

Sample Number*	Concentration (mg/kg, dry weight) Cadmium	Chromium	Copper	Lead	Zinc
01-79-20-0403	<1	9	<1	<4	18
01-90-06-0429	<1	22	19	26	57
01-91-06-0429	<1	29	23	18	49
01-92-06-0429	<1	21	17	60	25
01-93-06-0430	<1	39	33	81	28

*Sample Number = Survey Number - Station Number - Parameter Number - Date.

NR = Not Requested.

TABLE V-8

Results of Metals Analysis of San Francisco Bay Area Shellfish

Sample Number	Shellfish Type	Concentration (mg/kg, wet weight) Cadmium	Chromium	Copper	Lead	Mercury	Zinc
01-60-08-0423	Soft Clam	0.6 ✓	0.9	4.8	0.8	0.79 ✓	35 ✓
01-71-06-0330	" "	<0.5	<0.5	8.0	<5	<0.1	59 ✓
01-72-06-0330	" "	<0.5	<0.5	<0.5	<5	<0.1	21
01-73-05-0331	" "	<0.5	<0.5	<0.5	<5	<0.1	20
01-73-11-0331	Olympia Oyster	2.0 ✓	<0.5	68.5	<5	<0.1	14
01-74-05-0331	Soft Clam	<0.5	1.5	<0.5	<5	<0.1	25
01-75-05-0331	" "	<0.5	1.0	<0.5	<5	<0.1	30 ✓
01-76-05-0402	" "	<0.5	<0.5	<0.5	<5	<0.1	16
01-77-12-0402	" "	<0.5	20.0 ✓	<0.5	<5	<0.1	20
01-78-05-0403	" "	<0.5	<0.5	<0.5	<5	0.1	25
01-78-24-0330	Eastern Oyster	2.0 ✓	<0.5	30.0	<5	0.1	608
01-78-22-0330	Pacific Oyster	4.5 ✓	<0.5	45.5	<5	0.2	336
01-79-11-0403	Soft Clam	<0.5	<0.5	<0.5	<5	<0.1	14
01-79-14-0403	Eastern Oyster	NR	NR	NR	NR	<0.1	NR
01-79-17-0403	Pacific Oyster	<0.5	<0.5	<0.5	<5	<0.1	111
01-90-03-0429	Soft Clam	0.2	0.3	5.9	0.7	0.25 ✓	25

TABLE V-8

Results of Metals Analysis of San Francisco Bay
Area Shellfish
(continued)

Sample Number	Shellfish Type	Concentration (mg/kg, wet weight) Cadmium	Chromium	Copper	Lead	Mercury	Zinc
01-91-03-0429	Soft Clam	0.6	1.0	3.9	4.2 ✓	0.42 ✓	18
01-92-03-0429	" "	0.9	0.3	34 ✓	2.0 ✓	0.25 ✓	29
01-93-03-0429	" "	0.3	0.4	3.5	1.0	<0.02	21

*Sample Number = Survey Number - Station Number - Parameter Number - Date.

NR = Not Requested.

TABLE V- 8a

Concentration of Selected Heavy Metals In Shellfish
Wet Weight by Station[a]/
(In mg/kg)

EPA Lab Number	Coll. Date	Sample Description	Cadmium	Chromium	Copper	Lead	Mercury	Zinc
16SF042	4/7/72	#3/Bayview	0.21	2.62	5.73	10.53	0.03	18.71
5SF042	4/7/72	#9/Burlingame	0.15	0.88	1.20	1.32	0.01	8.48
15SF042	4/7/72	#10 Coyote Pt-N	1.41	0.79	48.19	1.75	0.15	156.63
6SF042	4/7/72	#14 Foster City	0.21	0.30	1.38	0.41	0.03	10.47
7SF042	4/7/72	#19 Oakland Airport	0.13	0.53	1.12	0.42	0.02	9.30
8SF042	4/7/72	#20 San Leandro Bay	0.33	0.56	1.34	1.22	0.02	10.62
14SF042	4/8/72	#22 Alameda Memorial State Park	0.35	1.17	1.98	0.93	0.05	24.03
13SF042	4/7/72	#23 Oakland Inner Harbor	0.58	0.67	1.21	3.82	0.06	35.05
28SF042	4/8/72	#27 Albany Hills	0.21	3.64	6.60	18.70	0.06	24.53
36SF042	4/8/72	#29 Pt. Richmond	0.25	0.31	1.94	0.71	0.09	20.25
35SF042	4/8/72	#30 Castro Pt. et al.	0.06	0.84	1.25	0.23	0.03	9.11
29SF042	4/8/72	#31 Tara Hills (L)	0.14	1.70	2.47	1.53	0.04	17.41
30SF042	4/8/72	#32 Tara Hills (M)	0.09	6.65	4.66	1.84	0.09	14.93
31SF042	4/8/72	#33 Tara Hills (R)	0.06	3.99	2.62	2.17	0.05	14.60

TABLE V- 8a

Concentration of Selected Heavy Metals In Shellfish
Wet Weight by Station[a/]
(In mg/kg)

EPA Lab Number	Coll. Date	Sample Description	Cadmium	Chromium	Copper	Lead	Mercury	Zinc
33SF042	4/8/72	#41 Strawberry Pt-W	0.29	1.47	4.05	1.79	0.06	19.32
32SF042	4/8/72	#42 Richardson Bay	0.16	2.96 ✓	3.52	2.92 ✓	0.06	18.27
Control[a/]	5/23/72	Johnson Oyster Company Drakes Estero	0.33	0.10	2.03	0.93	0.04	57.57

[a/] EPA, Region IX

[b/] Control is sample from Johnson Oyster Company, Drake's Estero.

TABLE V-9

Results of Analysis of San Francisco Bay Area Bottom Sediment, Shellfish, and Plankton Samples for Chlorinated Insecticides and Polychlorinated Biphenyls

Sample Number*	Sample Type	Chlorinated Insecticides (ng/g*)					Polychlorinated Biphenyls (ng/g*)		
		Chlordane	DDD	DDE	DDT	Dieldrin	Aroclor 1248	Aroclor 1254	Aroclor 1260
01-01-02-0326	Sediment	ND	ND	ND	ND	ND	ND	40	ND
01-02-02-0326	"	ND	ND	ND	ND	ND	ND	38	ND
01-03-02-0326	"	ND	ND	ND	ND	ND	ND	18	ND
01-03-03-0329	Plankton	ND	ND	ND	ND	ND	ND	ND	ND
01-04-02-0326	Sediment	ND	ND	ND	ND	ND	ND	15	ND
01-05-02-0326	"	ND	ND	ND	ND	ND	ND	17	ND
01-06-02-0326	"	ND	ND	ND	ND	ND	ND	18	ND
01-07-02-0326	"	ND	ND	ND	ND	8	ND	48	ND
01-07-03-0402	Plankton	ND	ND	ND	ND	ND	ND	ND	ND
01-08-02-0326	Sediment	ND	ND	ND	ND	ND	ND	30	ND
01-09-02-0326	"	ND	ND	ND	ND	3	ND	22	ND
01-10-02-0326	"	ND	ND	ND	ND	3	ND	38	ND
01-11-02-0326	"	ND	ND	ND	ND	ND	ND	25	25
01-11-05-0327	Plankton	ND	ND	ND	ND	ND	ND	ND	ND
01-12-02-0326	Sediment	ND	ND	ND	ND	ND	ND	89	ND
01-13-02-0326	"	ND	ND	ND	ND	ND	ND	58	ND

TABLE V-9

Results of Analysis of San Francisco Bay Area Bottom Sediment, Shellfish, and Plankton Samples for Chlorinated Insecticides and Polychlorinated Biphenyls (continued)

Sample Number*	Sample Type	Chlorinated Insecticides (ng/g*) Chlordane	DDD	DDE	DDT	Dieldrin	Polychlorinated Biphenyls (ng/g*) Aroclor 1248	Aroclor 1254	Aroclor 1260
01-14-02-0326	Sediment	ND	ND	ND	ND	ND	ND	69	ND
01-15-02-0326	"	ND	ND	ND	ND	ND	ND	74	ND
01-17-02-0326	"	ND	ND	ND	ND	ND	ND	48	ND
01-18-02-0326	"	ND	ND	ND	ND	ND	ND	33	ND
01-21-07-0502	Plankton	ND	ND	ND	ND	ND	ND	ND	ND
01-23-03-0501	Sediment	ND	2	1	ND	ND	ND	20	ND
01-30-03-0501	"	ND	1	1	2	ND	9	26	18
01-32-03-0501	"	ND	1	1	4	ND	4	11	8
01-35-03-0501	"	ND	2	ND	3	ND	ND	25	ND
01-39-03-0501	"	ND	ND	ND	1	ND	ND	10	ND
01-43-03-0423	"	ND	3	ND	ND	1	ND	10	ND
01-45-03-0423	"	ND	ND	ND	4	ND	ND	8	ND
01-46-03-0423	"	ND	1	ND	ND	ND	ND	40	ND
01-47-03-0423	"	ND	1	ND	ND	ND	ND	ND	ND
01-48-03-0423	"	ND	7	ND	3	ND	ND	20	ND
01-49-03-0423	"	ND	ND	ND	ND	ND	ND	ND	ND

TABLE V- 9

Results of Analysis of San Francisco Bay Area Bottom Sediment, Shellfish, and Plankton Samples for Chlorinated Insecticides and Polychlorinated Biphenyls (continued)

Sample Number *	Sample Type	Chlorinated Insecticides (ng/g*) Chlordane	DDD	DDE	DDT	Dieldrin	Polychlorinated Biphenyls (ng/g*) Aroclor 1248	Aroclor 1254	Aroclor 1260
01-50-03-0423	Sediment	ND	2	1	2	ND	ND	14	ND
01-51-03-0423	"	ND	ND	ND	ND	ND	ND	ND	ND
01-52-03-0423	"	ND	ND	ND	ND	ND	ND	ND	ND
01-54-03-0423	"	ND	ND	ND	ND	1	ND	12	ND
01-54-03-0423	Plankton	ND	ND	ND	ND	ND	ND	ND	ND
01-55-03-0423	Sediment	ND	3	1	ND	ND	ND	22	ND
01-55-03-0425	Plankton	ND	ND	ND	ND	ND	ND	ND	ND
01-57-03-0423	Sediment	ND	ND	ND	ND	ND	ND	4	ND
01-60-09-0423	"	ND	1	ND	3	ND	ND	6	ND
01-60-07-0423	Soft Clam	ND	8	3	8	2	ND	36	ND
01-71-08-0330	Sediment	ND	ND	ND	ND	ND	ND	ND	ND
01-71-05-0330	Soft Clam	30	8	4	5	7	ND	85	ND
01-72-11-0330	Sediment	ND	ND	ND	ND	4	ND	9	ND
01-72-05-0330	Soft Clam	ND	3	3	2	3	ND	41	ND
01-73-07-0331	Sediment	ND	ND	ND	ND	ND	ND	45	ND
01-73-10-0331	Olympia Oyster	35	29	24	9	17	170	285	ND
01-73-04-0331	Soft Clam	132	33	16	4	1	200	120	ND

TABLE V-9

Results of Analysis of San Francisco Bay Area Bottom Sediment, Shellfish, and Plankton Samples for Chlorinated Insecticides and Polychlorinated Biphenyls (continued)

Sample Number*	Sample Type	Chlordane	DDD	DDE	DDT	Dieldrin	Polychlorinated Biphenyls (ng/g*) Aroclor 1248	Aroclor 1254	Aroclor 1260
01-74-07-0331	Sediment	ND	ND	ND	ND	ND	50	50	ND
01-74-04-0331	Soft Clam	18	4	3	3	ND	ND	38	ND
01-75-07-0331	Sediment	ND	ND	ND	ND	ND	ND	13	ND
01-75-04-0331	Soft Clam	25	6	3	3	6	15	25	ND
01-76-08-0402	Sediment	ND	ND	ND	ND	ND	ND	5	ND
01-76-05-0402	Soft Clam	ND	ND	ND	ND	2	ND	22	ND
01-77-14-0402	Sediment	ND	ND	ND	ND	ND	ND	ND	ND
01-77-11-0402	Soft Clam	12	4	ND	ND	4	43	43	ND
01-78-07-0403	Sediment	ND	ND	ND	ND	ND	ND	275	ND
01-78-04-0403	Soft Clam	26	5	2	4	7	ND	63	ND
01-78-21-0330	Pacific Oyster	99	4	9	11	25	ND	275	ND
01-78-23-0330	Eastern Oyster	33	10	9	6	11	ND	105	ND
01-79-19-0403	Sediment	ND	ND	ND	ND	ND	ND	21	21
01-79-10-0403	Soft Clam	ND	ND	ND	ND	ND	ND	3	ND
01-79-13-0403	Eastern Oyster	ND	ND	ND	ND	ND	ND	6	ND
01-79-16-0403	Pacific Oyster	7	5	6	2	2	ND	18	ND

TABLE V-9

Results of Analysis of San Francisco Bay Area Bottom Sediment, Shellfish, and Plankton Samples for Chlorinated Insecticides and Polychlorinated Biphenyls (continued)

Sample Number*	Sample Type	Chlordane	DDD	DDE	DDT	Dieldrin	Polychlorinated Biphenyls (ng/g*) Aroclor 1248	Aroclor 1254	Aroclor 1260
01-90-04-0429	Sediment	ND	1	ND	3	ND	ND	35	ND
01-90-02-0429	Soft Clam	ND	8	2	3	1	ND	20	ND
01-91-04-0429	Sediment	ND	1	ND	4	ND	ND	13	ND
01-91-02-0429	Soft Clam	ND	13	2	9	1	ND	4	ND
01-92-04-0429	Sediment	ND	2	ND	1	ND	ND	13	ND
01-92-02-0429	Soft Clam	ND	8	1	3	1	ND	17	ND
01-93-04-0430	Sediment	ND	1	1	2	ND	ND	33	13
01-93-02-0430	Soft Clam	ND	25	3	3	2	ND	36	ND

Sample Number = Survey Number - Station Number - Parameter Number - Date.

ND = None Detected.

Concentration in ng/g, dry weight for sediments, wet weight for shellfish and plankton.

Detection limit = 1 ng/g.

TABLE V-9a

Concentration, in ppb, of Selected Chlorinated Hydrocarbons by Station - San Francisco Bay Study[a/]

Chlorinated Hydrocarbon	3	9	10	14	19	20	22	23	27	29	30	31	32	33	41	42	C	
Aroclor 1242-1254	26.5	10.5	446.0	23.8	91.0	75.0	64.7	119.	88.0	252.0	25.9	25.4	37.8	39.4	18.0	29.1	4.7	[illegible]
Dieldrin	-	0.9	2.8	0.9	1.2	1.0	1.0	0.4	4.0	-	-	1.0	1.2	0.8	-	0.6	-	-
op´ DDE	4.2	7.2	28.0	1.9	4.3	5.5	5.8	4.0	7.2	1.6	1.4	2.2	7.0	3.4	2.2	1.8	1.2	tr
pp´ DDE	1.3	4.4	13.0	0.8	2.0	3.5	2.9	2.1	2.0	1.2	1.3	0.8	1.7	2.0	2.0	1.9	2.6	2.1
op´ DDD		tr	-	-	-	-	-	-	1.2	tr	tr	tr	-	tr	-	tr	-	-
op´ DDT	1.2	3.6	22.0	0.8	2.3	8.0	2.4	1.0	1.6	0.4	0.5	0.4	-	1.2	0.9	0.7	1.8	1.3
pp´ DDD	1.1	3.6	7.0	0.5	1.7	2.5	1.4	2.0	2.8	1.2	1.2	1.2	1.7	2.2	0.9	0.7	1.2	0.6
pp´ DDT	2.3	4.8	24.0	1.1	3.0	3.5	2.4	2.0	3.6	1.0	1.2	0.6	0.8	1.6	0.3	1.3	-	-
Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8	2.2

a/ EPA - Region IX

TABLE V-10

RESULTS OF ANALYSIS OF SAN FRANCISCO AREA
SHELLFISH FOR PETROLEUM HYDROCARBONS

Sample No.	Shellfish Bed (Station)	Petroleum Hydrocarbons, µg/g* gas chromatography (gravimetric)
01-01-01-0811	Berkeley (25)	18 (17)
01-01-02-0812	Emeryville (24)	22 (17)
01-01-03-0812	Pt. Isabel (28)	13
01-01-04-0813	Pt. Pinole (31)	29 (20)
01-01-05-0813	Pt. Pinole (34)	14 (14)
01-01-06-0813	Rodeo (35)	15 (21)

*Wet weight based on drained meats.

VI. WASTE SOURCES

THIS SECTION TO BE

INSERTED LATER

VII. IMPACT OF POLLUTION ON WATER USES

A. COMMERCIAL SHELLFISH HARVESTING

The State of California Regional Water Quality Control Board has designated propagation and harvesting of shellfish a beneficial use to be protected in the San Francisco Bay system.[1/] This beneficial use is impaired, to a major degree, by water pollution resulting from the discharge, to the bay system, of inadequately treated municipal and industrial wastes, by combined sewer overflows, by urban runoff, and by dredging, landfill, and spoil disposal practices.

A century ago, a major commercial shellfishing industry was centered on San Francisco Bay. Harvests of oysters and clams reached a peak in the 1890's and then declined sharply after 1900. Presently, this industry is non-existent. Water pollution, resulting primarily from discharges of untreated sewage, has been the most important cause of the elimination of shellfish harvesting from the Bay system.[C/]

If existing water quality constraints are eliminated, the potential exists for reestablishment of a major shellfishery in the Bay. Although illegal -- owing to the closure of shellfish beds because of bacterial contamination, some harvesting of shellfish, by individuals, for food presently occurs. A sizeable standing crop of clams and native oysters is present in the bay system. Research has shown that Pacific and Eastern oysters can be grown using modern cultural methods.

The following sections discuss the history, present status, and potential development of the oyster and clam fisheries in the bay system and the estimated economic impact of pollution on the shellfish industry.

Oyster Fishery

History -- The native western oyster (*Ostrea lurida*) was present in San Francisco Bay in prodigious quantities before the 1890's, and clams and mussels were plentiful, too. Extensive beds of the oysters were located in shallow areas along the west side of the South Bay. The extent to which the shell deposits were built up by the native oysters is reflected by the more than 50 million cubic yards of shell that have been dredged from the bay over the past 30 years; an estimated 75 million cubic yards still remain in the bay.

The native oyster was exploited commercially by simply harvesting oysters from the natural beds. No attempt at oyster culture was made. The introduction of other commercially important oyster species combined with destruction of oyster beds by siltation and pollution rapidly decreased the importance of the native oyster. Since 1945, there has been little or no commercial harvest of the native oyster in California.[V/]

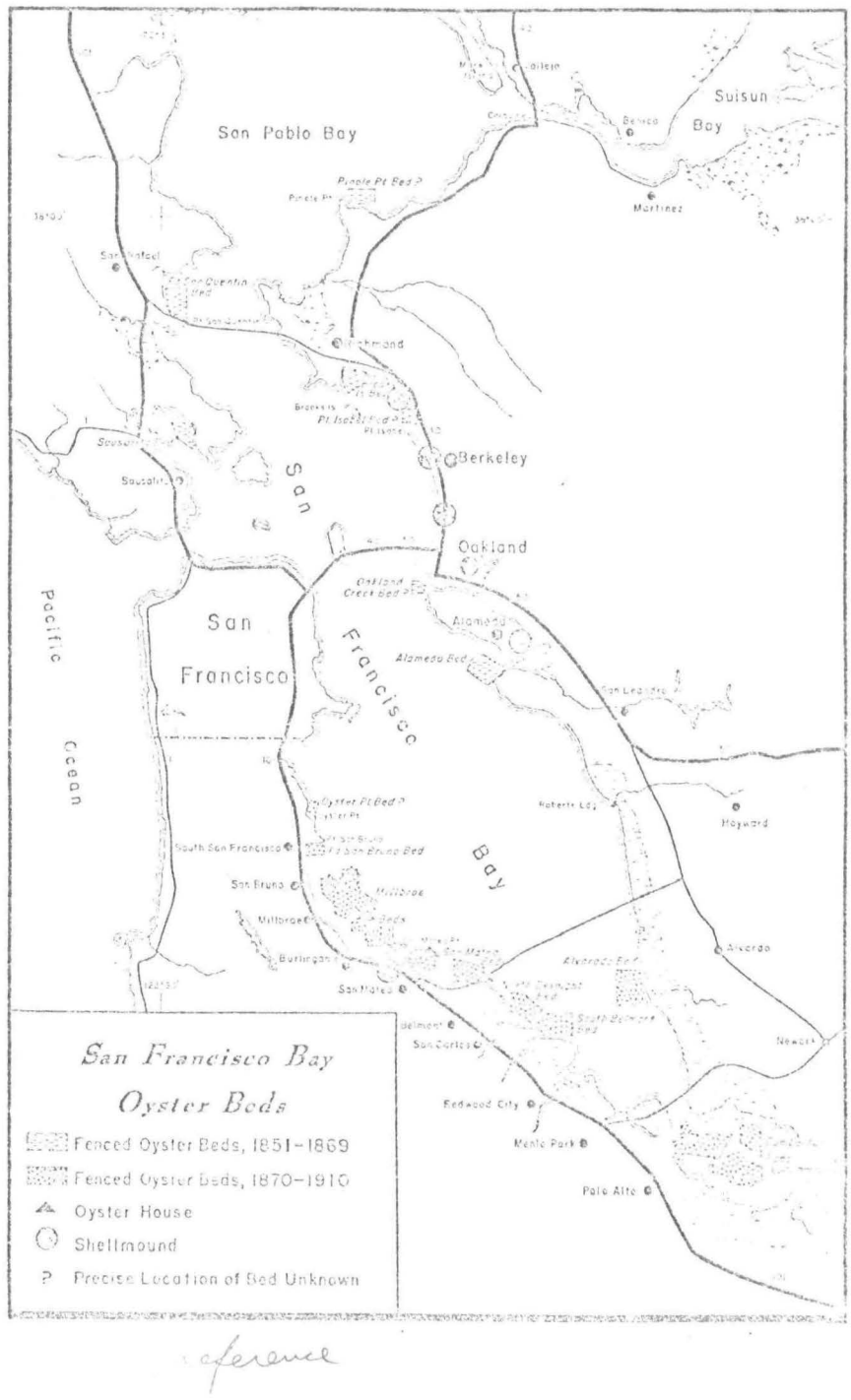
In 1869, the eastern oyster (*Crassostrea virginica*) was introduced to San Francisco Bay. This oyster thrived under culture and provided a major source of oysters during the next 30 years. The method of culture was simple. Seed oysters (spat) were imported from East-coast locations. The spat attached to shell pieces were set out in suitable beds and allowed to reach market size. The adult oysters were then harvested by hand.

The first commercial beds were located at Sausalito, Point San Quentin, Sheep Island, Oakland Creek, and Alameda Creek.[22/] These beds were soon abandoned owing to bacterial contamination or adverse physical conditions and, by 1875, all beds were located only in the southern portions

of San Francisco Bay.[22/] [Historical locations of commercial oyster beds are shown in Figure VII-1.] The Oakland and Alameda Creek beds were abandoned because of sewage and traffic on the bay.[22/] The Alvarado beds were abandoned because of adverse hydrographic conditions.

Between 1880 and 1900 the culture of eastern oysters in San Francisco Bay and the importing of seed oysters from the East Coast was a million-dollar-a-year business. During the 1890's the oyster industry of San Francisco Bay was the single most valuable fishery in California. Records of oyster harvests during this peak period are incomplete and conflicting, but they do provide an idea of the major oyster production then existing. Between the years 1888 and 1895 the annual oyster production (whole oysters including shells) was estimated to range from 9 to 15 million pounds, with a value of 500 to 700 thousand dollars.[20/] Other records of oyster harvests (meats only) indicated that a peak production of 3,060,000 pounds of oyster meat, valued at $867,000, was reached in 1899.[22/] During the 1887 to 1895 period imports of seed oysters ranged from 1.0 to 3.3 million pounds annually. Most of the oyster harvest was obtained from commercial beds, totalling 3,000 to 4,000 acres in area.[23/]

About 1900 in the southern end of San Francisco Bay, unknown events caused a radical change that adversely affected the growth rate and market condition of oysters grown there. Pollution also affected conditions in much of the bay. The choicest oyster growing locations were heavily contaminated, yielding oysters of poor quality. As a result, the oyster industry was short-lived. By 1908, oyster production had decreased 95 percent from reported landings in 1892.[23/]



reference

Figure VII-1. Historic Commercial Shellfish Bed Locations

Attempts were made to grow eastern oysters in other California waters, but met with little success. Shellfish harvests in California continued a long decline until 1931, when the pacific oyster (*Crassostrea gigas*) was imported from Japan. Commercial beds were successfully established in Bodega Lagoon, Tomales Bay, and Drakes Estero, small bays on the coast a short distance north of San Francisco Bay. Culture of the Pacific oyster was also successful in coastal Humboldt and Morro Bays. Pacific oysters were not cultured in San Francisco Bay, owing to the water pollution still being present.

The culture of Pacific oysters revived the California oyster industry and statewide landings steadily increased except during and immediately after World War II when imports of seed oysters from Japan were stopped. At the same time the San Francisco Bay oyster fishery steadily declined and is, at present, non-existent.

Present Status -- A survey of the intertidal zone of the Bay system in 1967 located 42 shellfish beds containing sizeable standing crops of shellfish.[24/] Native oysters were present in half these beds and numerous at 11 locations. Five beds contained an abundance of native oysters. No recent survey has been made of the distribution and populations of native oysters in areas of the bay lying below low tide elevation.

Eastern and Pacific oysters do not spawn well in the bay system because water temperatures are unfavorable. These oysters are thus rarely found except where artifically cultured.

There are no existing commercial oyster beds in the bay system. A state allotment, for oyster cultural purposes, of 3,000 acreas in San

Pablo Bay, was held by an oyster company during the 1960's, but was abandoned without development. Oystermen express an interest in developing an oyster fishery in the bay system if restrictions on harvesting are lifted.[6/]

Since 1960 the State Department of Fish and Game has been conducting studies of the rack culture of Eastern and Pacific oysters in Redwood Creek (in southern San Francisco Bay). The Leslie Salt Company also experimented with oyster culture in the same area. These studies indicated favorable growth rates can be achieved under present water quality conditions.

All of the bay system is closed to commercial harvesting of shellfish for human consumption because of the bacterial contamination of shellfish growing areas. In addition, the State Department of Health has recommended, to local health departments, the posting of most known shellfish beds in order to prevent sport harvesting of shellfish for human consumption. A number of beds have been posted. In spite of these prohibitions and postings, illegal harvesting of shellfish has been observed. In most cases, the shellfish taken were clams; the extent of illegal harvesting of native oysters is unknown. The State of California Department of Health studies have shown that shellfish from many of the beds are contaminated with bacteria, and, in some cases, with heavy metals and pesticides, to a degree that poses a health hazard to human consumption.[25/]

Studies, conducted during 1969 and 1970 by the State Department of Health, showed that, in several limited areas, bacterial concentrations in waters overlying shellfish beds met applicable limits for "Approved"

or "Conditionally Approved" shellfish harvesting areas.[25,26] In most cases, however, shellfish taken from these beds had unacceptable levels of bacterial contamination. Waste disposal and disinfection practices at nearby municipal waste sources were also found to be inadequate for guaranteeing the continued safety of shellfish harvesting, even if acceptable water quality existed over the beds. Thus, improvement in both water quality conditions and waste disposal practices will be needed before acceptable conditions will exist for approval of any shellfish harvesting areas.

Potential Development -- In view of the physical conditions of the bay system and of the capability for high oyster production that has been demonstrated in the past, it is possible that an oyster fishery of exceptional proportions could be developed using rack culture techniques. About 175,000 acres of the bay system are potential oyster grounds, based on physical conditions.[26] In the past about 3,000 to 4,000 acres of oyster beds were commercially maintained. Thus, development of at least 4,000 acres of oyster beds in the bay system would appear to be readily achievable.

During the 1890's, oyster production was in the range of 2,500 to 5,000 pounds of oysters per acre per year.[26] This corresponds to an oyster meat production of 400 to 750 pounds per acre. From 1958 to 1967 oyster meat production in California averaged about one million pounds annually. If it is assumed that this harvest was taken from the 4,400 acres of registered shellfish areas, the average oyster meat production was about 230 pounds per acre. This compares favorably with a California

Department of Fish and Game estimate of yields of 150 to 300 pounds per acre for culture of Pacific oysters.[27] The oysters harvested in the 1890's were eastern oysters, while recent harvests in California were primarily Pacific oysters.

A yield of 250 pounds of oyster meat per acre, from 4,000 acres, would produce an annual harvest of about 1 million pounds of oyster meat. Thus San Francisco Bay has the potential to match or exceed the oyster production of all other California growing areas combined.

The oyster production figures just mentioned are based on bottom culture methods historically used in San Francisco Bay. Modern rack culture methods hold the promise of even greater production levels. State Department of Fish and Game biologists have estimated that it would be possible to produce, using rack culture for about 80 percent of the production,[28] a total of about 13 millions pounds of oyster meat annually from the bay system. About 70 percent of the oysters would be grown in the southern portions of San Francisco Bay and the remainder in San Pablo Bay.

Clam Fishery

History -- The early shellfish fauna of the Bay system was extensive, but few species were of commercial importance. The most common edible species was the bent-nose clam (*Macoma nasuta*). Large quantities of these clams were probably dug from the South Bay for the market prior to 1876.[26]

The soft-shelled clam was accidentally introduced in oyster shipments about 1870. It soon displaced some native species and became widely distributed. It is an excellent food clam and formed the bulk of the San

Francisco clam trade. The mud flats of San Pablo Bay and the southern portions of San Francisco Bay were particularly favorable locations.

Harvests of clams from the bay system exhibited the same rise and fall as did oyster fishery. Between 1880 and 1900 clam production ranged between one and three million pounds annually, the highest production recorded.[23/] After 1900 clam production decreased sharply. Pollution and excessive digging contributed to this decline. Between 1916 and 1935 the annual commercial harvest ranged from 100 to 300 thousand pounds. The production continued to decline after 1935 and, after 1949, was essentially zero.

Present Status -- A survey of the intertidal zone of the Bay system in 1967 located 42 definable shellfish beds containing sizeable standing crops of clams.[24/] [Bed locations and clam populations observed in 1967 are summarized in Table VII-1. Bed locations are shown in Figure V-3.] In addition to the 42 beds, clams were found scattered throughout most of the intertidal zone. Sizeable clam populations are also believed to exist in areas below low tide elevation, although no recent surveys of these areas have been made.

A total of 19 of the 42 beds identified in 1967 were re-surveyed in early 1972 in order to evaluate possible changes in the size and number of clams present [Appendix C]. Fifteen of the 19 beds were found to have significantly smaller total weights of clams than in 1967. Shellfish beds surveyed and associated changes in clam populations have been summarized [Appendix C, Table C-3]. The beds that were re-surveyed were the larger beds with the some potential for commercial or sport shellfishing. Small

TABLE VII-1
SUMMARY OF SHELLFISH BED CHARACTERISTICS

Bed No	Location	Area (1,000 ft^2)	Shellfish Populations		Present Uses	Potential Uses	Limiting Factors
			Clams	Oysters			
1	Candlestick Point	0 5	small	present	bait	fully utilized	--
2	Bayview Park, northeast of	0.2	small	present	bait	bait	--
3	Bayview Park	19.0	medium	--	bait	--	--
4	Bayshore, to the east of	1.5	small	--	minor bait	bait	Storm drainage and sewer overflows
5	Visitation Valley, to the east of	15.5	small	present	minor bait	bait	--
6	Brisbane, to the east of	5.4	medium	numerous	fish food	bait and sport	Access, bacterial contamination
7	Oyster Point	0.6	small	numerous	minor bait	bait	Access
8	Point San Bruno, South Side	17.9	large	numerous	minor bait	bait and sport	Municipal and Industrial Wastes Bacterial contamination
9	Burlingame	250 0	large	numerous	fish food	commercial bait, sport shellfishing	Bacterial Contamination Most of area recently filled.
10	Coyote Point, north of	102.6	large	large	bait and sport	bait and sport	Bacterial Contamination.
11	Coyote Point, south of	78.0	medium	numerous	bait and sport	bait and sport	Bacterial Contamination. Municipal Wastes.
12	San Mateo Creek	1.0	small	(Old Commercial Bed)	fish food	bait	Municipal Wastes
13	West end of San Mateo Bridge	1.2	large	--	minor bait	limited sport	Municipal wastes.
14	Foster City	799.0	large	present (Old Commercial Bed)	minor bait	bait and major sport	Bacterial Contamination. Municipal Wastes.
15	Redwood City	18 0	small	numerous (Experimental Culture area)	fish food	bait and minor sport	Bacterial Contamination. Oil Spills.

TABLE VII-1 (CONTINUED)
SUMMARY OF SHELLFISH BED CHARACTERISTICS

Bed No.	Location	Area (1,000 ft^2)	Shellfish Populations		Present Uses	Potential Uses	Limiting Factors
			Clams	Oysters			
16	Dumbarton Bridge, west end of	1.9	medium	--	minor bait	bait	--
17	Dumbarton Bridge, east side of	7.2	medium	-	fish food	bait and minor sport	Bacterial Contamination.
18	San Leandro Marina	41.4	medium	--	bait	commercial bait	--
19	Oakland Airport	84.0	small	large (Major Native Oyster Bed)	fish food	bait and sport commercial oyster culturing	Bacterial Contamination. Municipal Wastes. Dredging Sediment Blanket.
20	San Leandro Bay	100.8	large	numerous (Old Commercial Bed)	bait and sport	commercial bait	Municipal and Industrial Wastes, Bacterial Contamination
21	Alameda Island, southwest corner	7.2	large	present	bait	bait and sport	Bacterial Contamination.
22	Alameda Memorial State Beach	17.4	large	numerous	bait and sport	major sport	Bacterial Contamination.
23	Oakland Inner Harbor, foot of Alice Street	39.0	medium	present	--	--	--
24	Emeryville, foot of Ashby Ave.	1.6	small	present	bait	bait	--
25	Berkeley, foot of Bancroft Way	22.8	medium	present	bait	bait	--
26	Berkeley, foot of University Ave.	0.8	small	--	bait and sport	bait and minor sport	Bacterial Contamination.
27	Albany Hill	3,780.0	large	--	fish food	commercial bait major sport	Bacterial Contamination. Municipal Wastes
28	Point Isabel, north of	1.1	medium	numerous	fish food	commercial bait minor sport	Bacterial Contamination. Municipal Wastes.
29	Point Richmond	90.0	medium	present	minor bait	bait and minor sport	Bacterial Contamination. Municipal Wastes

TABLE VII-1 (CONTINUED)
SUMMARY OF SHELLFISH BED CHARACTERISTICS

Bed No	Location	Area ($1,000 ft^2$)	Shellfish Populations		Present Uses	Potential Uses	Limiting Factors
			Clams	Oysters			
30	Castro Point, Molate Point, Point Orient, & Point San Pablo	128.4	medium	numerous	fish food	bait and sport	Bacterial Contamination.
31	Point Pinole, north side	unknown	unknown	unknown	unknown	unknown	Access.
32	Tara Hills	48.0	large (Old Commercial Bed)	--	sport	sport	Bacterial Contamination. Municipal Wastes.
33	Between Tara Hills & Pinole Beds	61.5	small	--	--	--	--
34	Pinole	60.0	large	--	fish food	bait	Bacterial Contamination Municipal Wastes.
35	Rodeo	5.0	small	dead	--	unknown	Municipal and Industrial Pollution
36	Gallinas Creek, south of	2.3	medium	--	fish food	bait	Municipal Wastes.
37	Area between Gallinas Creek & Rat Rock	1.1	medium	--	unknown	unknown	--
38	Rat Rock Area	2.0	medium	--	bait	bait	--
39	San Rafael Bay	25.0	large	numerous	unknown	unknown	Access
40	San Quentin	9 6	large	--	unknown	unknown	--
41	Strawberry Point, west side of	28 8	medium	present	bait and sport	major sport	Bacterial Contamination.
42	Richardson Bay, north end of Highway 101 Bridge	12.0	medium	--	unknown	unknown	--

beds as well as beds located near sewage outfalls were not re-surveyed. The Point San Bruno Bed was also not surveyed for this bed has been essentially completely destroyed by landfill. As measured by changes in the standing crop of legal harvest size clams, the total clam resource, in the 19 beds evaluated, decreased by about 42 percent. With the loss of the Point San Bruno Bed, it is probable that the clam resource in San Francisco Bay has been depleted by about half in the past five years.

Present use of the clam fishery is primarily for fish bait [Table VII-1], although some sport shellfishing takes place. As previously discussed in the section on oysters, such harvesting of clams for human consumption is illegal for it poses a health hazard to the consumer.

Potential Development -- Should public health restrictions be lifted, the present clam fishery is not considered adequate to support any significant commercial harvesting for human consumption. Substantial habitat improvement would be required to maintain a commercially harvestable clam population. The cost of such improvements could likely make commercial development uneconomical.

Based on the 1967 survey are the estimates that the clam fishery could support more than 400,000 man-days of sport shellfishing.[24/] The 1972 re-survey indicates that the present clam fishery would support only about half this much sport fishing [Appendix C, Table C-3]. This sport fishing would include the taking of clams for both fish bait and human consumption. The primary reason presently limiting full use of the clam resource is bacterial contamination of growing areas. Several beds could potentially support a commercial fish bait operation.[24/]

Reductions in clam populations are caused by discharges of municipal and industrial wastes in close proximity to shellfish beds and by destruction of habitat by landfill, dredging, and spoil disposal practices. Control of these variables, in order to minimize their impact on the clam fishery, could result in a greater use of this resource.

Economic Impacts

Commercial shellfish harvesting from the San Francisco Bay system has been eliminated by pollution as a beneficial use of the waters. The major shellfishing industry existing prior to 1900 has been eliminated as a ingredient of the regional economy. Since 1930 a major increase has occurred in the oyster fishery at other California locations, thus indicating the probability that the San Francisco oyster industry would have thrived economically if water quality constraints had been removed.

Elimination of an industry generating a million dollars annually in 1900 undoubtedly created a major impact on the San Francisco area economy. It is impossible to estimate the total economic effect the loss of this fishery has produced during the last 70 years. Two possible approaches can be taken, however, to estimate the current economic impact. Owing to the fact that the growth of the shellfish industry in other areas of California was primarily the result of a shift in commercial beds from San Francisco Bay to these areas as bay beds became polluted, the value of the out-state fishery could be considered one measure of the value of the lost fishery. A second estimate can be obtained from the value of the potential production discussed previously.

Statistics on California oyster harvest are available for several

years, between 1892 and 1922, and for every year thereafter [Table VII-2].[20] Since the year 1939, the statisitics are also available, categorized by fishing region.[29] The San Francisco fishing region includes the bay system and the coastal waters from Point Arena to Pigeon Point including Tomales Bay, Bodega Bay, Bolinas Lagoon, and Drakes Estero. Prior to 1939 essentially all of the California oyster harvest came from San Francisco Bay. In recent years, all of the oyster harvest reported for the San Francisco fishing region came from coastal waters other than San Francisco Bay.

By subtracting the value of the oyster harvest in the San Francisco region from the total California harvest [Table VII-2], one can determine the value of the oyster harvest from all other California regions. For the period 1958 to 1967 the total value of the harvest from other regions was $2,050,000, an annual average of $205,000.

The California fishery does not produce an oyster supply adequate to meet the California demand for oysters. Therefore supplies are shipped in from out-of-state. If water quality constraints are removed, San Francisco Bay has the potential to produce more oysters than the existing California fishery. An annual value of $205,000 for the lost fishery is considered a conservative estimate, as a larger oyster production would probably have occurred to meet local demands if restrictions on harvesting were to be removed.

As discussed previously, estimates of the oyster production potential of the San Francisco Bay system range from 1 to 13 million pounds of oyster meats annually. At a dockside price of $0.40 per pound this production would have an annual value of $400,000 to $5,200,000. The large

Table VII-2 Summary of Oyster Harvest Statistics

Year	Total Oyster Harvest (1,000 pounds of meat)		Value ($1,000)		Unit Price ($/lb)	
	California	San Francisco*	California	San Francisco	California	San Francisco
1892	1,316					
1895	1,145					
1899	3,060		867		0.28	
1904	1,406		536		0.38	
1908	729		337		0.46	
1915	387		166		0.43	
1922	74					
1923	69		24		0.35	
1924	53		23		0.43	
1925	57		24		0.43	
1926	61		26		0.43	
1927	55		24		0.43	
1928	77		32		0.43	
1929	53		27		0.50	
1930	78		32		0.42	
1931	245		76		0.32	
1932	59		19		0.33	
1933	86		29		0.33	
1934	101		43		0.43	
1935	107		40		0.37	
1936	105		27		0.26	
1937	163		38		0.24	
1938	213		50		0.23	
1939	246	242	51	50	0.21	0.21
1940	193	180	27	25	0.14	0.14
1941	256	240	48	42	0.19	0.18
1942	85	50	29	17	0.34	0.34
1943	117	57	38	19	0.33	0.33
1944	90	35	48	24	0.53	0.69
1945	48	19	28	17	0.59	0.90
1946	22	12	19	14	0.86	1.17
1947	24	19	26	22	1.05	1.16
1948	66	48	63	53	0.95	1.10
1949	35	20	26	18	0.76	0.90
1950	39	32	36	35	0.94	1.09

Table VII-2. Summary of Oyster Harvest Statistics

Year	Total Oyster Harvest (1,000 pounds of meat)		Value ($1,000)		Unit Price ($/lb)	
	California	San Francisco *	California	San Francisco	California	San Francisco
1951	43	41	46	53	1.06	1.29
1952	45	39	47	46	1.04	1.18
1953	38	34	44	43	1.18	1.26
1954	74	36	54	47	0.73	1.30
1955	218	42	89	56	0.40	1.33
1956	756	59	178	75	0.23	1.27
1957	1,359	64	287	41	0.21	0.64
1958	1,159	75	242	54	0.21	0.72
1959	1,653	54	309	42	0.19	0.78
1960	1,283	32	289	34	0.23	1.06
1961	1,221	79	296	63	0.25	0.80
1962	1,339	61	306	46	0.23	0.75
1963	1,300	186	226	36	0.17	0.19
1964	1,360	213	254	47	0.19	0.22
1965	1,063	195	263	64	0.25	0.33
1966	790	234	222	92	0.28	0.39
1967	742	199	207	81	0.28	0.40

* San Francisco Fishing Region including the San Francisco Bay System and coastal waters from Point Arena to Pigeon Point.

supply associated with the upper limit of potential production would probably result in reduced prices, making an upper limit of $2,600,000 ($0.20 per pound) for the potential value of the fishery more realistic.

It is doubtful whether a significant commercial clam industry can be established in the bay. The value of the potential commercial bait industry is unknown, but is probably small. It is probable that water quality constraints are the primary elements preventing the development of at least one-third of potential recreational shellfishing based on the existing clam fishery. As previously discussed, the potential recreational shellfishery has decreased from a value of about 400,000 man-days in 1967 to about 200,000 man-days in 1972. At a value of two dollars per man-day this decrease represents an economic loss of about $400,000 over a five-day period. The portion of this loss that can be attributed to water pollution is unknown, but it is believed to be substantial. Pollution also prevents the use of much of the remaining potential clam resource, valued on the same basis at $400,000.

Various studies have shown that the economic impact of the shellfish industry on the regional economy is about four times the dockside value of shellfish products.[30/] With this multiplier, the total economic impact of pollution on the economy of the San Francisco area, as the result of the loss of the oyster fishery, is in the range of $820,000 to $10,400,000.

This estimate considers only the multiplied economic effect of the harvested oysters. An additional economic impact would be produced by the importation of seed oysters to supply cultural requirements. That economic effect is unknown. Further, an additional but unknown economic impact is also produced by the loss of the clam fishery.

San Francisco Bay has the potential to produce a shellfish supply adequate to meet local needs and create a surplus that could be marketed in interstate commerce. Pollution of the bay prevents the realization of this potential.

Large-scale commercial production of oysters in San Francisco Bay would require culture of either Eastern or Pacific oysters. Such cultural practices would require the interstate importation of large numbers of seed oysters. Pollution of San Francisco Bay prevents the practice of oyster culture and, thus, prevents the market of seed oysters in interstate commerce to provide the basis for oyster production.

B. DETRIMENTAL EFFECTS ON AQUATIC LIFE

San Francisco Bay has been richly endowed with fish life. The fishes of San Francisco Bay can be divided into six categories: 1) schooling, pelagic, bait, and forage fishes; 2) flatfishes; 3) bottom fishes; 4) sharks, skates, and rays; 5) croakers; and 6) anadromous fishes. The most valuable (both commercial and sport fishing) group of fishes in San Francisco Bay are the anadromous fishes; the category includes such fishes as the striped bass and chinook salmon. The bait and forage fishes, such as smelt and whitebait, are extremely important as food for other fishes. Some species of whitebait inhabit the bay throughout the year; thus, water quality in the bay would affect them more than fish that occupy the bay only a portion of the year. During the period from 1916-1958, the commercial harvest of whitebait ranged from a high of 161,797 lb in 1916 to a low of 3,487 lb in 1943. The opinion has been expressed that the polluted condition of South Bay is probably among the

chief reasons these fish have not been seen in the same numbers as in former years.[20/]

Fish kills have occurred annually in San Francisco Bay, particularly in the Suisun Bay and Carquinez Strait area. These kills generally occur during the spring and summer in the vicinity of municipal waste treatment plants and industrial waste discharges and involve thousands of fish [Appendix F]. More than 56 percent of the reported fish kills were from unknown causes; however, of those from known causes, about 20 percent (of total kills) resulted from low dissolved oxygen, 7 percent from sewage, 9 percent from an industrial pollutant and the remainder (8 percent) from other causes. Most of these kills were investigated by the California Department of Fish and Game.

Food supply can also limit fish populations. The opossum shrimp is the most important source of food of a number of fishes at some stage during their life in San Francisco Bay. This crustacean requires 7-8 mg/l of dissolved oxygen[12/] and water temperatures below 22.8°C.[22/] The eutrophication of Suisun Bay and Western Delta waters that is projected is expected to lead to a dissolved oxygen depression.[20/] If the oxygen concentration drops below 6 mg/l, the anadromous fish population, including striped bass, king salmon, and American shad, is expected to decline.[20/]

Water temperatures in that area approached the critical temperature for opossum shrimp. When water temperatures exceed 22.2°C, opossum shrimp populations in the Sacramento-San Joaquin estuary generally decrease.[20/]

C. RECREATION

Waters of the San Francisco Bay system are heavily employed for non-contact recreation including boating, sailing, and fishing. Some areas of the bay also support contact recreation including swimming and water skiing. Prior to the late 1960's when widespread improvements in disinfection of waste effluents were made, bacterial contamination made most of the bay system unsafe for water contact recreation. In the vicinity of waste discharges bacterial concentrations posed a serious health hazard.

As a result of the improved disinfection practices, most of the bay system has water quality acceptable for water contact recreation during dry weather periods. Applicable water quality criteria are met most of the time at the Alameda, Coyote Point, and Point Molate beaches and part of the time at the San Francisco Aquatic Park and Marina beaches.—/ During wet weather, however, combined sewer overflows and sewage treatment plant bypassing caused by excessive infiltration produce bacterial contamination of recreation areas. Occasional malfunctioning of disinfection equipment at waste sources also contributes to bacterial contamination. In many areas bacterial levels are high enough to pose a health hazard to recreational shellfishing although such shellfishing continues.

Thus, impairment of recreational uses of the bay system has been substantially reduced in the last decade. However, impairment of such uses continues and will continue until combined sewer overflows and treatment plant bypasses are controlled, adequate controls are installed to ensure continuous disinfection of waste effluents, and until waste discharge points are relocated to offshore locations remote from beaches and recreational areas.

VIII. STATUS OF POLLUTION ABATEMENT

All sources of municipal and industrial wastes discharged to the San Francisco Bay system are subject to regulation by the California water pollution control program. This program is under the jurisdiction of the State Water Resources Control Board and nine regional boards. The majority of the San Francisco Bay system is under the jurisdiction of the San Francisco Bay Regional Water Quality Control Board headquartered in Oakland. Waste sources in the Delta area are regulated by the Central Valley Regional Water Quality Control Board with headquarters in Sacramento.

All waste dischargers are required to have a discharge permit from the appropriate regional board. These permits specify effluent limitations, receiving water standards, monitoring requirements, and an implementation schedule. The waste discharge requirements are designed to be compatible with and to supplement the Federal-State water quality standards [Appendix A] established in accordance with the Federal Water Pollution Control Act, as amended.

Three types of actions are taken by the regional boards to secure abatement of pollution. The first step is the issuance of resolutions. General policy, waste discharge requirements, and compliance time schedules are all issued by resolution. Individual dischargers are required to report periodically to the regional boards on their status of compliance with applicable resolutions and to submit self-monitoring data on their waste discharge and affected receiving waters. The boards then review the reports and self-monitoring data to assess the status of compliance with applicable requirements.

In cases where a discharger is found to be in non-compliance with either waste discharge requirements or compliance time schedules, the regional board may issue a Cease and Desist Order which specifies corrective actions to be taken including a time schedule for compliance. The Cease and Desist Order is the first step in the State's enforcement action.

If a waste discharger does not comply with the requirements of a Cease and Desist Order, the regional board may then refer the case to the appropriate legal authority for court action, the second and final state enforcement action. The state's timetable for completing abatement actions for all waste sources was set forth in the implementation plan developed as a part of the Federal-State water quality standards [Appendix H, Table H-1].

Although the self-monitoring program, supplemented in some cases by independent State sampling, may adequately assess compliance with waste discharge requirements, the program in the past has not required as complete a monitoring program as possible in order to assess overall adequacy of treatment facilities. In many cases, significant sources of pollution or waste quality parameters were not included in self-monitoring data and adequate definition of abatement needs was virtually impossible. Presently, the self-monitoring requirements are being revised and it is anticipated that all significant parameters will be included in the revised requirements.

All major dischargers to San Francisco Bay are under resolutions issued by the appropriate regional boards. In almost all cases, resolutions have been or are presently being revised to reflect new State policies

which include the water quality standards and the interim water quality management plans. Further revisions of the waste discharge requirements will probably be needed as the sub-regional water quality management plans are finalized. Revision of industrial waste discharge requirements will also be needed to meet Refuse Act permit requirements.

The San Francisco Bay Regional Water Quality Control Board summarized pollution abatement actions taken by the Board and resulting accomplishments in an informal report to EPA submitted on August 31, 1972. Pertinent excerpts follow:

".. Forty Three (43) per cent of the volume of municipal waste discharged to the Bay system now receives secondary treatment while the remaining fifty-seven (57) per cent which now receives primary treatment will receive secondary treatment or better when the subregional wastewater management programs now being implemented are complete.

".. All industries with the exception of Alameda Naval Air Station and Hunters Point Naval Shipyard provide treatment prior to discharge to the Bay System. Many of these industries provide a degree of treatment equivalent to secondary and the Regional Boards has initiated hearings on the establishment of secondary level treatment for all major industrial waste dischargers in the Region.

".. A total of one hundred twenty-two (122) cease and desist orders have been issued for violation of waste discharge requirements, nineteen (19) to industries, seventy-nine (79) to communities and twenty-four (24) to other types of waste dischargers. Sixty (60) orders have been issued subsequent to January 1, 1970.

".. Fourteen (14) cleanup and abatement orders have been issued to persons depositing waste that caused pollution or nuisance.

".. United States Navy (USS Midway) and Phillips Petroleum Company have been cited to the State Attorney General for causing oil to be deposited in waters of the State.

".. Six (6) waste dischargers were referred to the county district attorneys prior to 1970 all resulting in correction of violations. Twelve (12) waste dischargers have been referred to the State Attorney General for action since January 1, 1970;

four of these cases have resulted in decisions supportive of the State, corrective action was taken by four dischargers prior to court action and four cases are now in process of litigation or awaiting trial dates.

".. Adoption of requirements which provide for the implementation of subregional studies by including compliance time schedules consistent with timing of the subregional facilities. These actions include interim requirements providing improvement in treatment during the interim period, require source control of conservative toxicants and minimization of infiltration."

The present status of compliance with applicable resolutions and orders for all major waste dischargers and resulting actions by the State and/or Federal government for cases in non-compliance are summarized in tabular form in Appendix H [Municipal sources, Table H-2; Industrial sources, Table H-3; Federal facilities, Table H-4].

Review of the State enforcement actions and the status of abatement tables indicates one obvious trend. Many waste sources in the past have delayed construction of necessary treatment facilities. This is indicated by the numerous revisions of time schedules included in State resolutions. Recently major progress has been made in some instances, however, progress is still lacking in other cases.

As shown in Table VIII-1, about percent of the major waste sources listed in Table H-2, H-3, and H-4 are presently not in compliance with State waste discharge requirements. Table VIII-2 summarizes the State enforcement actions initiated to bring these sources into compliance with applicable requirements.

No enforcement measures against pollution of interstate or navigable waters have been taken by EPA in the Bay area pursuant to the provisions of the Federal Water Pollution Control Act. During 1971, however, settlements were achieved, in cooperation with the State, with two industrial

TABLE VIII-1

SUMMARY OF COMPLIANCE WITH STATE RESOLUTIONS

Source Category	Total Sources In Category	Sources Not Complying With Waste Discharge Requirements	
		Total	Percent
Major Municipal			
Major Industrial			
Federal Installation			
Total			

TABLE VIII-1

SUMMARY OF COMPLIANCE WITH STATE RESOLUTIONS

Source Category	Total Not In Compliance	Cease and Desist Orders	Time Schedule Established	Presently Meeting Time Schedule	Court Actions
Major Municipal					
Major Industrial					
Federal Installations					
Total					

dischargers in an effort to abate pollution or achieve compliance with State discharge requirements. The dischargers were Merck Chemical in South San Francisco and United States Steel in Pittsburg. In July 1972, a commitment letter was obtained from Fiberboard Corp. in Antioch.

The U.S. Attorney's office has taken action to prosecute several Refuse Act violations. Beginning in the Fall of 1970, information was received by the U.S. Attorney's office from private citizens concerning alleged industrial pollution of San Francisco Bay. These cases were referred to EPA for investigation. Several industries involved were subject to Cease and Desist Orders issued by the State Water Quality Control Board establishing dates for compliance, and installation of improved facilites.

The U.S. Attorney's office currently has 22 cases under investigation for alleged water pollution by industrial waste or unauthorized filling of navigable waters. The U.S. Army Corps of Engineers has issued warnings and demands to correct unauthorized fill operations. The companies involved are correcting the situation and the U.S. Attorney expects the Army to refer only two cases for injunctive relief. All fill occurrences, except one, were referred by private citizens and turned over to the Corps for investigation.

As can be seen by the above status report, much can be done to improve on the Federal-State program to achieve discharger compliance. A review of the large number of dischargers still not in compliance, indicates the need for a more agressive abatement program.

The state is strengthening their program and are developing requirements consistent with interim water quality management plans and water

quality standards. In addition to establishment of discharge requirements, strict but practicable time schedules must be developed. These schedules, which should be both Federally and State enforceable, should lead to compliance with water quality standards in the shortest possible time. Where long range goals are too far off and immediate improvements are necessary, interim requirements and time schedules must be established.

APPENDIX A

APPENDIX A

WATER QUALITY CRITERIA (OBJECTIVES) APPLICABLE TO THE TIDAL WATERS* OF THE SAN FRANCISCO BAY SYSTEM

A. WATER QUALITY OBJECTIVES APPLICABLE TO ALL TIDAL WATERS

Temperature
No significant variation beyond present natural background levels (Notes A and B);

Turbidity
No significant variation beyond present natural background levels (Notes A and B);

Apparent Color
No significant variation beyond present natural background levels (Notes A and B);

Bottom Deposits
None other than of natural causes (Note A);

Floating Materials
None other than of natural causes at any place;

Oil or Materials of Petroleum Origin or Products
None floating in quantities sufficient to cause an iridescence, or none suspended, or deposited on the substrate at any place;

Odors
None other than of natural causes at any place;

Dissolved Oxygen
Minimum of 5 mg/l; when natural factors cause lesser concentrations, then controllable water quality factors shall not cause further reduction in the concentration of dissolved oxygen;

Pesticides
No individual pesticide or combination of pesticides shall reach concentrations found to be deleterious to fish or wildlife at any place (Note A);

---

* Excerpts from "Water Quality Control Policy for Tidal Waters Inland from the Golden Gate within the San Francisco Bay Region," San Francisco Bay Regional Water Quality Control Board, State of California, 1967.

Toxic or Deleterious Substances

None present in concentrations which are deleterious to any of the beneficial water uses to be protected; none at levels which render aquatic life or wildlife unfit for human consumption (Note A);

Coliform Organisms

Sewage-bearing waste discharges shall at not time cause the quality of tidal waters which are determined by this Regional Board to be physically accessible at any time to the public for whole or limited body water-contact recreation uses and that are otherwise suitable for such uses to fail to meet the physical and bacteriological standards as set forth in California Administrative Code, Title 17, Sections 7957 and 7958;

> California Administrative Code, Title 17
>
> 7957. Physical Standard. No sewage, sludge, grease or other physical evidence of sewage discharge shall be visible at any time on any public beaches or water-contact sports areas.
>
> 7958. Bacteriological Standards. Bacteriological standards for each public beach or water-contact sports area shall be as follows:
>
> Samples of water from each sampling station at a public beach or public water-contact sports area shall have a most probable number of coliform organisms less than 1,000 per 100 ml. (10 per ml.); provided that not more than 20 percent of the samples at any sampling station, in any 30-day period, may exceed 1,000 per 100 ml. (10 per ml.), and provided further that no single sample when verified by a repeat sample taken within 48 hours shall exceed 10,000 per 100 ml. (100 per ml.).

Sewage-bearing waste discharges shall at no time cause areas protected by this Regional Board pursuant to Paragraph XVII of Resolution No. 803 for shellfishing for human consumption to exceed bacteriological standards to be adopted by this Board;

Nutrients

Total nitrogen concentration shall not exceed 2.0 mg/l as nitrogen at any point within the Region easterly of Carquines Strait; in no case shall nutrients be present in concentrations sufficient to cause deleterious or abnormal biotic growths except when factors which are not controllable cause greater concentrations (Note A);

Radioactivity

None present in concentrations exceeding levels set forth in California Radiation Control Regulations, Subchapter 4, Chapter 5, Title 17, California Administrative Code at any place; and

Hydrogen Ion Concentration - pH

The pH shall remain within the limits of 7.0 to 8.5; when natural factors cause the pH to be less than 7.0, then further depression by controllable factors will be determined by the Regional Board on a case-by-case basis.

B. WATER QUALITY OBJECTIVES APPLICABLE TO TIDAL WATERS EAST OF THE WESTERLY END OF CHIPPS ISLAND

Following levels in mg/l shall not be exceeded within 2,000 feet of diversions when tidal waters are used for domestic water supplies (Notes C and D):

Lead	0.05	Sulfates	250.
Selenium	0.01	Alkyl Benzene Sulfonates	0.5
Arsenic	0.01	Carbon Chloroform Extract	0.2
Chromium, Hexavalent	0.05	Cadmium	0.01
Cyanide	0.01	Barium	0.1
Silver	0.05	Zinc	0.1
Fluoride	0.5	Manganese	0.05
Phenols	0.001	Copper	0.01
		Total Dissolved Solids	500.

Boron shall not excees 0.5 mg/l within 1,000 feet of diversions when tidal waters are used for agricultural supplies (Note C); and

No substance or combination of substances shall be present in concentrations sufficient to cause taste and odors in domestic water supplies, within 2,000 feet of diversions when tidal waters are used for domestic water supplies (Note C).

NOTES

A. The water quality objective will generally apply at the outer limit of the rising waste plume or beyond a limited dilution area as determined by the Regional Board on a case-by-case basis pursuant to the intent stated in the second paragraph of Section II-A. In prescribing requirements for a particular waste discharge, the Regional Board may specify receiving water quality limits, other than the water quality objective contained herein, to apply at control points at or near the outer edge of the rising waste plume if time of exposure and other considerations indicate that adequate protection of beneficial uses is assured.

B. A significant variation beyond present natural background levels will be any level of water quality which has an adverse and unreasonable effect on beneficial water uses or causes nuisance; present natural background levels are not known precisely and will be determined on a case-by-case basis.

C. This objective shall be maintained to the extent that it is reasonably practicable until the domestic, industrial and agricultural water supplies are provided by alternate means to the satisfaction of the Regional Board.

D. Lower levels of these constituents may be adopted by the Regional Board at some future time if evidence becomes available to show that such limits are necessary for protection of aquatic life or wildlife.

APPENDIX B

APPENDIX B

SALMONELLA ANALYSES METHOD

National Field Investigations Center-Denver used a slight variation of the outlined procedure below in all their attempts to recover *Salmonella* in the shellfish.

The successful isolation of *Salmonella* is to be accredited to the Region IX, Environmental Protection Agency Laboratory which utilized the below described procedure.

Enrichments for Salmonella organisms consisted of the following steps. Ten gm shellfish meat (suspended in buffered dilution water and homogenized) was added to each of six flasks - three containing Tetrathionate Broth (Difco) and three containing Selenite Broth (Difco). A set of broths was incubated at each of three temperatures - 37°, 41.5°, 43°C. On three to five successive days, a sample from the contents of each flask was streaked onto XLD (Difco) and Brilliant Green (Difco) Agar plates. Colonies with morphologies typical of Salmonellae were isolated in pure culture, transferred to Brain Heart Infusion (BHI, Difco) slants, gramstained and screened for biochemical reactions in Enterotubes (Roche Diagnostics). Biochemical characters observed in the Enterotubes were as follows: fermentation of dextrose, dulcitol, and lactose; production of hydrogen sulfide and indole, phenylalanine deaminase, urease, and lysine decarboxglase; and citrate utilization. Isolates giving physiological reactions typical of Salmonella reaction patterns were screened for serological reactions with Salmonella Vi and somatic group antisera (Difco) and positive cultures were sent to State of California,

Department of Health, for final typing and identification.

Initial screening for Salmonellae was performed by the fluorescent antibody (FA) technique. Plates were prepared (XLD and Brilliant Green Agars) from enrichment broths after 18 to 24 hours incubation. The inoculated plates were incubated two to three hours, and colony smears were made on FA slides. The slides were then stained with FA Salmonella Panvalent Serum (Difco) and examined under a Leitz Fluorescence microscope. Salmonella enrichment procedures were discontinued for those samples giving less than 3+ fluorescence.

APPENDIX C

APPENDIX C

SHELLFISH POPULATION SURVEY

INTRODUCTION

The biological survey of the shellfish of San Francisco Bay consisted of three parts:

1. An appraisal of the changes in species composition and density between 1967 and 1972 of 19 selected shellfish beds.
2. A review of the ecological factors and space requirements needed for re-establishing oyster beds in San Francisco Bay.
3. A comparison between young market crabs caught in the San Francisco Bay and those caught in Eureka, California, regarding their pesticide and heavy metals content.

Shellfish of present and past importance in San Francisco Bay are listed in Table C-1.

The most extensive part of the survey was that of the shellfish beds to see if they had changed since the survey by Theodore Wooster of the California Fish and Game Department (1968).

The oyster industry had ceased being profitable about 1940 (Barrett, 1963). Pollution of the Bay has been mentioned as one of the reasons for the decline of oyster productivity in San Francisco Bay. The amount of oysters marketed in 1888 was close to a million pounds, but declined to slightly over one thousand pounds by 1939. Re-establishment of these beds would appear feasible if pollution discharges into the Bay were stopped.

Market crab catches off the California coastline have been declining for the last 10 years. San Francisco Bay serves as a nursery ground for the market crabs, although legal-sized crabs are not abundant in the Bay, so commercial fishermen do not attempt to catch them. Some crabs tagged by the California Fish and Game in the Bay have been caught outside of the Bay in the ocean. California Fish and Game personnel feel that more crabs should be found outside the Bay and there is some cause for their decline relating to their survival in the Bay. There has been insufficient data on metal and pesticide content of the crabs in their juvenile stages for these analyses to be useful in understanding the decrease in market crab harvest.

METHODS

The shellfish beds, previously surveyed by Wooster (1968), were sampled for species composition and density following his methods. Basically this involved taking a square foot of substrate to a depth that would include all available shellfish, and placing the material in a wooden-frame sampler having a 1/4 inch hardware cloth bottom. By shaking the sampler in water, the sand, mud, and small gravel would be removed, retaining larger material along with any clams. The shellfish from each square foot of sample were then put into a plastic

bag and taken back to the laboratory. Each shellfish was measured for size, and all shellfish of the same species combined to obtain a total weight for each sample.

Analyses of the differences between Wooster's data and the 1972 data were done by non-parametric methods. This was necessary because sampling sites were not chosen, nor sample distribution tested, so that parametric tests could be utilized (Steele and Torrie, 1960). Where too few samples were taken or no shellfish found, no statistical analysis was performed. The survey procedure and the validity of the resulting data was enhanced because of the assistance of Theodore Wooster in the survey. His assistance was provided by the courtesy of the California Fish and Game Department.

Possible commercial oyster bed locations were examined and evaluated in relation to water uses which now exist in San Francisco Bay.

California Fish and Game personnel caught commercial crabs in three locations of San Francisco Bay: Paradise Park Pier on Tiburon Point, a pier near the Carquinez Bridge, and the Red Rock Marina Pier near the Richmond-San Rafael Bridge. Other samples of crabs were collected at Eureka, California. Male and female juvenile crabs were separated, and the flesh from each put into separate jars, packed in ice, and then subsequently frozen until analyzed. The flesh from the crabs was to be analyzed for heavy metals and pesticides by standard EPA methods.

CLAM BED SURVEY

Nineteen beds were sampled to compare their present clam populations with those found by Wooster in 1967. The three principal species that were encountered were the Japanese Littleneck - JL (*Tapes semidecussata*), the soft-shelled clam - SS (*Mya arenaria*), and the Macoma - Mc (*Macoma inconspicua*). The first two species attain legal sizes (ca. 38mm); whereas the third species is too small for practical use.

The comparisons, between the clams found in 1967 and in 1972, concerning their average weights per square foot and size and the economic values of the "angler" days were most important. "Angler" days are found by dividing the total number of legal clams in a bed by 50, the legal daily limit.

Results

The location of the shellfish beds are shown numerically in Figure C-1, with the numbered beds identified in Table C-2. The sampling results are summarized in Table C-3 which compares for 1967 and 1972 values of nineteen beds sampled in both years. This Table gives the mean weight of clams per square foot, the total "angler days", the total weight of clams, and the square foot samples taken in the beds. Figure C-2 is a graphical presentation of the total weights of clams in the beds sampled.

Discussion

The main data from over 100 square foot samples taken from 19 clam beds is given in Table C-3. Approximately the same number of

samples were taken from each bed in each year, with more samples taken from the larger beds.

The three parameters compared for the two years - mean gms/ft^2, total "angler days", and total clam weight - all showed approximately 50 percent decrease from 1967 to 1972.

The mean weight of all clams in grams per square foot of sample declined from 196 to 113, a 42 percent decrease. The total weight of clams was derived by multiplying the mean weight in grams/ft^2 for each bed by the size of the bed. Thus large decreases in the weights per square foot would be of more significance if they occurred in the large beds. The total weight decreased by 53 percent from 1967 to 1972. The "angler days" based on legal-size clams in the beds declined by 50 percent from 1967 to 1972. However, not all legal-size clams could be used in calculating economic loss. Only the beds away from sewage outfalls were utlized in this calculation.

The value of the "angler days" was established by finding the prevailing commercial price for 50 legal sized clams, now approximately $2.00, depending on the weight of the clams. Other approaches to establishing economic value, e.g. basing it on recreational use could lead to higher "angler day" values.

Utilizing a value of $2.00 per angling day (a limit of 50 clams, all 38 mm or above in size), the decrease in value of the beds sampled is about $325,000. This represents a 42 percent decrease in the value of this resource. It must be stressed that this only includes the beds surveyed, and also leaves out the loss of the completely

covered Point San Bruno Bed. There are also available an unknown amount of areas of South San Francisco Bay which do not become exposed at low tides, but could be harvested by commercial digging machines.

Conclusion

A loss of $325,000 to the clam sport fishery of San Francisco Bay has been sustained since 1967. However, in most beds there are many legal and young clams remaining that could be utilized if they were safe to eat.

Water quality in the Bay should be enhanced in order to prevent further deterioration of the clam population, and to enable harvesting activities to resume.

OYSTER BEDS

The presence of commercial oyster beds in San Francisco Bay before 1940 raises the question of whether or not they could be re-established. The following facts should be noted before proposals to re-establish the beds are made:

1. The California Fish and Game have successfully raised oysters on a limited basis near Redwood City.

2. At present, about 6,000 acres are available for raising oysters in South Bay in hanging cultures, with an equal area available for bottom cultures. About the same area is available in San Pablo Bay for oyster culturing.

3. If these areas were utilized, the productivity should be equal to the total oyster productivity in the United States. Much of the eastern productivity is not in a hanging culture form. Productivity is lower when oysters grow on substrate.

4. The productivity of the beds started declining in the early 1900's. About that time, oyster seed planted in the Bay took longer to develop than elsewhere, and the oysters were thin and watery (Barrett, 1963).

5. Industrial pollution appeared primarily responsible for the decline in productivity. The amelioration of conditions which were bad in 1910 appears increasingly necessary.

6. Hanging cultures of oyster racks are now widely used. These are put in deep water where they will be regularly inundated by the changing tides. Oysters are still cultivated on shallow intertidal zones. However, this means that the area must be fenced to keep out rays and the oysters are subjected to siltation.

7. Many of the sites of the old oyster beds and possible new locations are not usable for the following reasons:

   a. Many old oyster beds sites are now partially filled (i.e. Bay Farm Island, San Rafael Bay, Oyster Point).

   b. Areas of restricted rights, such as shipping lanes, throughout the Bay and the Dumbarton Straits preclude oyster planting in many previously acceptable beds.

   c. Other areas of restricted rights, such as landing zones for amphibious airplanes, and anchorage locations for explosive-containing and regular vessels.

d. Some areas are serving in other capacities such as:

1) Access lanes for marinas.

2) Near-shore waterskiing and sailing areas.

3) Near-shore zones througout the Bay with good troll and bait fishing areas.

8. Esthetic reasons preclude putting the hanging cultures in some locations.

9. There is dispute over ownership of many submerged parts of the Bay

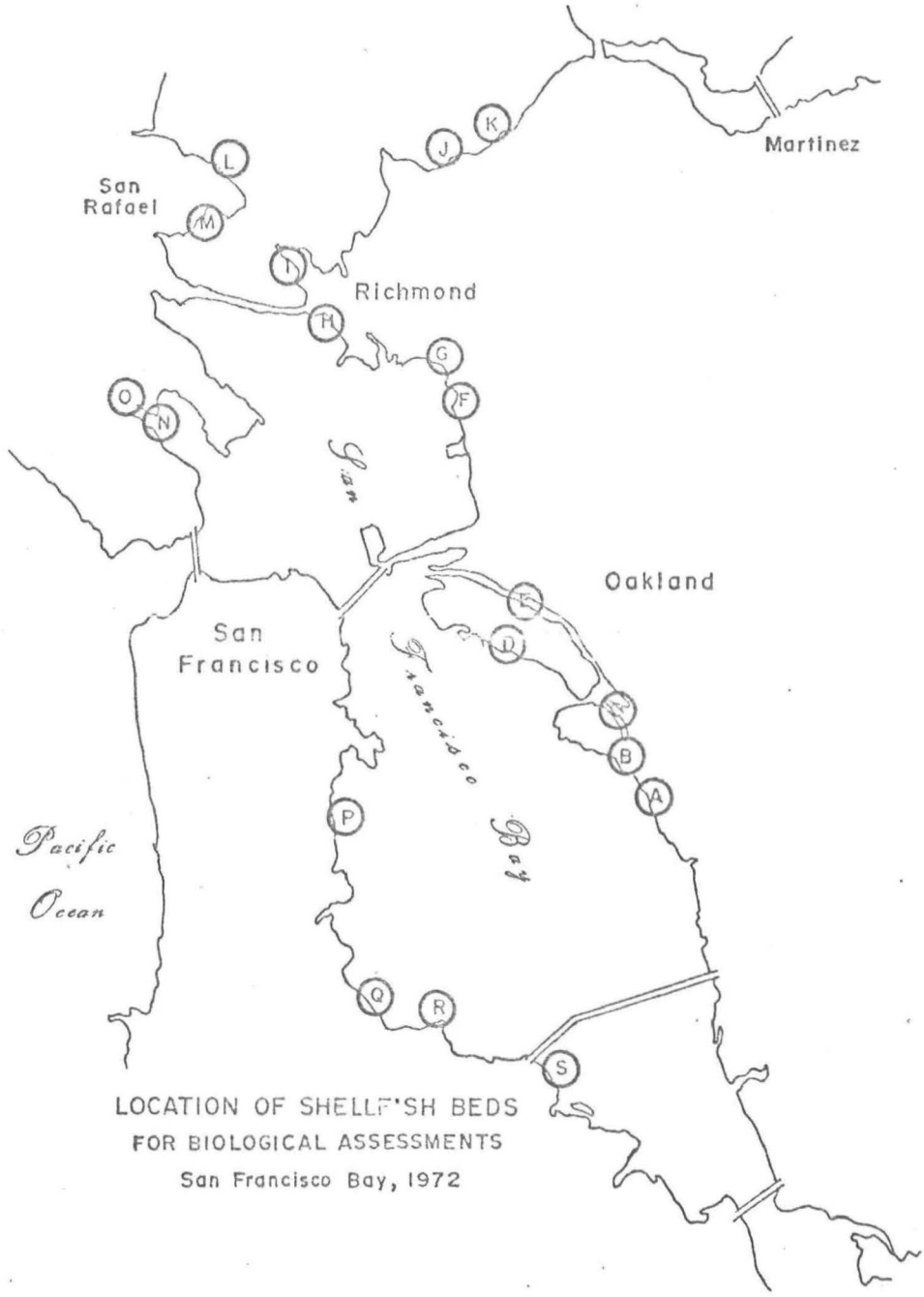
10. BCDC would have to approve the plantings.

11. Market oysters are now easily flown from the east, making the economic feasibility of plantings uncertain.

Conclusions

Although there are sites in the Bay available for oyster culturing, no attempts can be made to do this unless the waters of San Francisco Bay meet Public Health Standards for shellfish.

The re-established oyster beds in the Bay could yield productivity comparable to that in the entire United States, which is about 10,000,000 gallons per year. This would be worth $70,000,000 as Pacific oysters.



LOCATION OF SHELLF'SH BEDS
FOR BIOLOGICAL ASSESSMENTS
San Francisco Bay, 1972

FIGURE C-1

TABLE C-1

THE SAN FRANCISCO BAY STUDY-SHELLFISH OF IMPORTANCE

Scientific Name	Common Names or Names	Comments
(Clams)		
Mya arenaria	Soft-shell clam, eastern soft-shell clam, long clam, mud clam	Perhaps indigenous in Bay
Tapes semidecussata	Japanese littleneck	This clam and the soft-shell are of the most important to sportsmen
Protothaca staminea	Littleneck, hard shell, rock clam, rock cockle, Tomales Bay Cockle	Very few now found in Bay, usually near Strawberry Point
Macoma inconspicus		Found frequently in most beds, but too small for practical uses
Macoma nasuta	Bent-nose clam	Shells found frequently
--(Oysters)----------		
Ostrea lurida	Native oyster, Olympia oyster in Puget Sound	Small, widespread, but not commercially important in San Francisco Bay because of size and poor flesh
Crassostrea virginica	Eastern oyster	Shells found in great abundance. Once commercially important, but imported in half-grown or near marketing size and held in Bay until needed. Commercially important in east
Crassostrea gigas	Japanese oyster, giant pacific oyster, pacific oyster	This is the commercially important oyster grown from imported seed along the Pacific Coast
--(Mussels)----------		
Volsella demissa	Ribbed horse mussel	Prominent in South San Francisco Bay in Cord Grass
Mytilus edulis	Bay Mussel	Found in rock and pilings throughout Bay
--(Crab)----------		
Cancer magister	"Edible" crab, Dungeness crab	The Bay is a nursery area for females

TABLE C-2

IDENTIFICATION OF BEDS
NUMBERED IN FIGURE C-1

Code	Bed
A	San Leandro Marina
B	Oakland Airport
C	San Leandro Bay
D	Alameda Memorial State Beach
E	Oakland Inner Harbor
F	Albany Hills
G	Point Isabel
H	North of Keller Beach
I	Point Castro-Point San Pablo
J	Tara Hills
K	Pinole
L	China Camp
M	Beach Drive - San Rafael Bay
N	Strawberry Point
O	Richardson Bridge
P	Brisbane
Q	Burlingame
R	Coyote Point
S	Foster City

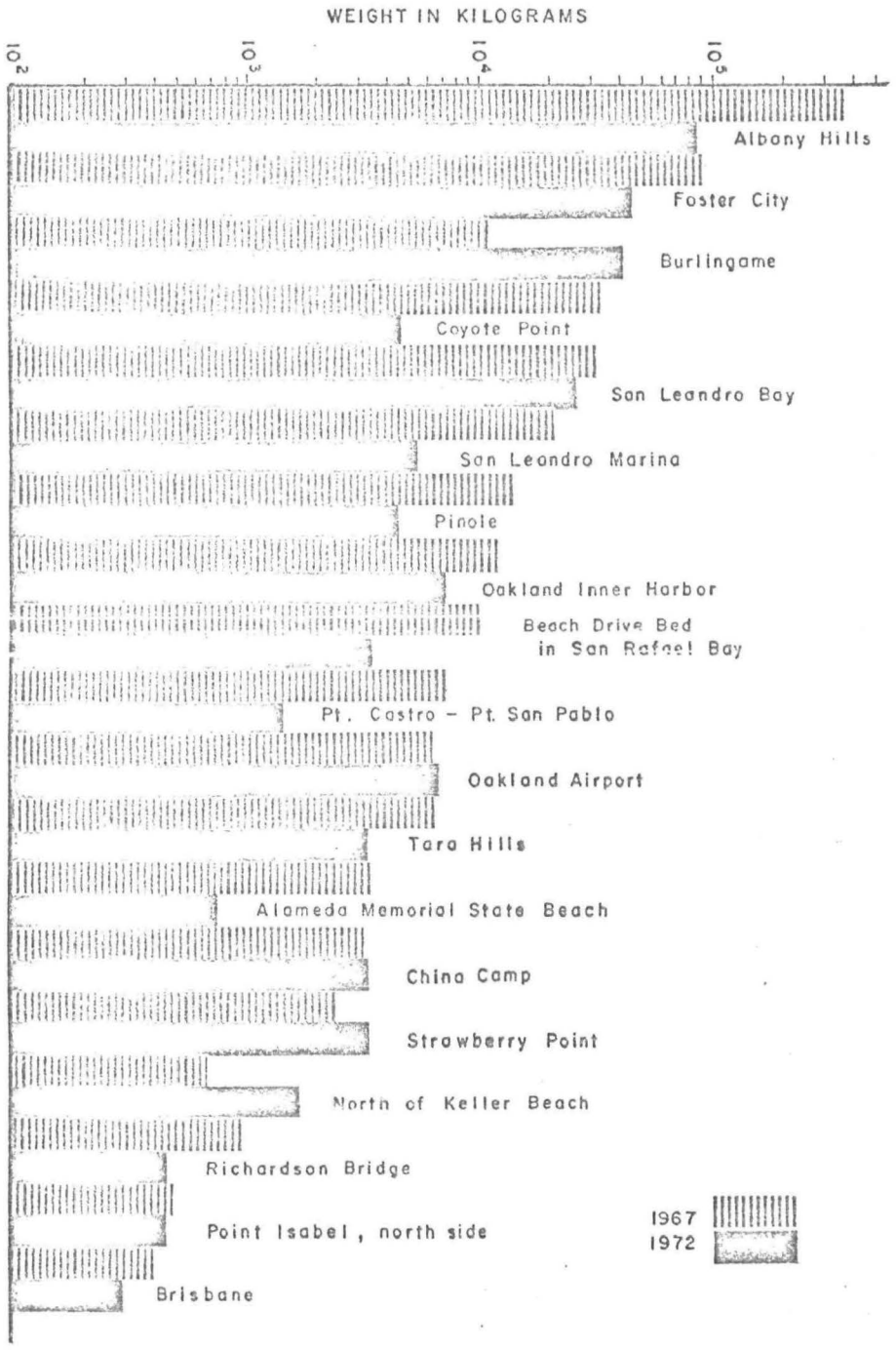
TABLE C-3

CHANGES IN CLAM POPULATION AND "ANGLER DAYS"

BETWEEN 1967 AND 1972 IN NINETEEN SAN FRANCISCO BAY BEDS

	Clam weight gms/ft^2 (mean)	Total "Angler Days"	Total Clam Weight in kg	Total Number of ft^2 Samples
1967	196	418911	618033	104
1972	113	208615	287550	116
Decrease	83	210296	330483	

FIGURE C-2
TOTAL WEIGHT PER BED OF CLAMS FOR THE 1967 AND 1972 SAMPLINGS



APPENDIX D

ATE OF CALIFORNIA—RESOURCES AGENCY RONALD REAGAN, Governor

E RTMENT OF FISH AND GAME
A..NE RESOURCES REGION

Marine Resources Laboratory
411 Burgess Drive
Menlo Park, California 94025

June 28, 1972

Mr. Bob Campbell
Environmental Protection Agency
Division of Field Investigation - Denver Center
Building 22 - Room 410 - Denver Federal Center
Denver, Colorado 80225

Dear Bob:

Thank you for your letter and data from Suisun and San Francisco Bays.

In my opinion the possibility of growing oysters in Suisun Bay does not look promising. Low salinity and lack of suitable oyster food are probably the main limiting factors. The fact that you found only limited quantities of soft shell clams and no littleneck clams or native oysters suggests that conditions are not favorable for growing Pacific or Eastern oysters.

San Pablo Bay, I feel, has some potential because of higher salinities and more oyster food production. South San Francisco Bay has the best potential. Salinities and temperatures are more favorable and there is probably a greater production of oyster food. The food supply could probably be enhanced ty the elimination of the contaminants.

I can not offer an explanation for the high cadmium count in the Pacific oysters. Dr. Craig Ruddell at Davis has obtained similar results from the same lot of oysters.

I hope that this information will be of help to you. If you need further information, please contact me.

Sincerely,

Walter A. Dahlstrom
Assoc. Marine Biologist

WAD:gb

APPENDIX E

APPENDIX E

TOXIC EFFECTS ON AQUATIC LIFE

TOXIC MATERIALS

Discharges to the Bay system of wastes containing materials toxic to aquatic life have occurred from both municipal and industrial sources. Both acute and chronic toxicity problems are believed to result from these discharges. In addition, spills of toxic materials have resulted in damage to aquatic life.

A survey of the literature on the toxicity of metals and pesticides to marine aquatic life is presented in the Appendix [Table E-3].

A brief comparison of the data collected during this study to reported toxic values is discussed below.

HEAVY METALS

Data on the heavy metals cadmium, chromium, copper, lead, zinc and mercury are available from the recent survey of the San Francisco Bay Area [Table E-1].

Analysis showed that cadmium, a very common metal, ranged from <0.01-<0.02 mg/l in the water. Table E-1 shows the LC_{50} (for explanation see appendix) for the oyster Crassostrea virginica to be 0.1-0.2 mg/l thus the water concentrations found during this survey are about 1/100 of the determined toxic level.

Chromium, which is toxic to Nereis virens (polychaete worm) at <5.0 mg/l, ranged from <0.01-0.05 mg/l in the water. Sediment samples ranged from <1.0-90.0 mg/kg while shellfish contained <0.05-20.0 mg/kg.

Chromium levels in the water are about 100 times less than the reported toxic values. However, the shellfish contained levels up to

four times the proposed FDA alert levels. As discussed elsewhere in this report the high sediment values may lead to contamination of the shellfish.

Copper, one of the most toxic heavy metals, ranged from <0.01-0.6 mg/l in the water. Data in Table E-1 shows that marine phytoplankton are killed by concentrations of 0.027-0.5 mg/l. Since these species of phytoplankton are important in the food chain of fish their elimination could reduce or completely eliminate the fish population of that area. In addition, copper is lethal to several molluscs in the range of 0.05-0.2 mg/l [Table E-1].

Lead concentrations of 0.7-<5.0 mg/l in ~~water~~ shellfish (see table V-8), as reported in this study, are about 10 times the lethal value of 0.5 mg/l for C. virginica (eastern oyster) [Table E-1]. However, California Fish and Game personnel have grown several species of molluscs in the Redwood City area for several years at a sub-chronic level.

Zinc levels of <0.01-0.15 mg/l in the water are well below toxic levels. However, oysters tend to accumulate the metal and values of 336 and 608 mg/kg were recorded. These values are about one-third the FDA alert level of 1,500 mg/kg.

PESTICIDES AND PCB'S

Data on the chlorinated hydrocarbon pesticides chlordane, DDT, DDD, DDE and dieldrin and the PCB (polychlorinated biphenyl) complex also are available from this investigation of the San Francisco Bay Area.

DDT and its metabolites DDE and DDD are generally toxic under acute conditions to marine invertebrates in the range of 0.002-0.02 mg/l (or parts per billion); values that are approached or exceeded in the Bay area. Table E-2 shows the oyster C. virginica to have an LC_{50}(DDT)

of 0.005 mg/l, a value that was exceeded in portions of the Bay. However, most values are below the acute toxic level and lead to conditions of reduced shell growth. Monochrysis lutheri, a plankton-flagellate, illustrates the point by exhibiting a 43 percent reduction in growth when exposed to 0.02 mg/l DDT for 96 hours [Table E-2]. Under similar conditions shellfish will often show a 50 percent reduction in growth.

Reported values for dieldrin range from 0.0055 mg/l (96 hour LC_{50}) for Leiostomus xanthurns (juvenile spot) to 0.005 mg/l for Palaemonetes vulgaris (grass shrimp). The oyster C. virginica has a reported value of 0.034 mg/l [Table E-2]. These values are all greater than the value obtained during this study [Table E-2]. However, the problem of sub-lethal concentrations again arises and the fact that although not killed by the compound significant reductions in growth rates, reproductive capabilities and physiological damage can and does result.

The PCB complex, virtually unstudied until the late 1960's, poses a threat unsurpassed by chlorinated hydrocarbon pesticides. Toxic levels with these compounds range from 0.005 mg/l for spot (L. xanthurus) to <0.0001 mg/l for Daphnia magna. Current trends at the Federal level are to establish a maximum water concentration of 0.002 mg/l and maximum concentration of 0.5 mg/l in tissue. Japan has recently established a maximum tissue level of 0.5 mg/l for off-shore and high seas organisms.

TABLE E-1

TOXICITY OF METALS*TO SELECTED MARINE ORGANISMS

	Al	As	Cd	Cr	Cu	Pb	Hg	Sn	Zn
Bacteria	132 ppm								
Green algae					0.1 ppm(no time span given)			0 002 ppm (no time span given)	
Phytoplankton (various species)					0.027 mg/l-0.050 mg/l				
Paracentrotus lividus (sea urchin)						200 mg/l egg abnormalities (no time span given)			
Balanus balanoides (adult barnacles)							0.5 mg/l (B. balanoides)		8 mg/l (B. balanoides)
Nereis virens (polychaete worm)				1 mg/l threshold	0.1 mg/l threshold				
Fusinus kobelti - snail (mollusk)					0.20 ppm threshold 0 10 ppm <100% mort.				
Haliotis fulgens - abalone (mollusk)					0 05 ppm <100% mort.				
Ischnochiton conspicuus (mollusk)					0 15 ppm threshold 0.10 ppm <100% mort.				
Papnia strainea var lucipiata (mollusk)					3 ppm =50% lethal				
Tegula gallina (mollusk)					0 10 ppm threshold 0.05 ppm <100% mort.				
T. viridula var. ligulata					0.10 ppm threshold 0.05 ppm < 100% mort.				

TABLE E-1 (CONTINUED)

TOXICITY OF METALS TO SELECTED MARINE ORGANISMS

	Al	As	Cd	Cr	Cu	Pb	Hg	Sn	Zn
E. oyster (Crassostrea virginica)			0.2 mg/l LC_{50} 0.1 mg/l LC_{50}			0.5 mg/l LC_{50} (12wks) 0.3 mg/l LC_{50} (18wks) 0.1-0.2 mg/l (12 weeks) Noticeable tissue charges			
Mytilus californianus (mussel)					0.15 ppm <100% mort. (30 days) 0.10 ppm <100% mort. (60 days)				
M. edulis (mussel)					0.20 ppm (17 days) LC_{50} 0.10 ppm (35 days) <100% mort.				
Carcinus maenas (shore crab)				40-60 ppm threshold	1-2 ppm threshold				
Leander squilla (small prawn)				5 ppm threshold	0.5 ppm threshold				

*Toxicities are for 96 hours (4 days) or more, except where no time span is given.
and manganese (Mn)
LC_{50} = Concentration required to kill 50% of the organisms in a specified length of time (e.g. 96 hours).
Source: Oregon State University. 1971. *Oceanography of the nearshore coastal waters of the Pacific Northwest relating to possible pollution.* Vol. II. Environmental Protection Agency, p. 84-98.

TABLE E-2

TOXICITY OF PESTICIDES TO SELECTED MARINE ORGANISMS

	Aldrin	DDT	Dieldrin	Endrin	Heptachlor	Lindane	Methoxychlor	Sevin	1 - Naphthol	Toxaphene	Malathion	Methyl Parathion	Parathion	Phosdrin R
Duraliella euchlora (plankton-flagellate)		0.02 mg/l 17% growth inhibition				7.5 mg/l 27% growth inhibition		0.1 mg/l 10% growth inhibition		0.01 mg/l 10% growth inhibition				
Monochrysis lutheri (plankton-flagellate)		0.02 mg/l 43% growth inhibition				1 mg/l 14% growth inhibition		0.1 mg/l 13% growth inhibition		0.000015 mg/l 22% growth inhibition				
Crassostrea virginica (oyster)	0.025mg/l 50% decrease in shell growth	.005 mg/l LC_{50}	0.034mg/l 50% decrease in shell growth	0 033mg/l 50% decrease in shell growth								1.0 mg/l 22% decrease in shell growth		
Crassostrea gigas (Pacific oyster larvae)								2.2 mg/l 50% development prevented	0.8 mg/l 50% development prevented					
Mytilus edulis (bay mussel, larvae)								2.3 mg/l 50% development prevented	1 3 mg/l 50% development prevented					
Crangon septemspinosa (sand shrimp)	8 µg/l LC_{50}	0 6 µg/l LC_{50}	7 µg/l LC_{50}	1.7 µg/l LC_{50}	8 µg/l LC_{50}	5 µg/l LC_{50}	4 µg/l LC_{50}				33 µg/l LC_{50}	2 µg/l LC_{50}		1 µg/l LC_{50}
Palaemonetes vulgaris (grass shrimp)	9 µg/l LC_{50}	2.0 µg/l LC_{50}	50 µg/l LC_{50}	1.8 µg/l LC_{50}	440 µg/l LC_{50}	10 µg/l LC_{50}	12 µg/l LC_{50}				82 µg/l LC_{50}	3 µg/l LC_{50}		69 µg/l LC_{50}

TABLE E-2 (CONTINUED)

TOXICITY OF PESTICIDES TO SELECTED MARINE ORGANISMS

	Aldrin	DDT	Dieldrin	Endrin	Heptachlor	Lindane	Methoxychlor	Sevin	1 - Naphthol	Toxaphene	Malathion	Methyl Parathion	Parathion	Phosdrin R
Penaeus aztecus (brown shrimp)												0.0055 mg/l 50% loss of equilibrium	0.001mg/l LC_{50}	0.25 mg/l LC_{50}
Leiostomus xanthurus (juvenile spot)	0.0055 mg/l LC_{50}	0.002mg/l LC_{50}	0.0055 mg/l LC_{50}	0.0006 mg/l LC_{50}	0.025mg/l LC_{50}	0.03mg/l LC_{50}	0.03mg/l LC_{50}			0.001mg/l LC_{50}	0.55mg/l LC_{50}			
Cyprinodon variegatus (juvenile sheepshead minnow)		0.005mg/l LC_{50}											0.06mg/l LC_{50}	0.83mg/l LC_{50}

*Toxicities are for 48 hour (2 days) periods or longer.

LC_{50} = Concentration required to kill 50% of the organisms in a specified length of time (e.g. 96 hours).

Source: Oregon State University. 1971. *Oceanography of the nearshore coastal waters of the Pacific Northwest relating to possible pollution.* Vol. II. Environmental Protection Agency. p. 101-110.

TABLE II-3

MAMMALIAN TOXICITY OF SELECTED METALS

Metal	Species	Dose	Effects	Reference
Arsenic	Man	Chronic intoxication	Neurologic changes, increased salivation, hoarseness, cough, laryngitis, conjunctivitis, colicky abdominal pain and various skin changes.	Vallee, B. L., D. D. Ulmer and W. E. C. Wacker. 1960. *Arsenic toxicology and biochemistry.* AMA Arch. Ind. Health 21(2) 132-151
Cadmium (Undefined)	Man	From water and food	Hypertension linked to increased retention of Cd in kidneys.	Lucis, O. J. and R. Lucis. 1969. *Distribution of cadmium^{109} and zinc^{65} in mice of inbred strains* Arch Environ. Health 19(3) 334-336.
				Stokinger, H. E. 1969 *The spectre of today's environmental pollution--U.S.A. brand new perspectives from an old scout.* American Ind. Hyg. Assoc. J 30 195-217
				Anon. 1970a *When metal can mean hypertension.* Med. World News 11 30
	Man	From water - "high concentration"	Disorders of renal function; phosphate level in the blood serum decreases; sizeable loss of minerals from the bones, "Itai Itai" disease.	Anon. 1970b *Cadmium in Ouch Ouch.* Chem. Eng. News 48 16.
				Anon. 1971. *Cadmium pollution and Itai-Itai disease.* Lancet 1 382-383.
Chromium ion Cr^{+6}	Man	25 mg/l in drinking water for 3 years (<0.9 mg/kg/day)	No harmful effects	Zehnpfennig, R. G. 1967. *Possible toxic effects of cyanates, thiocyanates, ferricyanides, ferrocyanides, and chromates discharged to surface water.* In Proc 22nd Ind Waste Conf (2) 879-883 Purdue Univ., Eng Ext Ser. 129
Chromium ion Cr^{+3}	Rat	Diet deficient in Cr.	Antherosclerosis, relative hypercholesteremia which increased with age, with mild to moderate hyperglycemia, increased incidence of aortic plagues.	Schroeder, H. A 1970 *Metallic micronutrients and intermediary metabolism* U S Clearinghouse Fed Sci. Tech Inform , AD 708581. 22 p.
Copper (Undefined) (only acute dosages given)	Man	10,000 mg/kg	Lethal	Grunau, E. B 1967. *Significance of copper in drinking water.* Staedtehygiene 18(7) 153-164.
	Man	60-100 mg	Gastroenteritis with nausea and intestinal irritation.	McKee, J. E. and H. W. Wolf (ed) 1963. *Water quality criteria.* The Resources Agency of California, State Water Quality Control Board, No. 3-A. 548 p.
	Man	10-30 mg	No poisoning even after many days.	Mckee and Wolf (1963).
Lead (Undefined)	Man	2.0-4.0 mg/l for 3 months (<.07-.14 mg/kg/day)	Harmful range.	Offner, H. G. and E. F. Witucki. 1968. *Toxic inorganic materials and their emergency detection by polarographic method.* J. Amer. water works Assoc. 60(8) 947-952.
	Man	From drinking water - high concentration	Disorder of renal function, phosphate level in the blood serum decreases, sizeable loss of minerals from bone.	Anon. (1970b)
	Man	Chronic lead poisoning	Microcytic anemia and encephalopathy	Shaw, M. W. 1970. *Human chromosome damage by chemical agents.* Ann. Rev. Med 21: 409-432

TABLE E-3 (CONTINUED)

MAMMALIAN TOXICITY OF SELECTED METALS

Metal	Species	Dose	Effects	Reference
Lead Pb	Man		Much like multiple sclerosis, CNS damage	Wilber, C. G 1969. *The biological aspects of water pollution.* Charles C. Thomas, Springfield, Ill. 96 p.
	Rat (and mouse)	25 mg/l for life (2.5 and 3.6 mg/kg/day)	Significant decrease in survival and longevity, no effect on growth rate	Schroeder (1970).
	Rat		Significant increase in serum cholesterol in female only; decrease in serum glucose in male; no effect on blood pressure or aortic plagues.	Schroeder (1970).
Manganese (Undefined)	Man		Three persons died as a result of poisoning by well water contaminated by manganese derived from dry cell batteries buried nearby.	McKee and Wolf (1963).
Mercury*	Man	Over a long period of time - in food, water, etc.	Anxiety, excessive self-consciousness, difficulty in concentrating, irritability, resentment of criticism, headache, fatigue, blushing and excessive perspiration.	Anon. 1970c. *Mercury menace prompts firm to offer test data* Ind. Res 12(10). 25.
	Man	Small amounts	Produce kidney damage, muscular tremors, irritability, and depression.	Anon. 1970d. *Mercury and mud.* Sci. Amer. 223(3). 82-86.
Nickel (Undefined)	Rat		Decrease in serum cholesterol in male, decrease in serum glucose in female, no effect on blood pressure or aortic plagues.	Schroeder (1970).
Zinc (Undefined)	Man	From drinking water - high concentration.	Disorder of renal function, phosphate level in the blood serum decreases, sizeable loss of minerals from the bones, "Itai Itai" disease.	Anon. (1970b).

*U.S. Department of Commerce Fishery Market News Report, dated Thursday, August 10, 1972, states that in Italy the mercury tolerance level for frozen fish is 0.7 ppm and for canned tuna 1.0 ppm. The FDA has set a limit of 0.5 ppm of mercury in fish for the United States.

Source. Little, A. D. 1971. Water Quality Criteria Data Book, Vol. 2. *Inorganic chemical pollution of freshwater.* Environmental Protection Agency. p. 139-187.

TABLE E-4
INDUSTRIAL POLLUTIONAL SOURCES CONTRIBUTING TO THE DETERIORATION
OR TOXICITY OF AQUATIC LIFE IN SAN FRANCISCO BAY
1971[a]/

Source		Settleable Matter ml/l/hr.	Suspended Solids mg/l	Oil and Grease mg/l	pH	Cr µg/l	Cu[c]/ mg/l	Pb mg/l	Zn mg/l	Phenol µg/l	Fish Toxicity 96 hr. % Survival	Fish Toxicity TLm	BOD mg/l	Temp °C
Union Oil	E-2										0-100 (81)		0	
California and Hawaiian Sugar Co.	E-E	Tr-17.7 (1.9)	14-3,236 (353)		6.1-8.6 (7.1)						45-100 (88.2)		510-2,820 (1,395)	24.3-52.7 (41.0)
	E-H	Tr-3.7 (0.97)	9.3-177 (54.9)		9.3-11.7 (10.5)									27.7-50.5 (37.5)
	E-V	Tr-0.75 (.116)	13-128 (65)		6.8*-8.7 (7.8)						50-100 (89.2)		320-2,580 (1,342)	
Phillips Petroleum Co. Avon Refinery						0.11-1.14 (0.43)					0-100 (37.1)	25-100 (74)		
	EA-2	0.03-0.48* (0.12)												
U. S. Steel Corp	F-1						N.D.-0.06 (0.022)	N.D.-.27 (0.06)						
	E-2	<.02-3.07* (0.40)					N.D.-0.06 (0.02)			0.04-0.48 (0.21)	40-100 (64.2)			
	E-3						N.D.-0.06 (0.02)							
Shell Oil Co. Pond #5				19-73 (30.7)									13-352 (182)	23-94 (34)
Shell Oil Co. Merck Chemical Division	Stream A	0-43 (7.1)	170-472 (335)		7.9-9.1* (8.6)									
	Stream B	0-100 (11.3)	25-71 (53.5)		8.1-10.3* (8.9)*									
	Stream C	.2-407 (236)	1,246-3,520 (2,330)		8.2-10.4* (9.6)						0-100 (63.5)	0.5-25		
	Stream D	92-331 (195)	2,216-44,300 (10,200)		9.7-10.4* (10.1)*						0-100 (41.5)	0.28-25 (9.9)		
	Stream E	.2-405 (77.8)	770-7,564 (2,740)		8.3-10.3* (9.4)*						0-100 (71.5)	6.7-25		
	Stream F	0-23 (4.4)	30-380 (224)		9.0-10.3* (9.6)*						60-100 (94)			
	Stream G	0-16 (1.8)	66-290 (179)		8.9-10.8* (9.8)*						0-100 (35)	36-100 (80)		
Humble Oil & Refinery Co.										<0.1-1.7 (0.6)	43-100 (69)		33-186 (77)	
Colgate Palmolive Company	E-1											31		

TABLE E-4 (CONTINUED)
INDUSTRIAL POLLUTIONAL SOURCES CONTRIBUTING TO THE DETERIORATION OR TOXICITY OF AQUATIC LIFE IN SAN FRANCISCO BAY
1971[a/]

	Settleable Matter ml/l/hr.	Suspended Solids mg/l	Oil and Grease mg/l	pH	Cr mg/l	Cu[c/] mg/l	Pb mg/l	Zn mg/l	Phenol mg/l	Fish Toxicity 96 hr. % Survival	Fish Toxicity TL$_m$	BOD mg/l	Temp °C
Hercules, Inc. Stream A						0-0 09 (0 02)							
Stream B				5.8-8.1 (7.5)		Nil-0 09 (0 02)							
Chevron Chemical Co. Ortho Division	0.0-5.5 (0 5)			4.9 -7.4 (6.6)							1.5-75 (20)		
Sequoia Refining Co.			5.2-18.5* (10.6)						0.1-0.8* (0 3)		32-100 (68)	74*-416* (243)*	
Cerro Copper and Brass Company					.04-.48*[b/] (.21)	0.05- 55 (2%)		0.52- .97 (.83)					
E. I. Dupont			0.8-15.2 (4.5)		0.10- 70 (0.34)		1.8-5.3 (2.7)			0-53 (25)			
Tillie Lewis Food	31	560		5.5									
Crown Zellerbach		95-132 (110)											
Kaiser Gypsum		54-147 (85)											
Stauffer Chemical Co. Martinez						0.005- 07 (0 032)	0.04-0.09 (0.07)	0.10-1.04 (0.62)		0*-100			
Pfizer Minerals Pigments & Metals Division 2" pipe				10.3-10.7									
Kaiser Steel Corporation Metals Products Division													
Drain No 4			21-36 (28)										
Drain No. 7			7.6-33 (20.3)										
Stanford Linear Accelerator Center										30-100 (87.5)			
Granada Sanitary District		92-136 (116)	52-57 (55)									230-290 (269)	
Allied Chemical Corp.				3.2-5.4 (4.3)									29.4-36.7 (30.6)
Shell Development Co. Tesoseal Creek				7.3-9.2 (8.5)									
Fiberboard Corp. San Joaquin	9-24 (17)	215-295 (239)											21.7-45.6 (36)
Stauffer Chemical Co. Richmond	<0.1-4* (0.7)					0.02-0 11 (0.06)							
Campbell Chain Div. of United Industries	0.2-3.5 (1 8)	6 8-137.4 (54.3)				0.94 -							
FMC Corporation	0.2-3 5 (1 8)	6.8-137.4 (54.3)											27-41 (33)

*Violation of effluent requirements.

a/ Figures represent the range in concentration; with the mean concentration in parentheses.

b/ Cr^{+6}

c/ N.D. = Not detectable.

TABLE E-5

DOMESTIC POLLUTION CONTRIBUTING TO THE DETERIORATION OR TOXICITY OF AQUATIC LIFE IN SAN FRANCISCO BAY, AND IS A HUMAN HEALTH HAZARD 1971[a]/

Source	Settleable Matter ml/l/hr.	Suspended Solids mg/l	Oil and Grease mg/l	Cr mg/l	Cu mg/l	Cd mg/l	Pb mg/l	Phenol mg/l	Fish Toxicity 96 hr. % Survival	Fish Toxicity TLm	BOD mg/l	Turbidity J.T.U.	Coliform MPN/100 ml
NAPA Sewage District		36-90 (66)	1 0-19.0 (8 3)										
City of San Carlos Sewage Treatment Plant		55-126 (101)	14 0-33 0 (21.4)								40-131 (95)		
North San Mateo County Sewage District		98-144 (118)	48 7-71.5 (55 8)								176-206 (188)		
Milpitas Sewage District			4.0-19.7 (11.5)										
City of Petaluma			5 9-18 3* (9.2)						0*-100 (45)*	57*-100 (83)		4 6-12.4* (7.8)	
San Rafael Sewage District									20-80 (38)				
City of Los Altos Sewage District		30-96 (47)	13.6-26.9* (18.6)*								69-153 (108)		
Las Gallinas Valley Sewage District			5 0-15 4* (8 9)								41-65* (48)		25-15,000 (7,364)
City of Millbrae Sewage Treatment Plant									10	68-88			
Sausalito-Marin City Sewage District		61-129 (79)	24-36 (31)						0-0* (0)	6*-71* (34)*	130-212 (163)		
City of Pittsburg Wastewater Plant		68-85 (76)	49 5-61.4 (55.4)								107-240 (173)		
City of Pittsburg Crop Storm Gen		62-126 (94)	35 1-43 (39)								47-108 (77)		
Estero Municipal Improvement District		43-142 (70)	3 6-40.3 (21 5)								16 8-115 (40 9)		
City of Pacifica Linda Mar Plant		82-118 (92)	34 1-55 7 (43)							20-33 (24)	103-130 (118)		
City of Benicia		123-211 (151)	16.2-138 (52.4)								184-423 (301)		
Contra Costa County Sewage District #7-A		74-222 (121)	27-37 (32)						0-0 (0)	14-25 (20)	85-150 (112)		
Marin County Sewage District #5		62-106 (85)	20*-96* (38)*						0-30* (15)*	21*-69* (45)*	157-206 (108)		
San Quentin Prison		63-136 (93)	47*-68* (50)*								76-189 (159)		
Crockett-Valona Sewage District		91-158 (134)	38*-51.4* (43)*								93-148 (125)		
Antioch Waste Treatment Plant											70-275 (137)		

TABLE E-5 (CONTINUED)
DOMESTIC POLLUTION CONTRIBUTING TO THE DETERIORATION OR TOXICITY OF AQUATIC LIFE
IN SAN FRANCISCO BAY, AND IS A HUMAN HEALTH HAZARD
1971[a]

Source	Settleable Matter ml/l/hr	Suspended Solids mg/l	Oil and Grease mg/l	Cr mg/l	Cu mg/l	Cd mg/l	Pb mg/l	Phenol mg/l	*Fish Toxicity 96 hr. % Survival	Fish Toxicity TLm	BOD mg/l	Turbidity J.T.U.	Coliform MPN/100 ml
San Jose-Santa Clara	0-7.4* (1.5)		5.4-22.3 (9.8)										
East Bay MUD - Sewage District #1		113-205 (107)	16-38 (24)	0.121-1.20 (.445)	0.08-0.36 (0.19)	0.10-0.73 (0.15)	0.02-0.36 (0.13)		0-70 (9.2)	15-100 (38)	113-242 (170)		
City and County of San Francisco													
North Point Plant			16.6-33.3 (23.7)		0.08-0.14 (0.10)				0-100 (55)	36->100 (88)	102-148 (124)		
Southeast Plant	0.58-4.75* (2.19)*	184-368 (282)	58*-89* (71)	1.05-3.3 (2.16)	0.11-0.46 (0.24)		0.02-0.81 (0.20)		0-100 (15)	12-100 (51)	176-281 (217)		1,406,000-61,910,000* (4,201,255)*
Richmond-Sunset		54-.02 (59)	35-47.5 (38.2)								122-146 (139)		
Central Contra Costa Sewage District		65-82 (74)	29-45 (38)						0 (0)	27-65 (51)	114-173 (136)		
Sunnyvale		38-125 (80)							0-100 (40)	38-100 (72)			
City of Palo Alto Sewage Treatment Plant		49.0-76.0 (59.9)	4.8-27.0* (15.3)*								53-133 (93)		
San Mateo, City of		79-103 (92.5)	32-52 (44)								118-179 (147)		
San Pablo Sewage District													
San Pablo Plant		48-179 (105)	25-55 (46)		<0.02-0.23 (0.11)				0-70 (6.4)	14.5-100 (40)*	145-250 (211)		
Tara Hills Plant		103-211 (152)	62-101 (75)						0 (0)	5.6-21 (8.9)	220-363 (255)		
City of Mountain View		34-86 (58)	18.4*-22.9* (21.2)*								109-179 (143)		
City of South San Francisco San Bruno Treatment Plant		31-145 (72)	7-26 (16)	0.1-1.2 (0.38)	0.25-0.6 (0.44)	0.0-0.1 (0.06)	0.0-1.0 (0.45)	.007-.251 (0.070)	0 (0)	17-86 (52)	66-139 (104)		
Vallejo Sewage District		72-102 (84)	30-44 (40)							25-49 (34)	113-195 (156)		28-599* (198)
City of San Leandro		25-105 (69)	8.7-19.3 (12.8)						0-100 (41)	26-100 (60)	48-143 (91)		
Menlo Park Sewage District									0-0				
Union Sewage District													
Plant #1		70-100 (64)	14.7-20.0 (18.4)								109-141 (123)		
Plant #2		50-66 (56)									41-86 (59)		

*Violation of effluent requirements.

[a] Figures represent the range in concentration, with the mean concentration in parentheses.

APPENDIX F

Table F-1

San Francisco Bay Area Fish Kill Reports for Period of January 1, 1965 through April, 1972

Reference No.	Date	Location	Species	Number	Cause
1	July 21, 1965	Tidewater Pier at Avon-Suisun Bay, Contra Costa County	Striped Bass Minnow Starry Flounder	90,000 1,000 100	Oil, Refinery waste
2	August 24, 1965	Oyster Point San Francisco Bay, San Mateo County	Striped Bass Halibut Other Fish Mollusk	75 25 750 10,000+	Bay Fill
3	May 2, 1966	Novato Creek, Bell Marin Keyes Lagoon and San Pablo Bay, Marin and Sonoma Counties	Striped Bass	120	Unknown
4	May 14, 1966	Carquinez Strait at Port Costa, Contra Costa County	Striped Bass	9	Unknown
5	May 25, 1966	San Pablo Bay at Union Oil Refinery Rodeo, Contra Costa County	Striped Bass	7,000	Phenol
6	June 1, 1966	Mission Rock Resourt Center and Boat Center San Francisco, S. F. County	Anchovy	7,200	Unknown
7	June 13, 1966	Railroad Bridge at Martinez, Contra Costa County	Striped Bass	7	Possibly Oil

Table F-1 (Continued)

Reference No.	Date	Location	Species	Number	Cause
8	June 16, 1966	Petaluma River, Sonoma County	Striped Bass	150	Low D.O.
9	June 24, 1966	Suisun Bay Near Mothball fleet, Solano County	Striped Bass	25	Unknown
10	July 22, 1966	Petaluma River, Sonoma County	Carp	90	Unknown
11	August 9, 1966	Leslie Salt Co. Sears Point, Solano County	Striped Bass	1,000+	High Salt concentration
12	May 21, 1967	San Leandro Marina, Alameda County	Striped Bass	162	Low D.O.
13	Sept. 7, 1967	Mare Island, Solano County	Shiners Striped Bass Staghorn Sculpins	2,000 500+ 20	Oil
14	Dec. 15, 1967	Foster City Lagoon, San Mateo County	Topsmelt Anchovy	18,000 2,000	Unknown
15	June 7, 1968	Suisun Bay, Contra Costa County	Striped Bass	25	Unknown
16	August 6, 1968	Ross Post Office Ross, Marin County	Steelhead Sculpin Roach	25 250 250	Raw Sewage
17	June 8, 1969	Alameda Beach S. F. Bay, Alameda County	Striped Bass Spiny Dog Shark	2 3	Possibly Pesticide

Table F-1 (Continued)

Reference No.	Date	Location	Species	Number	Cause
18	June 11, 1969	Bel Marin Keys Near Novato, Marin County	Carp Striped Bass	15 6	Unknown
19	June 14, 1969	Alameda Estuary Near Government Island, Alameda County	Striped Bass	6	Unknown
20	July 19, 1969	Port Chicago and Martinez, Contra Costa County	Striped Bass Catfish Shad	75 12 2	Unknown
21	August 21, 1969	Larkspur Lagoon, Marin County	Striped Bass	25	Pollution
22	Sept. 1, 1969	West of Sears Point Bridge, Solano County	Striped Bass	2,500	Low D.O.
23	Oct. 23, 1969	Westerly & off Crawford Slough (area adjacent to Grizzly Island), Solano County	Striped Bass Sucker Perch	450 1 1	Unknown
24	May 18, 1970	Bel Marin Keys, Marin County	Bay Mussels Striped Bass	15	Unknown Algal Bloom with possible Low D.O.
25	May 20, 1970	West Leslie Salt Pond, Hwy. 37 and Sonoma Creek, Solano County	Striped Bass Flounder Bullhead	2,000 1 75	Unknown Algal Bloom with possible Low D.O.

Table F-1 (Continued)

Reference No.	Date	Location	Species	Number	Cause
26	May 20, 1970	Port Costa Waterfront, Contra Costa County	Striped Bass	Several Hundred	Unknown (Annual Loss)
27	May 20, 1970	Nelson Resort downstream to mouth of Mare Island Channel and Carquinez Straits, Solano and Napa Counties	Striped Bass	1,100	Unknown
28	May 24, 1970	Suisun Bay, Contra Costa and Solano Counties	Striped Bass	25	Unknown (Annual Loss)
29	May 30, 1970	Carquinez Straits from Crockett upstream to Antioch, Contra Costa and Solano Counties	Striped Bass Shad Catfish	123 5 8	Unknown (Annual Loss)
30	June 1, 1970	Antioch Bridge to Crockett, Solano County	Striped Bass Sturgeon Shad Rough Fish	750 25 25 25	Unknown (Annual Loss)
31	June 23, 1970	Napa River between Vallejo and Cuttings Wharf, Napa County	Striped Bass	80	Unknown

Table F-1 (Continued)

Reference No.	Date	Location	Species	Number	Cause
32	Nov. 8, 1970	Redwood City Municipal Marina, San Mateo County	Black Perch Shiner Perch Walleye Perch	1,000 10,000 1,000	Unknown Low D.O. a contributing factor
33	April 8, 1971	Pier 35, South Side San Francisco, San Francisco County	Northern Anchovy Rock Cod Starry Flounder Assorted Perches	500 40 10 70	Unknown
34	May 6, 1971	Lake Merritt, Oakland, Alameda County	Shrimp Perch Gobie Bullhead Shiner Perch	5,000 1,000 100 75 2	Unknown
35	May 19, 1971	Redwood City Municipal Yacht Harbor, San Mateo County	Anchovy	15	Possibly Redwood City S.T.P.
36	May 20, 1971	Canal off Petaluma River and at Bel Marin Keys off Novato Creek, Marin County	Striped Bass	500	Probably D.O. Extensive algal bloom
37	May 22, 1971	Benecia Flats, Contra Costa County	Striped Bass	1	Unknown, Red tide conditions in Carquinez Strait from Port Costa to Crockett
38	May 22, 1971	Off Antioch near Kimbal Island, Contra Costa County	Carp Squawfish	1 1	Unknown, Red Tide conditions in Carquinez Strait from Port Costa to Crockett

Table F-1 (Continued)

Reference No.	Date	Location	Species	Number	Cause
39	May 29, 1971	Midshipmen Point--Tubbs Island, Solano County	Striped Bass	80-85	Entrapment and Elevated Temperatures Low Tides, Low D.O.
40	June 30, 1971	San Leandro Bay near mouth of San Leandro Creek, Oakland, and San Leandro Creek from mouth of Hagenberger Road, Alameda County	Striped Bass	100	Unknown
41	June 7 to July 12, 1971	Lower Napa River, Napa County	Striped Bass	90 (Boat count)	Unknown
42	June 7 to July 12, 1971	Eastern San Pablo Bay, Napa and Contra Costa Counties	Striped Bass	89 (Boat count)	Unknown
43	June 7 to July 12, 1971	Carquinez Strait, Solano and Contra Costa Counties	Striped Bass	362 (Boat count)	Unknown
44	June 7 to July 12, 1971	Suisun Bay, Solano and Contra Costa Counties	Striped Bass	122 (Boat count)	Unknown
45	Sept. 17, 1971	Redwood Shores Redwood City, San Mateo County	Bait Fish Shrimp Turbot Mudsucker & Unknown Amount of Cleaned-up Fish	2,000 8,000 1 300	Poor Water Circulation in a Closed Lagoon System. Possibly Low D.O.
46	Oct. 15, 1971	Tidal Creek behind 440 DuBois Street San Rafael, Marin County	Unknown Fry Stickleback	35 15	Possibly Sewage

APPENDIX G

THIS SECTION TO BE

INSERTED LATER

APPENDIX H

APPENDIX H

Table H-1. Time Schedule for Compliance with Water Quality Objectives*

1. Review data from checking and self-monitoring programs for existing waste discharges to determine compliance with this policy - review data on a continuing basis and complete determination no later than July 1, 1968;

2. Develop waste discharge requirements and self-monitoring programs which will assure compliance with this policy and the policy of Resolution No. 803 as expeditiously as possible and in accordance with the following schedule:

   a. For all new waste discharges - before the discharge commences;

   b. For all existing waste discharge not under requirements at present - give priority to industrial waste discharges and complete no later than December 31, 1968;

   c. For all existing waste discharges under requirements at present - complete review and necessary revisions no later than December 31, 1970; and

3. Initiate formal enforcement proceedings pursuant to the Regional Board's policy in accordance with the following schedule:

   a. For dischargers who are not under waste discharge requirements at the time this policy becomes effective - initiate proceedings no later than December 31, 1970 for those dischargers found to be in violation of requirements which are consistent with this policy.

   b. For dischargers who are under waste discharge requirements which are consistent with this policy - initiate proceedings no later than December 31, 1968 for those dischargers found to be in violation of said requirements.

   c. For dischargers who are under waste discharge requirements which are not consistent with this policy at the time it becomes effective - initiate proceedings no later than December 31, 1970 for those dischargers found to be in violation of said revised requirements.

4. Require all entities to determine and report on conditions contrary to this policy caused by the discharge of combined stormwater runoff and sewage including measures needed and schedule for compliance with this policy no later than July 1, 1968;

TABLE H-1 (Continued)

5. Eliminate dairy wastes as a factor causing conditions contrary to this policy no later than December 31, 1971, through the enforcement of requirements and the support of the dairy industry's self-policing program;

6. Implement, within budget limitations, a basic data program no later than December 31, 1967.

* Source: "Water Quality Control Policy for Tidal Waters Inland from the Golden Gate Within the San Francisco Bay Region," San Francisco Bay Regional Water Quality Control Board, 1967.

TABLE H-1

STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Alviso, City of	Resol. 364(6/15/61) WDR, RWR 69-40(8/28/69) Bact. reg.	(Resol. 364 indicated that peremptory order issued by State Dept. Public Health on 3/8/61. Directs certain actions with schedule.)	(Resol. 364 also states const. of new fac. are contrary to SFBPLB policy favoring consolidation)	(1972-73) Connect to San Jose Main Plant.	Alviso has been annexed by San Jose ( ). STP now operated by City of San Jose. $250,000 interceptor and pumping to San Jose STP defined in State needs list for FY 72-73.
Los Altos, City of	Resol. 212(3/15/56) RWR 641(2/18/65) amends 212 eliminates grease standard 675(6/17/65) schedule for compliance 67-53(10/19/67) WDR, RWR - rescends 212 reg. for alternatives of joint treat. 68-16(4/30/68) C&D order (with schedule) 68-74(12/18/68) amends C&D order (with schedule) 70-60( ) reissue of C&D (with schedule) (Presently not complying with active resol.)	Resol. 70-60* Compliance with Cl_2 reg. by 8/15/70. Other reg. Complete const.& oper. 11/30/71. Demo compli. 6/1/72	Improvements to STP completed 11/65. A contract for expansion of facilities was awarded early 1970. (See Palo Alto)		*Revises schedules that appeared in Resol. 675 (partial schedule), 68-16(complete const. 3/31/70) and 68-74(complete const. & oper. 2/28/71). Agreement has been reached between Los Altos, Palo Alto and Mountain View. (See Palo Alto)

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	NPDES PLAN	COMMENTS
Milpitas Sanitary Dist.	Resol. 124(4/16/53) RWR 442(1/17/63) rescends 124 revises requirements 475(6/20/63) revises 442 519(12/19/63) schedules for compli. 530(1/16/64) C&D order (with schedule) 67-8(2/16/67) amends C&D order & revises schedule 69-27(6/24/69) revises RWR & WDR rescends 442 & 475 70-6(3/14/70) C&D order 70-58(7/23/70) SWRC formal enforcement action ( ) rescinds 70-6 (Presently complying with active resols)		Effluent settling pond completed 9/2/69 SF Bay Board finds SD in compliance.	(1974-75) Interceptor toward central bay with deep water outfall.	C&D order (70-6) included additional connection ban subsequent to 3/14/70. Has been rescinded. On 4/2/70, SWRCB remanded to the SF Bay Board continuing jurisdiction. MSD is now participating with San Jose for connection to facilities. Schedules indicates capacity will be available by 1/1/73 and will discontinue operations at present Milpitas plant.

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Menlo Park S.D.	24(10/10/50) RWR __ (6/20/63) rescinds 24 RWR, WDR 524 (12/10/63) schedule 590 (8/20/64) C&D order 668 (6/17/65) Amends schedule 702 (9/16/65) Amends 590 & 668, RWR, WDR 67-13(4/25/67) C&D amends 590, 668, 702 67-54(10/19/67) Req. for joint treatment alternatives 67-59(11/16/67) WDR, RWR for interim fac. 68-55(9/25/68) req. for proposed M.P. fac. 68-69(12/18/68) C&D order amends 67-13, 702. 668, 590 69-40(5/28/69) Bact. req. (Presently complying with active resolutions)		Improvements & extensions of stabilization completed late 1969	(1974-74) - Interceptor sewer toward Central Bay with deep-water outfall	Menlo Park cannot make decision as to joint treatment with the suoregional facilities for San Mateo County or South Bay Dischargers
Redwood City	262(12/19/57) RWR 453(4/18/62) rescinds 262 revises WDR, RWR 523(12/19/63) schedule 702(9/6/65) amends 67-15(4/28/67) amends schedule 67-54(10/19/67) revises WDR, RWR 68-17(4/30/68) C&D order & schedule 68-71(12/18/68) joint treat. alter. revises schedule 70-4(5/14/70) C&D revises sched. 70-62(7/20/70) amends C&D deletes add. connection ban Presently complying with active resolutions	Resolution 70-4: ACC 3/31/70 Complete const. 4/1/71 Demo compli 5/1/71	Limited improvements - made periodically Facility for sludge treat. & disposal & excess chlorination completed 7/70. Add. connections ban dropped. (Continued)		* Order 70-4 revises several past schedule. The C&D also included an add. connection ban. The dischargers filed a stay order 5/12/70. Removed from court calendar because progress was being made thru negotiations. $6,500,000 project for facilities for Redwood City, San Carlos, Belmont & possibly others defined in State needs list for FY 74 & 75.

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Redwood City, City of (Continued)			(Cont'd) Further improvements to be completed 4/71 - includes joint treatment with San Carlos-Belmont (Joint Auth. for the Strategy Consolidation Sewerage Plan)		
San Carlos,-Belmont Cities of (New tributary to Redwood City System)	303(5/21/59) RWR 343(10/20/60) rescinds 303, revises RWR, WDR (Incomplete)				

TABLE 1-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQC PLAN	COMMENTS
Mountain View, City of	13(8/17/50) RWR 221(10/18/56) revises RWR rescinds 13 640(2/18/65) revises RWR rescinds RWR - rescinds grease & oil standard 650(3/18/65) schedule for 221 788(10/22/66) rescinds 650 requires summary regarding joint treat. 67-53(10/19/67) WDR, RWR for alternatives of joint treatment 67-70(12/21/67) revises WDR, rescinds 221 68-15(4/30/68) C&D order with schedule 68-73( ) amends C&D order & schedule 70-61(7/23/70) reissues C&D order with revised schedule (Presently complying with active resol.)	70-61 C&D order* Demo compli. with Cl_2 req. 8/15/70 Complete all const. and oper. 11/30/71 Demo Compli. 6/1/72	Detention pond (after) primary clarifier) in conjunction with chlorination completed 8/70 (See Palo Alto)	? 1971-72	*Revises schedules established in Resol 650 (comp. const. 5/1/69), 68-15 (complete const. 3/31/70) and 68-73 (complete const. 2/28/71). Agreement reached between Mountain View, Los Altos and Palo Alto for regional system. (See Palo Alto) $600,00 for Class A interceptor defined in State needs list for FY 72-73 for Mountain View Sanitary Dist.
Palo Alto, City of	436(12/20/62) RWR 796(11/17/66) schedule for 436 67-53(10/19/67) WDR, RWR for alternatives of joint treatment 68-3(1/18/68) schedule for 67-53 68-14( ) C&D order & revises schedule	Resol 70-59 C&D order* Demo. compli. with Cl_2 req. 8/15/70 Complete all const. and oper. 11/30/71 Demo compli. 6/1/72	Joint treatment facilities for Palo Alto, Mountain View, and Los Altos completed 4/72 plant includes fac. for treat. of ind. wastes		Will connect to common central bay deep water outfall with South Bay Dischargers (See Palo Alto)

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	NEW PLAN	COMMENTS
Palo Alto, City of (Continued)	68-72(12/18/68) amends C&D & revises schedule 70-59(7/23/70) reissues C&D & revises schedule (Presently not complying with active resol.)	Resol 70-57* Division A - Cl_2 facilities F - Railroad spur Acc for spur 8/24/70 place in oper 2/28/71 Demo with Cl_2 req. 3/31/71	Division A- Completed 5/71 Division F- Completed	(1974-75) Connect to central bay deep water outfall	South Bay Dischargers have submitted report for construction of deep water outfall to Central SF Bay. Tenative schedule calls for Federal & State approval by 12/31/72, complete construction 6/30/77 and commence operation 7/31/77. The following municipalities are involved in the joint outfall: San Jose-Santa Clara system San Jose; Santa Clara; County San. Dist. 2,3 &4; Burbank & Cupertino San. Dist. Palo Alto Los Altos Sunnyvale Mountain View Milpitas San. Dist. $240,000,000 project for subregional treatment plants, interceptors and outfall serving South Bay Dischargers by State needs list for FY 73-74
San Jose, City of	316(11/13/59) WDR 68-11(3/21/68) revises WDR 69-26(6/24/69) C&D order with schedule 70-57(7/30/70) reissue C&D order 70-9(11/24/70) revises WDR 71-36(6/24/71) amends schedule of C&D order 71-78(11/23/71) C&D order for toxicity with schedule ( ) amends 68-11 (Presently complying with active resol.)	Division B - Prim & Secondary additions C - Sludge cond. & digesters Advertise 9/30/70) receive bids 12/15/70 Acc 12/19/70 comp. const. - to be estab. Division E - Water Reclamation Plant FP 3/31/71 Request auth to Advertise 4/5/71 bids open 5/5/71 Acc 8/5/71 complete const. 8/5/72 Resol 71-78 for toxicity FP 3/15/72 Implement prog. for wastes to system 5/1/72 Report (feas. of removing NH_3) 3/1/72 Report on sources & abatement program 5/1/72 Resol for sub. prg. plan Complete st[illegible] 1/1/72 Submit schedule 2/25/72	Division B- Grant offer 6/71 UC C - Grant offer UC D - Sludge lagoon grant offer 6/71 UC E - Water Reclamation Plant		

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
OF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Sunnyvale, City of	120 (3/17/53) RWR 642 (2/18/65) C&D order 723 (2/17/66) RWR,WDR (11/25/69) Rescinds 723 revises RWR,WDR 69-61( ) revises WDR & schedule 70-13(2/16/70) requests tighter schedule 70-92(11/24/72) amends 69-61 and revises schedule (Presently complying with active resolutions)	Resol 70-92* Compli with BC req. Complete subregion study 1/1/72 Submit FP 3/15/72	Facilites complete 1968? New facilites completes 9/72	(1974-75) Connect to central Bay deepwater outfall	*Schedules in past resol and/or orders referred to treatment plant improvements - See Status
Union S.D. - Irvington	Resol 297 (12/18/56) WDR, RWR 646 (3/18/65) 653 (4/15/65) C&D order & schedule 689 (7/18/65) C&D - revised schedule 69-40 (8/28/68) Bact.req. (Presently complying with active resol)	689 C&D order* F 12/15/65 FP 6/15/65 ACC 3/15/66 Complete Constr. 3/15/67 Demo.Compli 10/01/67 69-40 for Cl_2 regs. ACC 5/15/70 Complete Const.7/31/70	Participation in joint study of deep water outfall (See Hayward)	(1974-75) Interceptor sewer toward central Bay with deepwater outfall	*Revises past schedules Part of East Bay Dischargers (see Hayward)
Union S.D. - Newark	Resol 487 (8/14/63)RWR,WDR 652 (4/15/65)C&D order & schedule 688 (7/15/67)revises 652 69-10 (8/23/69) Bact.req. 69-46 ( ) rescinds 688 & 67-9 (Presently complying with active resol)	Resol 67-9* Comple Constr. 6/67 Demo. Compli. 10/15/67	New facilities completed 6/67 Participating in joint study of deepwater outfall	(1972-73) Interim improvements 1974-75 Interceptor sewer toward central Bay with deepwater outfall	*Revises past schedules Part of East Bay Dischargers (see Hayward)

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Union Sanitary District	66 (7/19/51) RWR 395(2/15/62) rescinds 66 revises RWR, WDR (Presently not complying with active resolutions)		Intermediate Plant completed 1960 Now tributary to Union SD - Irvington Plant Participating in joint study of deep water outfall (See Hayward)	(1975-76) Interceptor Sewer toward Central Bay	Part of East Bay Discharges (See Hayward)
Burlingame, City of	Resol. 23 (9/21/50) RWR 254(10/17/57) rescinds 23, revises RWR, WDR 472(6/20/63) rescinds 254, revises RWR, WDR- 701(9/19/64) schedule 765(6/16/66) schedule for wet weather flow control 67-11(4/28/67) C & D order 67-51(10/19/67) rescinds 472, revises RWR, WDR 67-52(10/19/67) amends 67-11 68-76(12/18/68) rescinds 765 & 701 (bypassing)	72-40 Forthwith for bypass prohibition Schedule for prohibition of discharges to nearshore Submit FP 10/1/72 FP 5/1/73 ACC 8/1/73 Complete Construction 6/1/74	Improvements to treatment plant - UC (grant offer 2/68) Participating as possible joint outfall to central bay deep waters (See So. San Francisco)	1971-72 Connect to South San Francisco and San Bruno joint plant	72-40 prohibits bypassing and prohibits discharge within 200 feet of shoreline Participating in possible joint outfall (See So. San Francisco) Joint study with Millbrae for common outfall

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Burlingame (cont.)	71-75(10/28/71) req. for So. San Francisco for possible joint project including Burlingame 72-10(7/25/72) amends 67-51 schedule (Presently complying with active resolutions)				$3,200,000 project for interceptor sewer from Burlingame and Millbrae to So. San Francisco defined in State needs list for FY 72-73
East Bay Municipal Utility District - Special District #1	Resol. 73(9/20/51) WDR 718(1/20/66) amends 73 & schedule 68-8(3/21/68) rescinds 73 & 718 revises WDR, RWR 70-37(6/23/70) amends 68-8 70-81(10/22/70) amends 68-8 72-21(5/23/72) amends 70-81 & schedule (Presently not complying with active resolutions)	Resol. 72-21 FP for primary improvements & pumping stations 6/1/72 FP for secondary & sludge treatment & disposal 12/1/72 ACC for primary improvement 12/15/72 ACC for second improvement 6/1/73 FP for bldg. add & outfall modifications 5/1/73 Complete Construction prim. improve 7/1/74 bldg. add & outfall modifications 9/1/74 secondary improvements, sludge treatment & disposal 2/15/75	Removal of Discharge of digested sludge (vacuum filtration & trucking to land fill completed 7/71) Presently developing FP for chemical treatment facility (completion expected 4/1/72)	(1971-72) Chemical & expanded primary treatment (1972-73) Sobrante Plant chemical flocc., centrifuge & precoat filter (1973-74) Walnut Creek Filter Plant Chemical floc. centrifuging and precoat filter	Pilot plan tests have indicated best alternative method for achieving 85% removal of BOD EBMUD also participating in joint outfall study for East Bay Discharges (See Hayward) EBMUD received grant offer during FY 71-72 for STP improvements. Total eligible costs $53,200,000

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Estero Municipal Improvement District	414(5/17/62) WDR, RWR 69-39(8/28/69) Bact. req.		Primary Facility & Sludge Disposal facility completed 6/69	(1972-73) Consolidate sludge disposal facilities with San Mateo (1972-73) Connect to City of San Mateo plant enlargements	An interceptor connecting to City of San Mateo defined in State needs list for FY 73-74
	(Presently not complying with active resolutions)				
Guadalupe Valley M.I.D.	281 (8/21/58) RWR 69-40(8/28/69) Bact. req.			(1971-72) Connect to Bayshore S.D.	Guadalupe Valley MID plant completed in 1960 Serves Brisbane and Crocker industrial park. Proposes to abandon plant and become tributary to San Francisco plants.
	(Presently not complying with active resolutions)				
Hayward, City of	422(7/19/62) 718( ) schedule 704( ) C & D Order & schedule rescinds 422 70-53(6/25/70) WDR to conform with Porter Cologne Act 72-9(8/22/72)	_____ schedule for deep water outfall agree ment F & adm. of Phase I project & authorize preparation of EIS & PP 10/72 Final agreements F & adm. 1/73 Initiate studies for reduction of storm water infiltration & adopt sewer ordinance 2/73	Oxidation pond complete 9/66 New stabilization ponds & appurtenances UC (grant offer 9/70)	(1971-72) interim improvements - extension of ponds, sludge dewatering facilities, and aerators. (1975-76) Interceptor Sewer toward Central Bay.	Outfall project program involve Hayward, San Leandro, Union, Oro Loma, and Castro Valley Sanitary Districts. Also includes wet weather flow from East Bay MUD.

TABLE H-1
(CONTINUED)
STATUS OF COMPLIANCE
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Hayward, City of (continued)	(Not presently complying with active resolutions)	PP 3/73 Auth. FP for Phase I 5/73 F 12/73 FP 2/74 ACC 9/74 Complete Const. 12/75 Demo. Compliance 4/76	Also participating in East Bay Discharger plan for joint outfall to central bay deep waters.		$57,000,000 project for East Bay Interceptor sewer and outfall defined in State needs list for FY 73-74/
Millbrae, City of	527(1/16/64) WDR 582(7/16/64) schedule 702(9/16/64) amends 582 736(3/17/68) C & D order & schedule 67-4(11/19/67) amends C & D and revises schedule 69-40(8/28/69) Bact. req. 71-75(10/28/71) WDR for joint treatment 72-39( ) amends 527 and 69-40. Revises WDR, RWR and revises schedule (Presently not complying with active resolutions)	Resol. 72-39* Submit PP 10/1/72 FP 5/1/73 ACC 8/1/73 Complete Const. 6/1/74	Consultant has been authorized to proceed with FP for central bay deep water outfall. Joint project with Burlingame.	(1971-72) Interceptor sewer to eliminate wet weather bypasses.	* Revises several past schedules. $143,000 project for pump station and interceptor defined in State needs list for FY 73-74, Priority III.
Oro Loma Sanitary District	(Presently not complying with active resolutions)		Participating in joint study of deep water outfall (See Hayward)	(1975-76) Interceptor sewer to Bard central bay	Part of East Bay Discharges (See Hayward)
San Francisco - Southeast			Proposed consolidation with other SF plants to new facility with discharge to ocean		$33,500,000 project listed for outfall from SE plant to Lake Merced outfall defined in State needs list fo FY 72-73.

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
San Francisco - Southeast (Cont.)	--$30,000,000 project for interception of combined discharge (Priority II) --$ 690,000 project replacing airport pressure force main (Priority III) --$30,000,000 project for interception and treatment of combined discharge also listed for FY 74-75 (Priority II) as well as FY 75-76 (Priority II) as well as FY 76-77 (Priority II)			(1971-72) Solids handling, sludge filtration, digesters and effluent outfall changes, grit removal (1972-76) interception and treatment of combined sewer discharges. Not yet defined.	The following are defined on State needs list for FY 73-74: --$67,000,000 project for treatment & secondary solids handling @ SE plant --$10,650,000 project of Northpoint eff. transported to SE Plant --$22,000,000 for treat and solids handling at Richmond-Sunset Plant.
San Francisco International Airport (Sewage)	70-25( ) WDR, RWR 70-31(3/26/70) C & D order (Presently complying with active resolutions)		New STP completed 7/71.	(1971-72) Treatment of individual wastes with disposal to deep water outfall with sewage--also replace interceptor	Case turned over to State Attorney General 11/10/70. Attorney General advised of improvements No enforcement action taken.
San Leandro, City of	(Presently not complying with active resolutions)		Participating in joint study of deep water outfall (See Hayward)	(1971-72) solids handling and aerators (1975-76) Interceptor sewer toward central bay.	Part of East Bay Discharges (See Hayward

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
San Mateo, City of	(Presently complying with active resolutions)			(1972-73) interim improvements	$1,500,000 project for enlargement of treatment plant and interceptor from Estero MID defined in State needs list for FY 73-74.
So. San Francisco-San Bruno	(Presently not complying with active resolutions)		Participating in joint study for deep water outfall to central SF Bay	(1971-72) improvements & outfall extension	SSF is acting as central agent for SSF, San Bruno, SF International Airport, Merck Chemical, and possibly Millbrae and Burlingame for joint outfall project
California State Prison-San Quentin	575(7/16/64) WDR 67-49(9/21/67) amends 575: better disinfect 68-29(4/30/68) WDR - rescinds 575 & 67-49 69-21(4/23/69) Time Schedule for 68-29 69-41(8/23/69) Revision of 68-29 (Presently complying with active resolutions)			(1972-73) Interceptor to Pt. San Quentin-with deep water outfall to	Flow: dry .94 mgd wet 3.6 design 1.0 pop: 5,000

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Marin County SD #1	351(2/16/61) WDR 68-28(4/30/68) WDR rescinds 351, 409, 67-48 71-43(6/24/71) WDR rescinds 68-28 incl. schedule 71-52(7/22/71) C & D	68-28 incl. 90% BOD removal 71-43 submit comply schedule by 7/1/72 Comply: floating matter: forthwith new const: 7/1/73 no bypass: 4/1/74	7/72-on schedule	(1972-73) Interceptor to Pt. San Quentin with deep water outfall to Bay--also wet weather treatment interim improvements	Flow: dry 4.0 mgd pop: 52,000 wet-15 at plant design 4.5 71-43: incl. stronger stds. for coliform turbidity, BOD, nutrients. Bypass prohib. flow limit 4.5 mgd 71-52 viol: floating matter Bypass Connection Ban Sub-regional programs to be implemented 73-74 part of program held up by law suits (Ross Valley trunk sewer). $10,000,000 project for treatment plant enlargements & joint outfall with Marin Co. SD #1, San Quentin Prison & San Rafael SD (possibly other dischargers will be included). Defined in State needs list for FY 73-74
	(Presently not complying with active resolutions)				
Marin County SD #5 Main Plant	511(10/17/63)WDR (Paradise Cove only) 69-3(1/15/69) Rescinds 511 287(9/18/58) WDR Main Plant			(1972-73) interim improvements	Main Plant Flow: dry: .7 mgd design: 1.4 mgd pop: 6,000 Outfall to Raccoon Strait

TABLE H-1 (CONTINUED)
STATUS OF ABATE [illegible]
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Marin County SD #5 Main Plant (Cont.)	70-104(12/22/70) Amend. to 287 incl. schedule	70-104: Complete improvements by 5/1/71.		See also Richardson Bay SD	District resists particularly in sub-regional plan. Wants to implement tertiary treatment on its own.
	(Presently not complying with active resolutions)				
Mill Valley, City of	732(3/15/66)WDR w/schedule 785(9/15/66)Time Sched. 71-13(2/25/71)WDR amends 732 71-34(6/24/71) C & D	732: submit sched. by 7/15/66 785: Comply by 7/1/67 71-34: Stop bypass forthwith, complete compliance plan: 7/1/72	Programs to reduce infiltration are in progress. Bond issue passed, applied to State & EPA for interim improvements.	(1971-72) aerated lagoon and chlorination	Flow: Dry 1.7 mgd design 1.8 mgd pop: 16,000 outfall to Richardson Bay 732 no bypass 71-13: Flow limit: 1.8 mgd Tighter effluent stds. Conforms to interim plan except for outfall specs. 71-34: viol: disinfect BOD, toxicit. turbidity, floatin matter, bypass, excessive flo. Connection ban.
	(Presently not complying with active resolutions)				

TABLE h-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQ'I PLAN	COMMENTS
Richardson Bay S.D.	228 (11/15/56) WDR 71-14 (2/25/71) WDR 71-3' (6/24/71) C&D w/ time sched 8/2?/72 - Board grants extension of by-pass prohib. (presently not complying with active resols)	71-33: No bypass: 4/1/73 submit comp-sched: 7/1/72	7/6/71: Connection ban appealed to State by dev. 7/27.CB appealled to courts 8/5. State upholds ban 3/15/72: Court upholds ban 7/22: RBSD asks l yr extension on bypass prohib so money allocated for interim compliance can be spent on long-range program	1971-72 interim improvements 1972-73 Marin Muni Water Dist-Interceptor from Richardson Bay to ocean. Treatment plant and deep water outfall. Possible joint project with other Marin Co. discharges	Flow(Trestle Glen) dry: .2mgd design: .3mgd pop: 4200 Sewage from rest of dist. pumped to Sausalito plant 71-14: No bypass Flow limit .3-gd 71-33: viol: floating matter foam, BOD, disinfect, turbid, toxicity, untreatened viol: bypass. Connection ban. Program to cut infil, disinfect, facilities enlarged land disposal of some effluent

TABLE B-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	NOW PLAN	COMMENTS
Richmond, City of	130 ( )WDR 721 (2/17/66) WDR rescinds 130 69-40 (69)Amend. requires disinfect. 69-46 (9/25/69)rescinds 327 (?) 747] C&D rescinded by 68-6] 70-9 (1/29/70)		Plant improvement compl. 10/69	1975-76 interceptor from Antioch toward Richmond-deepwater outfall	flow: design: 12.2mgd pop: design: 98000
San Francisco - North Point				1971-72 deepwater outfall, main sump and pump alteration, turbidity and grease removal 1972-76 interception and treatment of discharges from combined sewers	
Sausalito - Marin City S.D.				1971-72 interim improvements	

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Seafirth Estate					
Stege Sanitary District (Connected to East Bay M.U.D.				1971-72 Chemical and expanded primary treatment	
American Canyon Co. Water District					
Calistoga, City of				1972-73 interim reclamation for irrigation 1974-75 land disposal facilities	

TABLE F-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Contra Costa County S.D. No. 7-A				1971-72 expanded primary treatment or ponding 1975-76 interceptor from Antioch toward Richmond, deepwater outfall.	$35,000,000 project for transportation fac. from Crockett Valona to Richmond plant defined in State needs list for FY 74-75 $712,000 project for new secondary plant defined in State needs list for FY 72-73
Hercules, City of				1972-73 interceptor sewer to City of Pinole 1975-76 interceptor from Antioch toward Richmond, deepwater outfall.	To connect to Pinole $90,000 project for interceptor to Pinole STP defined in State needs list for FY 72-73

TABLE H-1
(CONTINUED)
STATUS OF ATTAINMENT
OF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Las Gallinas Valley S.D.	380 (10/19/61) Long Range Plan 396 (2/15/62) WDR 69-40(/28/69) Requires disinfect. Time Sched 72-10 (3/28/72) WDR w/ schedule	72-10 submit compl. sched. 7/1/72 Comply w/flow limit: 12/31/73 No bypass. forthwith	Disinfect begun 4/70	1972-73 interim improvements (See also Marin Co SD #6 - Ignacio)	Flow: dry: 2.1 mgd wet: 10.5 " design: 2.25 " pop: 30,000 outfall to Miller Cr 72-10 conforms to interim plan flo limit 2.25 mgd sub-reg plan to b implemented '75-' Plant may be ex-panded in interim $400,000 project for disinfection and sludge handling fac. and enlargement of biofilter defined in State needs list for FY 72-73

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQ1 PLAN	COMMENTS
Marin County S.D. No. 6-Ignacio	596(8/20/64) WDR 69-8(2/13/69) WDR Rescinds 470 & 596 69-15(3/13/69) C&D w/Sched. 69-28(6/24/69) amends 69-15 69-49(9/25/69) amends 69-15 & 69-28 70-72(9/24/70) amends 69-8 70-86 (10/22/70) amends 69-15, 69-28 & 69-49 (Presently not complying with active resol)	69-49: comply by 4/15/70 70-86: comply w/70-72 by 2/1/73 submit subreg. sched by 3/15/71	Construction is a little behind sched, but should meet compliance sched.	(75-76) N. Marin Co. & S. Sonoma Co.-Interceptor to Pt. San Pedro with deep water outfall. Interceptor may go as far as Pt. San Quentin or to ocean as joint project with So. Marin discharges	Flow: .7 mgd to be enlarged to 1.2 pop: 10,000 outfall to Novato cr. seasonal irrigation use of effluent. 69-8: strict coliform std. (concern over irrigation use). 70-72. requires dev. of subreg plan with alternative to proposed San Pablo outfall. Bypass prohib. Plan is to upgrade No-ato & Ignacio plants, & use combined outfall to S. Pablo Bay. Reg. bd wants different outfall location. Grants forthcoming, bonds sold. $33,000,000 project for subreg. transport of treatment and possibly reclamation fac defined in State needs list for FY 73-74

TABLE A-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Marin County S.D. No. 6-Novato	(See Ignacio) (Presently not complying with active resols)			(See Ignacio)	Flow: dry: 1.8 mgd design: 2.7 (to be enlarged to 3.0) pop: 21,700 Outfall to Novato Cr. within 500' of water-oriented residential area. effluent used for seasonal irrigation. (See Ignacio)

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Marin County S.D. No. 6-Bahia	470(6/20/63) WDR 69-8(2/13/69) WDR rescinds 470 & 596 70-72 (9/24/70) 71-16 (2/25/71) (Presently not complying with active resols)	when constr. is complete, parts of 70-72 relating to Bahia are rescinded.		(See Ignacio)	Flow: design: .2 mgd Pop: 2000(design) ultimate flow .8 mgd " pop 8,000 outfall to Petaluma R. To be expanded as development continues & abandoned after tie-in w/subreg plan. State does not want to fund Bahia because it is a one-developer project. 71-16: no bypass (See Ignacio)

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Meadowood Development Co.				?	
Napa County S.D.			1975-76 Interceptor from Napa to Vallejo and plant enlargements at Vallejo.		

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Petaluma, City of				1971-72 pump station, force mains and new oxidation ponds. (See also Marin Co. SD #6-Ignacio)	
Pinole, City of				1975-76 Interceptor from Antioch toward Richmond, deep-water outfall	

TABLE H-1
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
MUNICIPALITIES

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	WQM PLAN	COMMENTS
Rodeo S.D.				1971-72 interim chemical facilities 1975-76 Interceptor from Antioch toward Richmond, deepwater outfall.	
St. Helena, City of				1971-72 Thomas Lane interceptor 1974-75 Land disposal facilities.	$70,000 project for Thomas Lane interceptor defined in State needs list for FY 72-73 (priority III)

TABLE H-2

STATUS OF ABATEMENT
SF BAY DISCHARGERS
INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
				Typ. stds. Process waste 4mg OIS - continued 4, Cooling waste 1.
FMC, Inorganic Chem Div Newark	4/16/64 Disch. Reg.			
	69- 11/25/69 Disch. Reg.			
	72- 8/10/72	To be filed 9/15/72 by FMC		Viol. of floating mat setteable solids
Crown Zellerbach Antioch	71-14 WDR (4/20/71) incl. schedule revised sched. 6/25/71	No discharge of toxic or biostim. by 6/76 Complete constr. by 9/1/73 of all treatment facilities		
Fibreboard - Pulp & Paper Antioch	302 WDR (1960) 71-17 WDR (4/20/71) incl. schedule rescinds 302	comply by 1/1/73, later extended to 7/74 No disch of toxic of biostim. mtl. by 6/76		EPA has proposed a compliance plan w/final comp by 7/7
Fibreboard - Board Mill Antioch	316 (WDR (7/24/58)) 71/18 WDR (4/20/71) (rescinds 316) w/schedule	compliance by 1/1/73		

TABLE 4-2
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
duPont Antioch	71-13 WDR (4/20/71) w/schedule	comply by 3/1/73		
Rickmont Foods Antioch	172 WDR (4/24/58) 61-99 C&D (7/20/61)(solids) 64-166 C&D (10/27/64)(pH) 71-16 WDR (4/20/71)(rescinds 172) no toxic or biostim discharge after 6/76		new equip. installed early '72	
Tillie Lewis Foods Antioch	173 (4/24/58) WDR 71-15 (1/71) WDR(rescinds 171)	comply by 7/1/73 no toxic or biostim. after 6/76		
Merck & Co South San Francisco	685 Disch. Reg 7/16/65 69-31 Disch. Reg	Reduce Solids Load at Source 12/1/70 Complete wastewater study 8/31/70 Submit final rpt. 4 mos. after staff consultation on study		Typical stds for receiving wtr. & waste sewa & Ind waste

TABLE H-2
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS

INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
Merck (Cont.)	71-22 C&D 4/22/71	limit loads 5/1/71 get agreement w/SSF for outfall tie-in by 6/1/71 Complete in plant collection system 1' mos after approval of tie-in compliance w/69-31 within 1 month of tie-in	Files indicate compliance w/time schedule	
	71-64 Rescinds 685			685 not needed after sewage is disposed to city system. Ind was covered by 69-31

TABLE H-2
(CONTINUED)
STATUS OF TREATMENT
SF BAY DISCHARGERS

INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
P G & E San Francisco (Hunters Point)	218 WDR 8/16/72			Minimal stds for oil, toxicity in effluent & receiving wtr.
	541 WDR 2/20/64	Expands & extends monitoring program & std; to include cleaning process waste		Some minor oil spills noted over past few years
Allied Chem. Richmond	_____WDR 1/25/65	Typical zoning water stds (incl. ph 6.5-8.3) but no pH std for effluent	Neutralization facility installed 2/70	
	_____WDR 4/25/72	Adds effluent pH std to be complied w/ forthwith	Facility upgraded 5/72	Sulfuric Acid plant .04 mgd pH 1-3 waste State F & G sued in '69. Allied pleaded guilty. 4/13/72 EPA requests 1899 action. 8/72-Board to consider C & D for violations of effluent pH in 6/72

TABLE H-2
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS

INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
Stauffer Chem. Richmond				New WDR to conform to interim plan have been drafted, will require compliance by 7/73. EPA questioned CE permit application (didn't match actual operations) 8/1/72
Chevron Chem-Ortho Richmond	627 WDR (1/25/65) (6/13/67) 627 extended to cover new waste 'E' 70/43 (8/6/70) Not in file			Wastes: A, B & D - Toxic wastes from pesticide mfr. B is burned, A & D go to evap. ponds, C is fertilizer waste, released after settling pond treatment. E is from herbicide mfr. - evap. ponds. Concern is leakage from ponds & nutrient level of 'c'. Files indicate previous violations have been corrected.

TABLE H-2
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS
INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
SHELL OIL MARTINEZ	71-8 1/28/71 Prohib. of ocean discharge of refinery wastes	Compl. by 12/31/72	Compliance on schedule	Has active program to route storm wastes thru chem. treatment
ALLIED CHEM. NICHOLS	68-41 WDR (7/18/68) 69-30 Schedule (5/24/69) 70-20 WDR (3/26/70)	69-30: Compl. by 12/31/70 70-20: Changes WDR to conform to process changes	5/69 Pesticide mfr. discontinued	Ind. wastes incl. acids, pesticides residues 2/4/71 State F & G sues, wins (2 yr. probation, fine). F & G finds Allied in compliance by 4/71
	72-_____ C & D (8/10/72)	72-_____: submit sched. 8/15/72	Compliance with 70-20 achieved by 4/71	New WDR under consid to conform to Interim Plan 72-_____ violation. settleable matter
PHILLIPS PETROL. AVON	67-31 WDR (6/13/67) 71-9 C & D (2/25/71)	71-9 Compl. by 8/71 (toxicity)	7/72 In Compliance, on schedule	Refinery waste & sewa 2/6/69 Oil spill. F & sues. Number of compla in 69 from other spil fish kills, odor, explosions
	72-45 Rescinds 71-9 (7/25/72)			71-9 viol: toxicity coliform

TABLE H-2
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS

INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
Phillips Avon (Cont.)				7/72: New WDR to conform to Interim Plan considered. Phillips requests delay until EPA/API Study is out.
SHELL CHEM PITTSBURG	68-36 WDR (6/20/68)			2 mgd ind. waste diluted of 12 mgd bay water & sewage. Board considered C & D, but main plant was shutdown 8/31/70, reducing waste to .2 mgd treated in holding (monitored)
STAUFFER CHEM RICHMOND	68-68 WDR (12/18/68) 71-21 C & D (4/22/71) 71-24 72-46 Rescinds 71-21 (7/25/72)	71-24 - To cover new plant ops.	In compliance 7/72 (facilities compl. late '71)	71-21 viol: pH, toxicity
U.S. STEEL PITTSBURG	594 WDR (9/17/64) 70-88 WDR (11/4/70) amends, expands 594 70-97 C & D (11/24/70)		In substantial compliance by 8/72	20 mgd ind waste 70-97 viol: Discoloration, settleables, pH, lead 12/23/70 USS appeal to State WRCB 3/4/71 SWRCB upholds Req. 3 (State Res 71-9) 3/9/71 USS appeals SWRCB 3/18/71 SWRCB denies appeal (State Res 71-10)

TABLE H-2
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS

INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
U.S. Steel Pittsburg (Cont.)				4/2/71 USS appeals to court 8/3/71 Settled out of court $5000 fine, schedule of improvements
DOW CHEM PITTSBURG	_____ WDR (1/15/59) _____ revision (3/21/68) for new plant process 71-40 WDR (6/24/71) w/schedule	71-40 tighter, more extensive controls for specific discharges - compliance by 3/72 except for thermal waste (1976)	Dow on schedule w/ compliance schd., has been publicly commended by Board for efforts	14 ind. wastes, incl. H Cl, pesticide residues. 8/72 - New WDR to conform to interim plan under consideration.
PG & E PITTSBURG	542 WDR (2/20/64) 68-24 WDR (5/22/68) 70-51 WDR (5/25/70) 71-82 WDR (11/23/71) Rescinds 70-51	542- for cleaning waste only 68-31: For units 1-6. Thermal stds not defined 70-51 for unit 7. Thermal std- not to raise receiving water temp. more than 6° 71-62 applies to dredging during unit 7 constr.		Cooling water 724,000 gal./minute (units 1-6) Unit 7 volume. 51 mgd Objections by F & C, F&S, F&A to once-thru cooling unit 7 cause delay in CoE permit approval. (Reg. Bd. did not object) By 3/71 PG decides to switch to a semi closed system, partly to response to state wide therm policy adopted 1/7/71 which permitted max 4° rise. #7 t be in op by late '72

TABLE H-2
(CONTINUED)
STATUS OF ABATEMENT
SF BAY DISCHARGERS

INDUSTRY

DISCHARGER	RESOLUTIONS AND/OR ORDERS	MOST RECENT IMPLEMENTATION SCHEDULE (OR COMMENTS)	STATUS	COMMENTS
Union Oil Rodeo	68-27 WDR (4/30/68) 70-75-Compliance Sched. (9/24/70) 71-51 C & D (7/22/71) 71-62 Amendment to 68-27	(Compliance by 1/15/71 (70-75) Rpt. compl. dates by 1/1/72 (71-51) 71-62 coliform std. restated.	2/72 Union claims compliance on DO, coliform will meet toxicity by 8/73.	Refinery wastes 40 mgd 71-51 violations DO, toxicity, coliform 8/72 new WDR being drafted to conform to interim plan: Compliance by '76.
Sequoia Refining	776 WDR (6/18/65) 69-39 Addition to 776: bacterial stds. 71-10 C & D (2/25/71)		71-10: in substantial compliance since 3/71	Sewage & Ind. Wastes 0.1 mgd 71-10: viol. of phen Ph, threatened viol of grease, toxicity, ammon. hydrox. 8/72 - Board to consider lifting C & D

TABLE H-3
STATUS OF TREATMENT S F. BAY DISCHARGER
FEDERAL INSTALLATIONS

DISCHARGER	RESOLUTIONS AND/OR ORDERS	IMPLEMENTATION SCHEDULES (or comments)	STATUS	WQC PLAN	COMMENTS
U.S.N. Yerba Buena Island	Res=69-47 (25 Sept. 69) Exec. Order 11507 WQCP for Tidal Waters Inland from Golden Gate		P-750 went to bid March 1972. No completion date set		Connect to U.S.N. Treasure Island secondary treatment plant (Project P-750) Abandon existing primary treatment plant and eliminate it as a discharger
U.S.N. Treasure Island	Res=69-47 (25 Sept. 69) Exec. Order 11507 WQCP for Tidal Waters Inland from Golden Gate		P-750 went to bid March 1972. No completion date set		Secondary treatment with effluent chlorination at present
U.S.N. Radio Station Skaggs Island	Letter from S.F. Bay WQCB (9June 70)		Project (P-038)-Going to Bid March 1972-No completion date		(P-038) Spray irrigation for main treatment plant effluent. Effluents from aeration tank and one septic tank to two new evaporation ponds
U.S.N. Mare Island	Res=70-105 (Dec.22,1970) S.F. Bay WQCB Exec. Order 11507 WQCP for Tidal Waters Inland from Golden Gate	Vallejo connection start:-Summer 1973 finish:fall 1975	Separate sanitation & storm sewer systems-open for bid 8 March 1972		Connect to Vallejo Sanition & Flood Control District Change over to separate sanitary & storm sewers
U.S. Naval Fuel Annex, Pt. Molate	Notification Jun.6,1970 Res=70-46 May 28, 1972 Exec. Order 11507 WQCP for Tidal Waters Inland from Golden Gate		Package Treatment Plant out to bid April 25, 1972		Presently: primary treatment by Imhoff Tank & discharged to S.F. Bay through an outfall

TABLE H-3 (Continued)
STATUS OF ABATEMENT S.F. BAY DISCHARGER
FEDERAL INSTALLATIONS

DISCHARGER	RESOLUTIONS AND/OR ORDERS	IMPLEMENTATION SCHEDULES (or comments)	STATUS	WQ PLAN	COMMENTS
U.S. Naval Weapons Station, Concord	None-except those for Contra Costa S.D. No. 7B	Fall 1972-Begin construction Summer 1973-Complete connection to Central Contra Costa S.D.	28Sept.68-Connection & treatment negotiated with C.C.C.C.S.D. FY'71 Connection furded		Connect to Central Contra Costa County S.D. for sewage treatment. P-011
Hamilton Air Force Base	Res#69-24 (May 28, 1969)			1973-74 Sub-regional treatment & possible reclamation - combined plan with S.D. No.6 of Marin County, etc.	Presently: Industrial wastes pretreated & then mixed with sanitary sewage. Mixture receives secondary treatment & is discharged to San Pablo Bay
Travis Air Force Base	Res#95 (april 16, 1952) domestic waste Res#147 (March 18,1954) industrial waste Tentative resolution in 1968 not yet adopted			1975-76 Reclamation for groundwater recharge and irrigation	Present all wastes given primary treatment followed by aerated lagoons, settling ponds & chlorination. Discharge to Union Creek

APPENDIX I

APPENDIX I

METHODS OF CHEMICAL ANALYSIS

Methods used by NFIC-Denver in general followed established EPA procedures.[1] These methods are described below showing the exact procedures used where the established procedures were inadequate or nonexistent.

1. Hexane Extractables (Oil and Grease)

Sediment samples were analyzed using Soxhlet extraction. Samples were dried at 105°C overnight and percent moisture calculated. Approximately 30 grams of the ground sample were extracted with n-hexane for four hours. The extract was then evaporated to constant weight. Results were calculated on the dry weight basis.

2. Metals (except mercury)

a. Water Samples. All metals analyses except mercury were determined using a double beam atomic absorption spectrophotometer with a high solids burner head. Optimization procedures were according to manufacturer's recommendations. Matrix effects were compensated for in the standards and blanks by using substitute ocean water[1] as diluent. One hundred milliliter aliquotes were treated with 5 ml HCl and digested for 15 minutes. Samples were then cooled to room temperature and analyzed by direct aspiration.

b. Shellfish. Approximately 5 grams of the ground shellfish flesh were weighed and digested using concentrated nitric acid. Aqua regia was then added and further digestion carried out to near dryness.

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[1] Methods for Chemical Analysis of Water and Wastes, EPA, National Research Center, AQC Laboratory, Cincinnati, Ohio, 1971.

The samples were then brought to 100 ml using distilled water and analyzed by direct aspiration in an atomic absorption spectrophotometer. Results were calculated on a wet weight (drained meats) basis.

c. Sediments. Moisture contents were determined on approximately 20 grams of wet sample and 5 gram aliquotes of the wet sample were prepared and analyzed as for shellfish. Results were calculated on the dry weight basis.

3. Mercury

Mercury in water, sediment and shellfish tissue was analyzed by the cold vapor technique of absorption of radiation at 253.7 nm by mercury vapor. Water and tissue samples were prepared by digestion with sulfuric and nitric acids at 58°C followed by overnight oxidation with potassium permanganate. Sediments required digestion in aqua regia before oxidation. All samples were subjected to a final oxidation with potassium persulfate before analysis.

4. Chlorinated Pesticides, Polychlorinated Biphenyls, and Petroleum Products

a. Extraction. Aqueous suspensions of plankton were extracted by direct liquid-liquid extraction using a 75 ml portion of hexane followed by a 25 ml portion of hexane.

Two hundred gram samples of air dried sediments were extracted in a blender with 200 ml hexane at high speed for 2 minutes. The centrifuged supernate was then decanted and concentrated to 5 to 10 ml.

Twenty to 40 gram samples of drained shellfish tissue were weighed, frozen, chopped and then extracted in a blender with 200 ml hexane. The centrifuged supernate was then decanted and concentrated to 5 to 10 ml.

b. Acetonitrile Partition. Hexane extracts were diluted to 25 ml

and partitioned with four 25-ml portions of hexane-saturated acetonitrile. The acetonitrile fractions were then concentrated to near dryness and taken up to 10 ml with hexane.

c. Alumina Column Cleanup.[2/] Ten ml hexane extracts from the acetonitrile partition were passed through an alumina column (5% H_2O). The column was eluted with 10 percent ethyl ether in hexane. Ten 50-ml fractions are collected and concentrated to 1 to 10 ml.

d. Flame Ionization Gas Chromatography. The hexane layer from the acetonitrile partitioning were concentrated to 1 to 10 ml and added to the top of a 5 percent deactivated alumina column. The column was eluted with hexane. The first 30 ml was collected. Aliphatic hydrocarbons were determined by gas chromatographic response and by weighing the evaporated residue. Petroleum hydrocarbons produce characteristic gas chromatograms that contain a homologous series of n-alkanes, and a broad evelope of branched and cyclic hydrocarbons.

e. Electron-Capture Gas Chromatography. The alumina column fractions were run on the electron capture gas chromatograph and individual or pairs of pesticides and PCB's identified by comparing retention times with those of standards run concurrently. Quantitative estimates are made by peak height comparisons. The order of elution of pesticides from the alumina column gives confirmation of the tentative GC identification as well as do p-value determinations.[3/]

[2/] "Infrared Identification of Chlorinated Insecticides in the Tissues of Poisoned Fish," H. W. Boyle, R. H. Burttschell, and A. A. Rosen. "Organic Pesticides in the Environment," Advances in Chemistry Series, No. 60, 207-218, 1966.

[3/] "Extraction p-Values of Pesticides and Related Compounds in Six Binary Solvent Systems," M. C. Bowman and M. Beroza. J.A.O.A.C., Volume 48, No. 5, 1965.

APPENDIX J

APPENDIX J

ALERT LEVELS OF TRACE METALS IN SHELLFISH

1968 National Shellfish Sanitation Workshop Proposed Alert Levels in Shellfish*

Metal	Alert Level (ppm drained meats)
Zinc	1,500
Copper	100
Cadmium, lead, mercury, and chromium (combined)	2

*Species not specified.

1971 National Shellfish Sanitation Workshop Proposed Alert Levels in Shellfish

Metal	Species	Alert Level (mg/kg drained meats)
Cadmium	Oyster Northeast	3.5
	Oyster Southern	1.5
	Soft Clams	0.5
Lead	Oyster Northern and Southern	2.0
	Soft Clam Northern and Southern	5.0
Chromium	Oyster Northern and Southern	2.0
	Soft Clam Northern and Southern	5.0
Mercury	Oyster Northern and Southern	0.2
	Soft Clam Northern and Southern	0.2
Copper	Oyster Northeast	175
	Oyster Southern	42
	Soft Clams Northern and Southern	25
Zinc	Oyster Northeast	2,000
	Oyster Southern	1,000
	Soft Clams Northern and Southern	30