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MISCELLANEOUS FIELD STUDIES
MAP MF- 332

MUNICIPAL AND INDUSTRIAL WASTEWATER LOADING IN THE SAN FRANCISCO BAY ,CALIFORNIA,1970

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INTRODUCTION

The purpose of this release is to describe the approximate volumes and significant pollutional loading attributable to municipal and industrial wastewater discharged into San Francisco Bay. The six receiving-water regions (fig. 1) are the same as those used previously by Pearson, Storrs, and Selleck (1969) in describing results of the comprehensive wastewater-monitoring program conducted by the University of California, Berkeley, during the period 1960-64.

WASTEWATER LOADING

Municipal and industrial wastewater loading within each of the receiving-water regions is shown in figure 2. Municipal wastewater loading was calculated from 1970 sewage-treatment plant operational data supplied by the California Regional Water Quality Control Board, San Francisco Bay Region and direct contacts with the various private and municipal sewerage agencies. Industrial wastewater loading was taken from the report by Pearson, Storrs, and Selleck (1969). Although these data are several years old, a recent unpublished summary of major bay area wastewater dischargers compiled by the Regional Water Quality Control Board indicates that present regional industrial wastewater loading is not significantly different from that monitored during 1960-64. The wastewater parameters and constituents shown in figure 2 were chosen because of their significance to water quality in the bay.

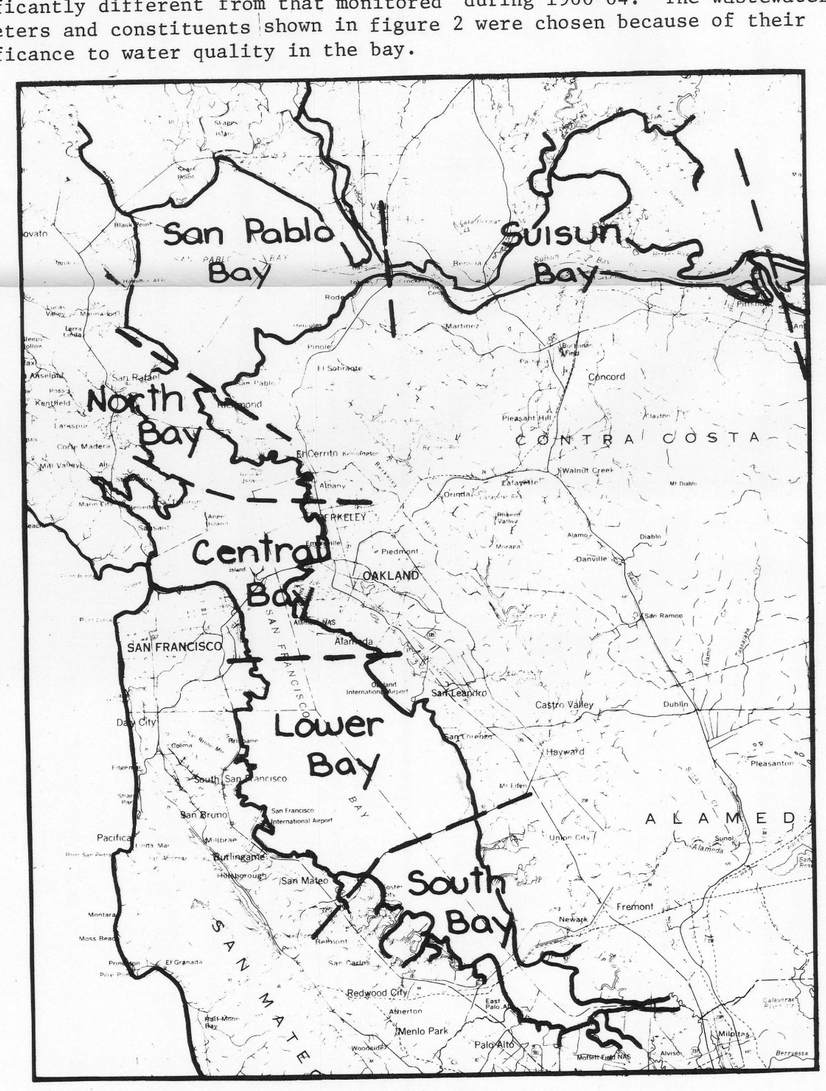

Figure 1.--Receiving-water regions.

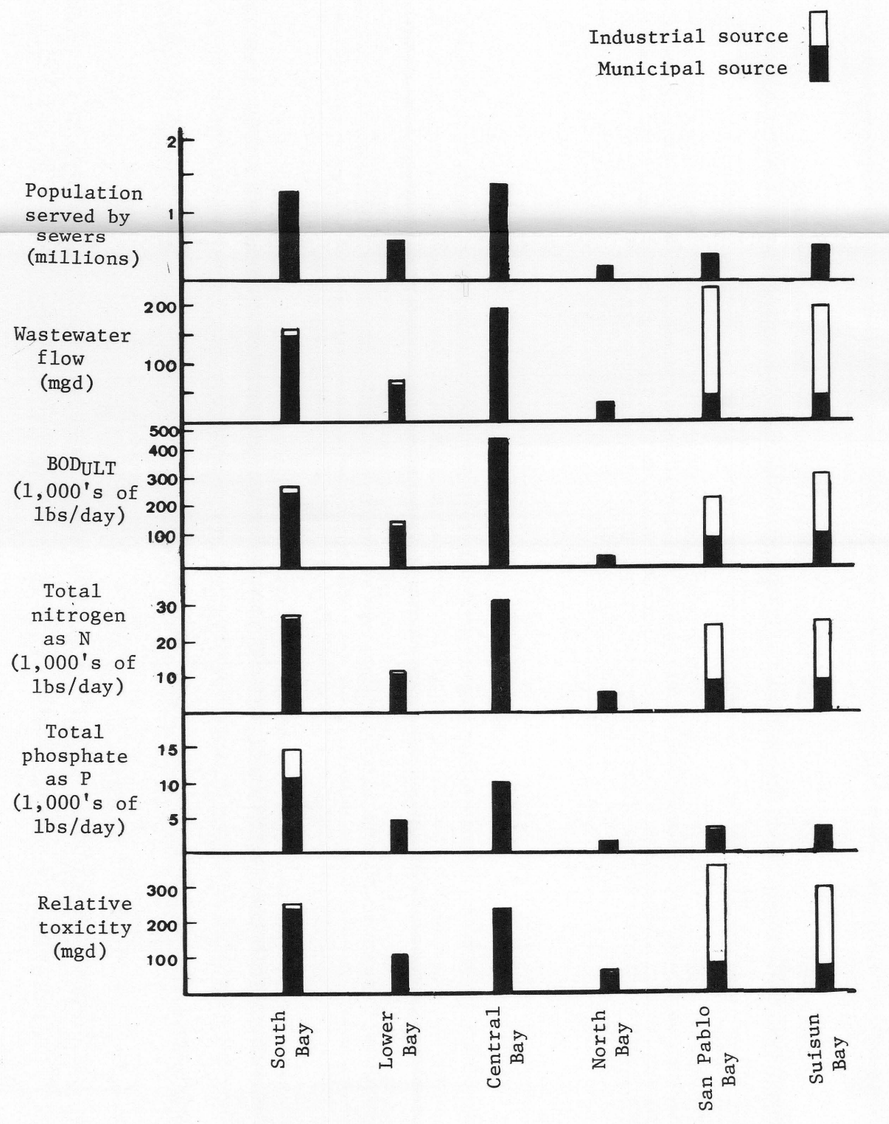

Figure 2.--Municipal and industrial wastewater flows and pollutional loading, San Francisco Bay, 1970.

EXPLANATION OF POLLUTIONAL CHARACTERISTICS

Biochemical Oxygen Demand (BOD): The quantity of oxygen used in the biochemical oxidation of organic matter under standard laboratory conditions. The standard test gives an indication of the carbonaceous, organic strength of a wastewater.

Wastewater with high BOD can cause dissolved oxygen depletion in receiving water near outfalls. Low dissolved oxygen levels can be lethal to aquatic organisms and cause obnoxious odors and other nuisance conditions.

Because many municipal and industrial wastewater discharges to the bay remain in the system much longer than 5 days, the available BOD data were modified to compute the loadings shown in figure 2 (the normal BOD test measures biochemical oxygen demand only over a 5-day period). The modified parameter known as ultimate biochemical oxygen demand (BOD_{ULT}) accounts for the total carbonaceous demand of the wastewater (usually considered complete after about 20 days) and the additional oxygen demand resulting from the oxidation of organic and ammonia nitrogen to nitrate nitrogen form (fig. 3).

The BOD of municipal wastewater is to a large extent dependent upon the level of treatment (table 1). The BOD of industrial wastewater is highly variable and can be determined only by monitoring the individual effluent.

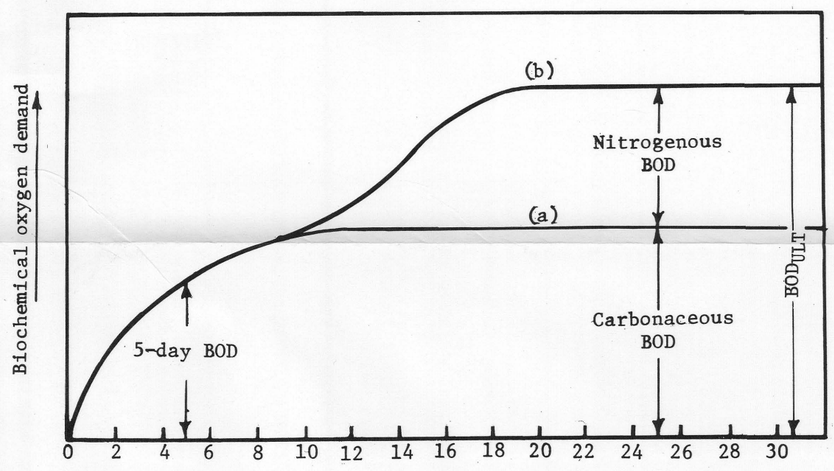

Figure 3.--BOD curve, depicting (a) normal carbonaceous oxygen demand, and (b) combined carbonaceous and nitrogenous oxygen demand.

Nitrogen and Phosphorus: Two of the many nutrients essential for the growth of aquatic plants in the bay and other receiving water. The large quantities of nitrogen and phosphorus discharged in municipal and industrial wastewater are commonly cited as major contributing agents for nuisance algal blooms which occur periodically in parts of the bay and in many tidal sloughs. Agricultural wastewater entering the bay from the delta region is also a major source of nitrogen and phosphorus.

Nitrogen and phosphorus loads discharged in municipal wastewater can generally be approximated if waste treatment levels are known (table 1). Loads discharged in industrial effluents vary widely and in most cases can be quantified only by direct measurement.

Table 1.--Per capita municipal wastewater loading coefficients for various levels of treatment

Type of wastewater treatment[1]	BOD_{ULT} (lb/cap/day)	Total nitrogen as N (lb/cap/day)	Total phosphate as P (lb/cap/day)
Primary	0.25	0.025	0.008
Secondary			
Trickling filter	.11	.016	.008
Activated sludge	.13	.020	.006
Combination	.07	.010	.005
Tertiary	.03	.005	.001
Intermediate (physical-chemical)	.07	.010	.003
Oxidation ponds (slow rate)	.06	.008	.003

[1]Total loads can be estimated from the table by multiplying the coefficients by the population served by a given treatment facility. Waste-loading coefficients were synthesized from data contained in reports by Kaiser Engineers (1969) and Pearson, Storrs, and Selleck (1969).

Toxicity: Almost all municipal and industrial wastewater is in some degree toxic to aquatic life. The recommended test for toxicity is a standard laboratory bioassay procedure (American Public Health Association and others, 1971, p. 562). In this test, various dilutions of the wastewater are made and several organisms of the same species are placed in each of the resulting solutions. Usually test organisms are fish native to the receiving water. The degree of waste toxicity is determined by noting the strength of the wastewater solution in which one-half of the test organisms are able to survive for a given time period, usually 48 to 96 hours. This measurement of wastewater toxicity is commonly termed "median tolerance limit" (TL_m) and is expressed as a percentage. Thus, a small percentage, or low TL_m value, indicates a highly toxic wastewater. In the San Francisco Bay area, industrial wastewater containing substances such as phenols or heavy metals commonly has a TL_m in the 3 to 50-percent range, whereas municipal wastewater has toxicity values in the 57 to 95-percent range (Pearson, Storrs, and Selleck, 1969).

Relative toxicity is a term used to express the relation of volume of discharged wastewater to its toxicity. For example, a mildly toxic effluent discharged in large quantities may have the same relative toxicity as a highly toxic effluent discharged in lesser quantities. Relative toxicity is computed by dividing the average wastewater flow by the TL_m.

REFERENCES

American Public Health Association and others, 1971, Standard methods for the examination of water and wastewater (13th ed.): New York, Am. Public Health Assoc., Inc., 874 p.

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