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Monterey, California
November 13-15, 1986

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MUNICIPAL WASTEWATER AND RUNOFF INPUTS TO THE SOUTHERN CALIFORNIA BIGHT

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INTRODUCTION

The Southern California Bight is defined as an open embayment extending for 570 kilometers from Point Conception to Cabo Colnett, Baja California (figure 1). It is bordered by the west coast of Southern California and the eastern edge of the California current. The nearshore waters are protected from northern storms and offshore currents by a southeast break in the continental coastline and eight offshore islands (1). The two largest sources of anthropogenic inputs to these coastal waters are municipal wastewater outfalls and surface runoff. Each year approximately 1.7×10^9 cubic meters (1200 million gallons per day) of treated municipal effluent (6) and 0.6×10^9 cubic meters (500,000 acre feet per year) of runoff (1) enter the United States portion of bight.

Past studies have shown that municipal wastewater emissions greatly exceeded most estimates runoff contaminant emissions due to greater flows and higher contaminant concentrations (1,2,3,4,5,9). Extensive monitoring of the combined municipal discharges during the past fifteen years have shown that significant reductions in most outfall contaminants have occurred despite an increasing human population and increasing effluent flow (6). Runoff has been studied much less because of the scattered inputs and the lack of an agency identified as responsible for monitoring water quality. The lack of comprehensive long term monitoring and the much greater seasonal and annual variability (outfall flows vary by about 10 percent annually while runoff can vary by more than a factor of ten) make estimates of emissions and trends difficult.

Municipal effluents have been improved by source control and improved treatment while little has been done to treat or reduce the volume of contaminated runoff although much of the runoff from undeveloped areas is captured for later use. Since the population continues to increase and development continues to increase the amount of impervious surface area, we can expect increases in the volume and concentrations of contaminated runoff.

The high intensity storms and the highly developed land in much of Southern California produce significant inputs of contaminants. Eganhouse has estimated that the Los Angeles River contributes 1 percent of the world input of petroleum hydrocarbon from runoff (4). Contaminants of particular concern from runoff are polynuclear aromatic hydrocarbons, other petroleum compounds, lead, zinc, and suspended solids.

Runoff contaminants are influenced by several factors including; rainfall, land use (10), legal and illegal dumping (11).

Major variations in year to year flow are not unusual (1968 runoff was 31 percent of normal while 1969 was 680 percent of normal) and flow may control the amount of contaminants that are discharged more than any other factor. Suspended solids are mainly transported during high flows so that during low flow years the total emissions of solids are disproportionately less than in high flow years.

The five counties bordering the bight are all included in the 150 most populated counties in the United States and three of the five are in the top ten (Los Angeles the number one and Orange and San Diego numbers six and seven) (7). These five counties experienced a thirty three percent increase in population between 1970 and 1980 and had a combined population in excess of thirteen million in 1985 with eight million registered motor vehicles (7). Therefore, even minor individual sources can result in large regional emissions.

METHODS

Municipal wastewater discharges are monitored in accordance with their National Pollution Discharge Elimination System (NPDES) Permit requirements that are established by the Regional Water

Quality Control Boards (RWCQB). The contaminants measured and the frequency of measurements depends on the volume and sources of wastewater for each plant so that monitoring programs are not identical. The Southern California Coastal Water Research Project (SCCWRP) has been collecting this monitoring data from its sponsoring agencies plants and the RWQCB's for over fifteen years and summarizing the mass emissions inputs for the bight. Although the data is for only eight outfalls it represents over ninety percent of the total outfall inputs to Southern California marine waters.

The combined flow and mass emissions between 1971 and 1985 for the following outfalls have been summarized: San Diego City's Pint Loma outfall, Encina Water Pollution Control Facility at Carlsbad, Southeast Regional Reclamation Agency at Dana Point, County Sanitation Districts of Orange County at Huntington Beach, County Sanitation Districts of Los Angeles at Whites Point, City of Los Angeles in Santa Monica Bay, and the City of Oxnard at Oxnard.

SCCWRP has conducted three studies of runoff. In 1971/72 representative channels were samples from all the drainages in Southern California (1). In 1978/79 a smaller study focused on the Los Angeles River which represents about thirty percent of the total gaged runoff to marine waters from Southern California. In 1985/86 the Los Angeles river was sampled again as a preliminary exercise to a two year study of the runoff from Ventura through San Diego. All of the samples were collected by lowering a one gallon sampling bottle in a weighed sampler from an overpass and collecting water through the water column. Approximately ten samples were taken at each site during a storm; representing beginning flow, peak flow and tailing flow. Each sample was analyzed separately and the volume of flow between samples and the total volume was provided by the Flood Control Districts.

The mass emissions for each storm were calculated by multiplying the average concentration by the average flow for each sampling interval and then summing the emissions for all the sampling intervals.

RESULTS

Municipal Outfalls

Several important trends can be seen in the annual emissions from the major southern California outfalls.

Despite increased reclamation of treated effluent for ground water and stream augmentation, the flow has increased by twenty eight percent during the last fifteen years (Figure 2a).

Suspended solids and the contaminants associated with them such as metals and oil and grease have been reduced by 20 to 60 percent (Figures 2c-f). PCB's and DDT which have been banned from use have been reduced by 90 to 99 percent (Figure 2d). Constituents that are more soluble such as biochemical oxygen demand and ammonia nitrogen have not shown much change (Figure 2b and 2c).

Runoff

A current estimate of runoff input from all of Southern California and comparison with the total emissions from outfall will require the completion of our comprehensive survey now in progress, however, comparisons between an outfall and a storm channel with similar flows can be made. The Los Angeles River is typically responsible for thirty percent of the total southern California gaged runoff to marine waters and the County Sanitation Districts of Orange County contributes about twenty percent of the total municipal effluent to southern California marine waters.

The estimated mass emissions from three surveys of the Los Angeles River and the 1985 mass emissions from the County Sanitation Districts of Orange County are shown in Table 1. Detailed comparisons of the Los Angeles River emissions are difficult because the estimates are based on a total of only seven storms and there is a ten fold difference in flows. Some observations however can be made.

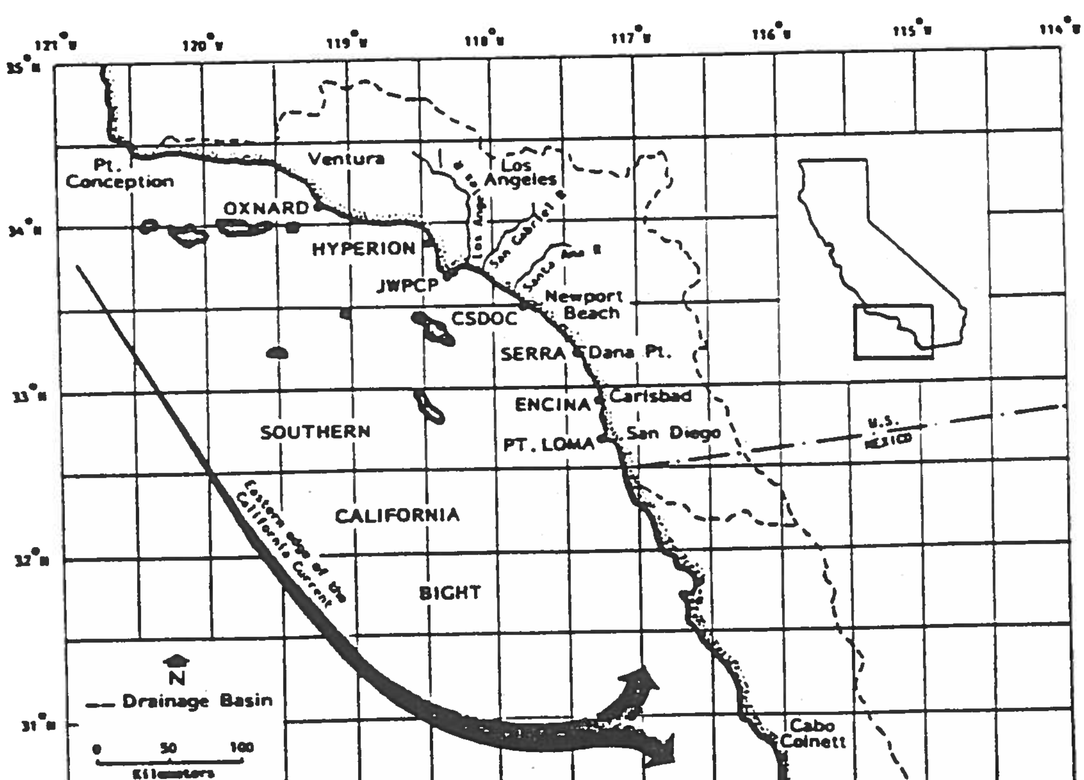
The largest emissions of all measured contaminants in the Los Angeles River (except DDT) occurred in the year when the flow was the highest. This is probably due to the much larger amount of suspended solids that were emitted since most contaminants are associated with particulates. DDT has continuously decreased with time despite increases in flow. Although there was a five fold increase in flow between 1971-72 and 1985-86 lead, DDT and PCB's decreased by factors of two, thirty one and twenty.

In 1985-86 Los Angeles River flow was close to its long term average flow and comparable to the County Sanitations Districts of Orange County (CSDOC). The CSDOC outfall only discharged about ten

TABLE 1. Estimates of runoff emissions for the Los Angeles River and the County Sanitation Districts of Orange County in metric tons per year[a].

	Los Angeles River			CSDOC Outfall
	1971/72	1979/80	1985/86	1985[b]
Flow[a]	68	673	290	320
Suspended solids	14,000	1,350,000	116,000	14,500
Oil and Grease	1,290		2,900	4,400
Silver	0.15	0.54	0.08	3.0
Cadmium	0.0	2.7	0.3	2.8
Chromium	6	67	11	11
Copper	9	58	15	32
Nickel	5	41	5	32
Lead	64	108	32	12
Zinc	68	646	81	52
DDT[a]	630	220	20	11
PCB's[a]	180	210	9	11

[a]flow in millions of cubic meters, DDT and PCB's in kilograms per year.
[b]CSDOC provides 35 percent primary and 65 secondary treatment.



The SCCWRP Study Area

FIG. 1

percent of the solids as the river but exceeded the river emissions of oil and grease, silver, cadmium, copper, nickel and PCB's. The river exceeded the outfall's lead emission by a factor of two and one half.

DISCUSSION

Municipal outfall discharges are the largest source of terrestrial fresh water and most anthropogenic contaminants to Southern California coastal waters (1,2,3,8,9). There are approximately fifty-two wastewater treatment facilities in Southern California with fifteen outfalls discharging directly into marine waters (8).

Improvements in effluent quality in the 1970's were due to improved sludge dewatering and source control as the amount of secondary treatment remained about ten percent of the combined discharge. During the 1980's when the amount of secondary treatment approached forty percent reductions were due to improvements in all three areas.

Significant additional decreases in suspended solids and contaminants should occur next year when the City of Los Angeles burns its sludge instead of discharging it and when additional planned secondary treatment is built.

The combined impacts of historic and present outfall discharges have been documented in monitoring programs focused on marine resources. Future emphasis should be placed on analyzing compounds which ~~that are~~ have been detected but not identified ~~unidentifiable~~ and on the discharge and survival of pathogens.

SUMMARY

Much monitoring of municipal outfall discharges has occurred in the last fifteen years and most contaminants of concern have shown consistent decreasing trends in mass emissions.

On the average, runoff accounts for twenty five percent of the total fresh water input to Southern California waters. Little of the coastal basins are not subject to agricultural and urban development. As development continues the quality of the runoff will decrease and the impacts on receiving waters will increase. It is important to improve the estimates of runoff emissions and to determine the extent of its impact on the marine environment.

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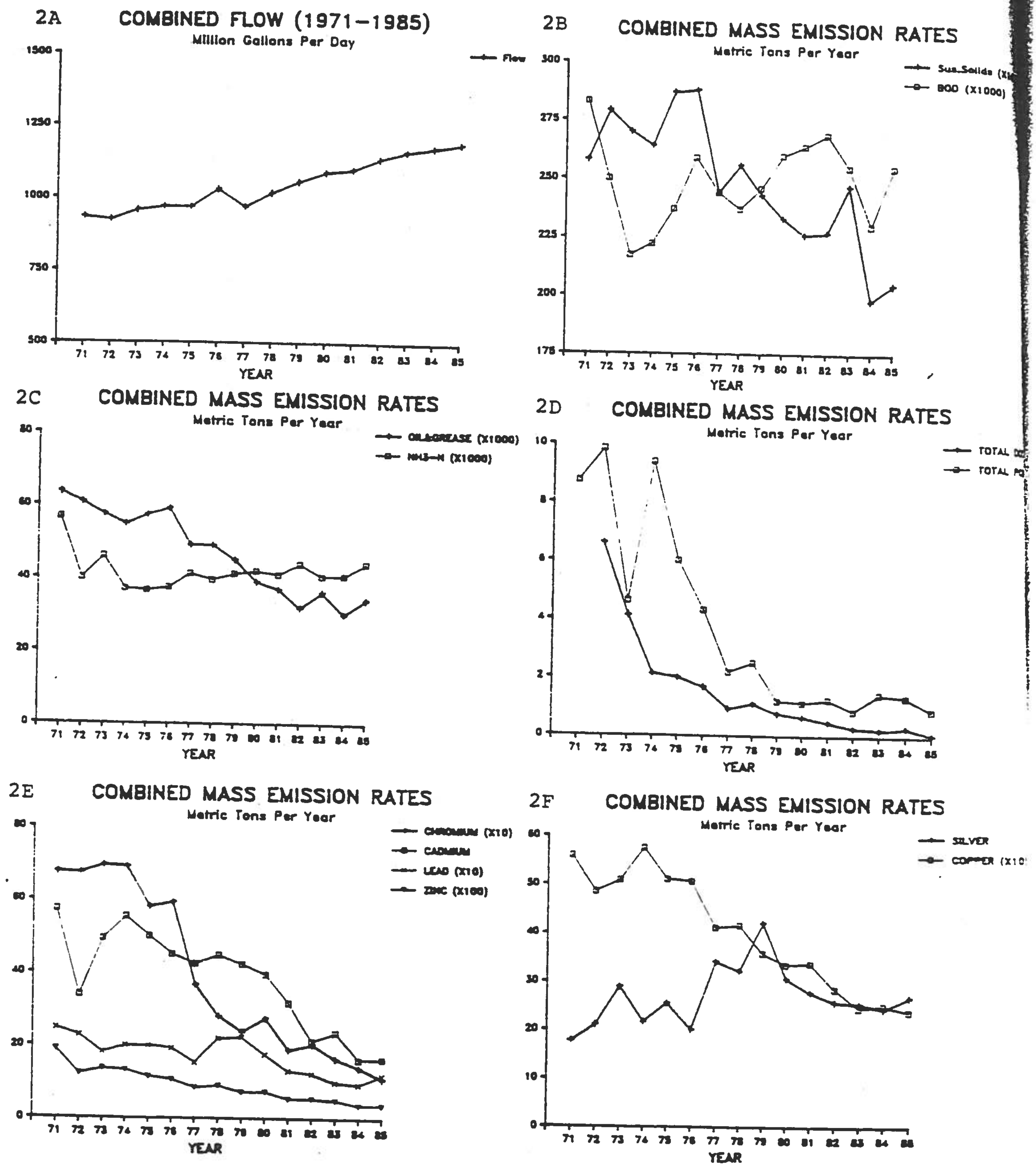

Figure 2A-F. Combined mass emissions from eight southern California outfalls from 1971 through 1985 in METRIC TONS.