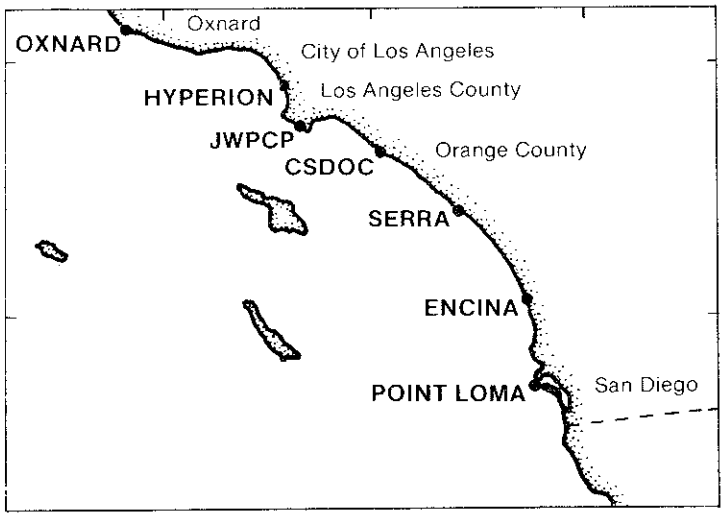

Outfall	Sponsor	Distance of Discharge Offshore (m)	Average Discharge Depth (m)
OXNARD	City of Oxnard	1,860	15
HYPERION	Los Angeles City Bureau of Sanitation	11,200 (7-mile) 8,300 (5-mile)	95 57
JWPCP	Los Angeles County Sanitation Districts	2,400 (90-in.) 3,660 (120-in.)	60 60
CSDOC	Orange County Sanitation Districts	7,250	60
SERRA	South East Regional Reclamation Authority	3,300	31
ENCINA	Encina Water Pollution Control Facility	2,400	45
POINT LOMA	City of San Diego	4,000	60

Figure 1. Locations of the seven dischargers summarized in this report.

Characteristics of Municipal Wastewaters in 1986 and 1987

Since 1971, wastewater treatment plants that discharge in the coastal waters of southern California have monitored general constituents (e.g., suspended solids, oil and grease, biological oxygen demand, and nutrients), trace metals, and some chlorinated hydrocarbons (DDT [includes six isomers] and polychlorinated biphenyls [PCBs; includes Aroclors 1242 and 1254]). This report summarizes the results of the monitoring data from the seven SCCWRP sponsors (Figure 1) for 1986 and 1987 and compares the results with those of past discharges.

Flow from these seven plants (Table 1) constitutes over 90% of the municipal discharges to the Southern California Bight. For the past 17 years, the combined contaminant emissions from these treatment plants have largely decreased despite steady annual increases in total flow (Table 2). Since 1971 the flow has increased by 32% (Figure 2), while suspended solids and biological oxygen demand (BOD) have been reduced by 48% (Figure 3).

The concentrations of effluent constituents and mass emissions for each of the seven plants for 1986 and 1987 are listed in Tables 3 and 4. Changes in trace contaminant concentrations from 1985, when we last summarized data, have shown some of the greatest decreases since monitoring began (Table 2). The combined flow increased by 27 million gallons per day (MGD; 37 x 10^9 L/yr) while suspended solids, BOD, and oil and grease emissions were reduced by 25, 40, and 38%, respectively. During the same period the emissions of trace metals were reduced by 20 to 50% (Figures 4a and 4b). The output of DDT remained about the same at 50 kg/yr, while PCBs

Table 1. Treatment and flows (in MGD) for seven outfalls for 1987. (Total flow was [1231 MGD]).

Plant	Advanced Primary	Secondary	Dilute Sludge
Hyperion	273	100	3
JWPCP	170	197	
CSDOC	112	140	
Point Loma	183		
Oxnard		18	
Encina	10[a]	10	
SERRA		15	
Total	**748**	**480**	**3**

[a] Primary (not advanced primary).

were reduced by about 60% to 250 kg/yr (Figure 5).

Silver emissions in the last two years are similar to other metals' emission and show about a 50% reduction between 1985 and 1987. However, the long-term trend is unlike any other contaminant. Silver emission doubled between the early 1970s and 1979, whereas most metals exhibited decreases for that same period. Although the cause of this increase was never determined, increased photographic and other industrial processes have been suggested as likely causes. Silver discharges dropped 25% between 1979 and 1980 but decreased only about 10% over the next five years (1980-1985).

Although the recent reductions have been large, the present levels are about equal to the early 1970 values. Silver will

Table 2. Combined mass emissions for 1971-1987 from seven municipal outfalls in metric tons per year except as noted.

Constituent	1971	1972	1973	1974	1975	1976	1977	1978
Flow								
L (10^9/yr)	1286	1274	1319	1336	1361	1419	1335	1402
MGD	931	922	955	967	985	1027	966	1015
Tot. Susp. Solids	288000	279000	270000	264000	287000	288000	244000	256000
BOD[c]	283000	250000	217000	222000	237000	259000	244000	237000
Oil & Grease	63500	60600	57400	54700	57400	59100	49000	49000
NH3-N	56600	39900	45900	37000	36600	37400	41200	39500
Ag	18	21	29	22	26	20	34	32
As				21	12	11	14	15
Cd	57	34	49	55	50	45	42	45
Cr	676	673	695	690	580	593	366	280
Cu	559	485	509	575	511	507	412	417
Hg				3	2	3	3	2
Ni	339	273	318	314	124	307	264	320
Pb	243	226	180	199	196	191	152	219
Se[d]				18	17	22	23	23
Zn	1880	1210	1360	1320	1142	1064	837	905
Tot. DDT[e] (kg/yr)	21700	6600	4120	2120	1990	1670	920	1110
Tot. PCB[e] (kg/yr)	8730	9830	4620	9390	6010	4310	2180	2510

[a] SERRA and Encina data first included.
[b] Discharge from Hyperion 7-mile outfall was terminated in November 1987.
[c] Hyperion 7-mile outfall data excluded.
[d] Data include only JWPCP, Hyperion 5- and 7-mile outfalls, and Point Loma.
[e] Values for 1971-75 are from SCCWRP's final report to the U.S. Enivironmental Protection Agency for Grant Nos. 801153 and R803707.

remain an important contaminant for municipal wastewater monitoring because effluents are responsible for more than 90% of anthropogenic inputs, and elevated levels in transplanted and natural mussels have shown that it is one of the best indicators of the presence of municipal outfalls.

Whereas the combined discharge to the bight has generally shown a steady increase in flow and decreases in contaminant emissions, individual outfall emissions have exhibited much greater annual variations. Examples of local fluctuations in emissions are the Hyperion 5- and 7-mile discharges.

Discharges from the Hyperion Treatment Plant to Santa Monica Bay over the last six years have shown some of the greatest increases and decreases in emissions since monitoring has been conducted. Between 1981 and 1983, the 5-mile discharge volumes increased by over 40 MGD (55 x 10^9 L/yr) and suspended solids mass emissions more than doubled between 1982 and 1985 (39,000 to 87,000 metric tons/yr). Most of the trace contaminants showed little increase in concentrations or mass emissions during this time.

Expansion and rehabilitation of facilities upstream and at the Hyperion plant since 1985 have

1979	1980	1981	1982[a]	1983	1984	1985	1986	1987[b]
1456	1516	1516	1567	1611	1622	1644	1691	1702
1054	1097	1097	1134	1166	1174	1190	1224	1231
243000	233000	226000	227000	247000	198000	205000	187000	162000
246000	260000	264000	269000	256000	230000	255000	184000	169000
45000	39000	37000	31900	36300	30200	34300	29300	26600
41200	42000	41000	44000	40600	40800	44200	43900	45600
42	31	28	26	26	25	27	22	15
15	11	12	9	10	18	16	12	12
42	40	33	21	24	16	17	15	10
237	275	187	203	164	140	110	88	60
359	336	339	286	247	252	240	205	135
3	2	2	1	1	1	1	1	<1
256	224	167	169	165	134	120	129	78
223	175	130	123	99	94	120	106	64
8	11	15	9	10	9	13	8	7
724	730	540	549	505	374	377	345	276
760	640	470	290	220	310	58	50	53
1190	1130	1250	860	1440	1340	820	480	250

Table 3. Average annual concentrations for 1986 and 1987 in milligrams per liter except as noted.[a]

Constituent	JWPCP		HYP5		HYP7[b]		CSDOC	
	1986	1987	1986	1987	1986	1987	1986	1987
Flow								
L (10^9/yr)	503	506	542	518	5.4	4.7	329	348
MGD	364	366	392	375	3.9	3.4	238	252
Susp. Solids	82	73	77	58	13000[c]	12600[c]	49	47
Settl. Solids (ml/L)	0.4	0.3	1.1	0.8			0.8	0.4
BOD	100	108	148	116			76	76
Oil & Grease	10.2	11.1	21.3	15.2	687	694	10.1	12.8
NH3-N	40	37.9	16	16.2	377	486	25	25
Organic-N	8	7.4	7.54	6.4	511	554		
Total P	8.1	7.5	5.42	4.4	241	275		
MBAS	2.8	3.3	4.42	4.25			?	
Cyanide	0.02	0.02	0.017	0.027	0.07	0.078	0.001	<0.02
Phenol	1.6	2	0.038	0.041	0.15	0.098		
Turbidity (NTU)	58	52	50	43			27	26
Toxicity (TU)	1.03	1.14	1.03	1.1	17.8	28.3	0.26	0.45
Ag	0.008	0.008	0.017	0.010	0.43	0.231	0.012	0.01
As	0.007	0.007	0.009	0.008	0.29	0.352	0.004	0.004
Cd	0.004	0.002	0.009	0.006	0.72	0.659	0.004	0.004
Cr	0.058	0.052	0.036	0.014	4.65	3.6	0.027	0.021
Cu	0.052	0.042	0.12	0.057	13.2	9.35	0.083	0.075
Hg	0.0004	0.0003	0.0003	0.0001	0.034	0.024	0.0003	0.0002
Ni	0.059	0.051	0.113	0.056	2.5	1.56	0.033	0.03
Pb	0.055	0.046	0.051	0.043	3.24	1.79	0.023	0.01
Se	0.014	0.013	0.001	<0.005	0.053	0.038		
Zn	0.16	0.12	0.218	0.21	15.8	13.5	0.093	0.07
Total DDT (μg/L)	0.07	0.06	0.005	<0.02	0.14	<0.2	0.035	0.039
Total PCB (μg/L)	ND	ND	<0.1	0.007	4.87	0.39	1.38	0.708

[a]Abbreviations: MBAS, methylene blue activated substances; ND, not detected.
[b]Terminated November 1987.
[c]Total solids.

Table 4. Calculated annual mass emissions for 1986 and 1987 in metric tons per year except as noted.[a]

Constituent	JWPCP		HYP5		HYP7[b]		CSDOC	
	1986	1987	1986	1987	1986	1987	1986	1987
Flow								
L (10^9/yr)	503	506	542	518	5.4	4.7	329	348
MGD	364	366	392	375	3.9	3.4	238	252
Susp. Solids	41200	36900	41700	30000	70200[c]	59200[c]	16100	16400
BOD	50300	54600	80200	60000			25000	26500
Oil & Grease	5130	5610	11500	7900	3710	3260	3320	4500
NO3-N	261	253	149	7				
NO2-N	10	15	60	135				
NH3-N	20100	19200	8670	8400	2810	2280	8220	8700
Organic-N	4020	3740	4080	3330	2760	2600		
Total P	4070	3790	2930	2280	1300	1290		
MBAS	1410	1670	2390	2200				
Cyanide	10	10	9	14	0.4	0.4	0.2	<7
Phenol	805	1010	21	21	0.8	0.5		
Ag	4	4	9	5	2	1	4	3
As	4	4	5	4	2	2	1	1
Cd	2	1	5	3	4	3	1	1
Cr	29	26	19	7	25	17	9	7
Cu	26	21	65	30	71	44	27	26
Hg	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.1
Ni	30	26	61	29	14	7	11	10
Pb	28	23	28	22	18	8	7	3
Se	7	7	0.5	<3	0.3	0.2		
Zn	80	61	118	109	85	63	30	24
Total DDT (kg/yr)	35	30	3	<10	0.8	<1	12	14
Total PCB (kg/yr)	ND	ND	<54	4	26	2	454	250

[a]Abbreviations: MBAS, methylene blue activated substances; ND, not detected.
[b]Terminated November 1987.
[c]Total solids.

POINT LOMA		OXNARD		ENCINA		SERRA	
1986	1987	1986	1987	1986	1987	1986	1987
245	253	25	24	25	27	17	21
177	183	18.2	17.7	17.8	19.8	12.6	15.4
64	67	26.8	25.3	43.4	51.8	18.8	23.7
0.2	0.4	0.1	0.1	0.14	0.3	0.3	<0.3
106	100	25.5	22.6	52.9	63.0	12.6	13.7
21.6	20.3	3.7	3.9	9.35	6.6	1.3	1.5
24.2	24.3	8	6.2	20	21.3	15.6	6.4
		6	5.3				
10.7	7.52						
4.1	3						
0.010	0.009	0.022	0.007		<0.01	<0.01	0.06
0.006	0.005		0.021		0.001	<0.005	0.028
56	63	16.	16.1	31	34	6	7.2
1.23	1.43	0.17	0.07	1.14	0.94		
0.009	0.006	0.004	0.003	0.003	0.005	<0.01	0.003
0.004	0.004	0.004	0.003	0.001	0.001	0.003	0.01
0.009	0.004	0.007	0.003	0.001	0.008	<0.01	<0.01
0.02	0.008	0.008	0.003	0.002	<0.02		
0.05	0.047	0.072	0.047	0.029	0.04	0.019	0.01
0.0003	0.0002	0.0007	0.0002	0.0004	<0.001	0.0005	<0.001
0.05	0.017	0.058	0.051	0.006	0.02	0.008	<0.01
0.1	0.019	0.054	0.023	0.004	0.009	<0.03	0.04
0.002	0.002			ND			
0.09	0.059	0.063	0.069	0.065	0.10	0.34	0.104
ND	0.036	<0.1	<0.03	ND	ND		
ND	ND	<1	<0.2	ND	ND		

POINT LOMA		OXNARD		ENCINA		SERRA	
1986	1987	1986	1987	1986	1987	1986	1987
245	253	25	24	25	27	17	21
177	183	18.2	17.7	17.8	19.8	12.6	15.4
15600	16900	674	619	1070	1400	327	504
25900	25300	641	550	1300	1700	219	290
5280	5130	93	95	230	180	23	32
		143	160				
445		15	12				
5920	6100	201	150	492	580	270	136
		151	130				
2620	1900						
1000	760						
2	2	0.5	0.2		<0.3		1
			0.5		0.03		0.6
2	2	0.1	0.1	0.06	0.14	<0.2	0.06
1	1	0.1	0.1	0.02	0.03	0.05	0.21
2	1	0.2	0.1	0.01	0.22	<0.2	<0.2
5	2	0.2	0.1	0.05	<0.5		
12	12	1.8	1.2	0.71	1.1	0.33	0.21
0.1	0.1	0.02	0.01	0.01	<0.03	<0.008	<0.02
12	4	1.5	1.2	0.15	0.54	0.14	<0.2
24	5	1.4	0.6	0.10	0.24	<0.5	0.9
<1	<1					0.00	
22	15	1.6	1.7	1.6	2.7	5.92	2.2
<9	9	<3	<1				
<16	ND	<25	<5				

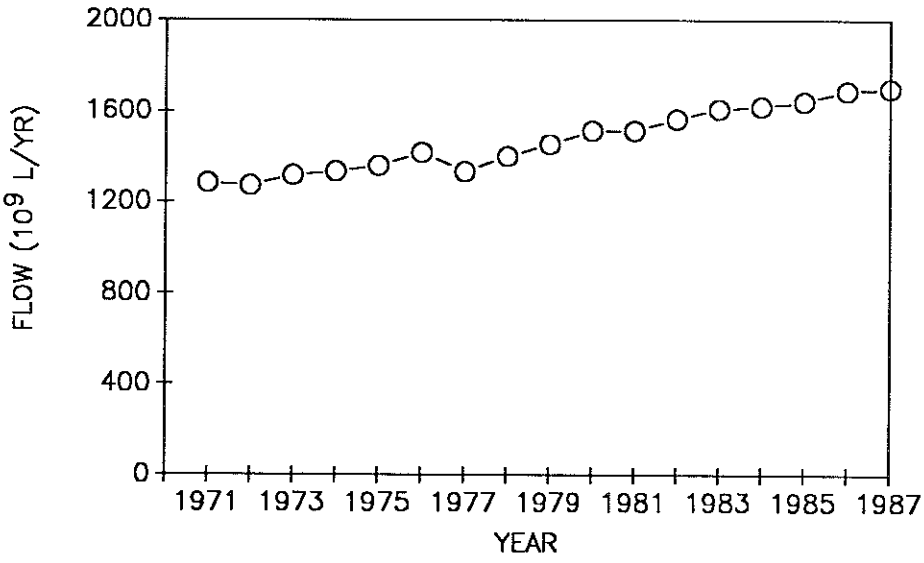

Figure 2. Combined annual flow from seven dischargers.

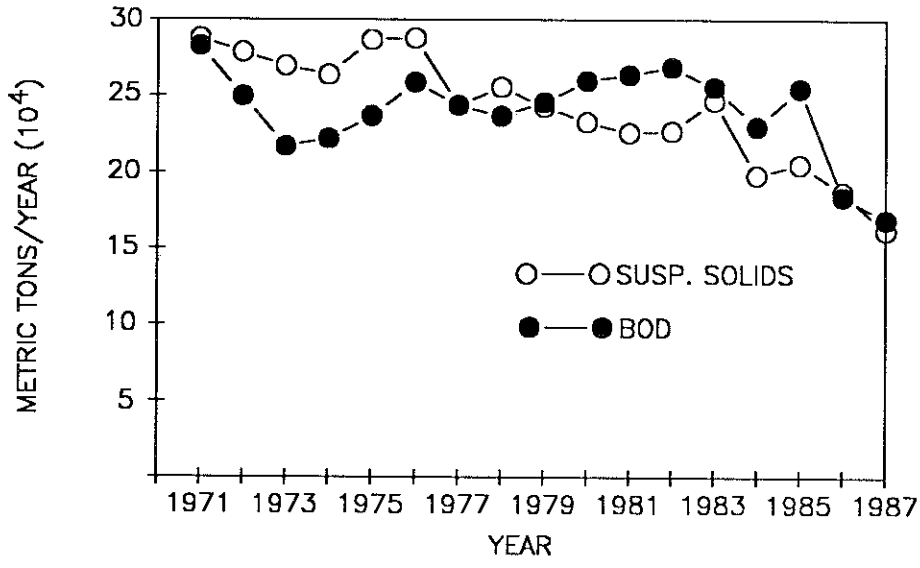

Figure 3. Combined BOD and suspended solids from seven dischargers.

reduced the 5-mile discharge by 30 MGD (48 x 10^9 L/yr) and the suspended solids by 57,000 metric tons/yr between 1985 and 1987. The latest data show that solids emissions are 15% lower than the 1971 emissions despite a 10% increase in flow.

The Hyperion 7-mile sludge outfall discharge has also undergone major changes in the past few years. Solids emissions increased 53% between 1985 and 1986 (44,000 to 70,000 metric tons/yr). Discharge was terminated in November 1987, and the solids are now transported to landfill. Although the outfall only operated for 10 months in 1987, it emitted 0.3% of the flow and 37% of the solids discharged by all municipal discharges to the bight. Its elimination will cause significant reductions in solids and trace metal annual inputs to the bight as of 1988.

The second largest discharge, the Joint Water Pollution Control Plant (JWPCP) outfalls at White Point, has continued to significantly reduce emissions. A steep decline in suspended solids occurred in 1984 after 200 MGD (276 x 10^9 L/yr) of secondary treatment was added in 1983. Between 1985 and 1987 suspended solids have been reduced an additional 15% and eight of the ten monitored metals have been reduced by 15 to 20%. Table 5 shows corrections for JWPCP 1985 data presented in SCCWRP's 1986 Annual Report.

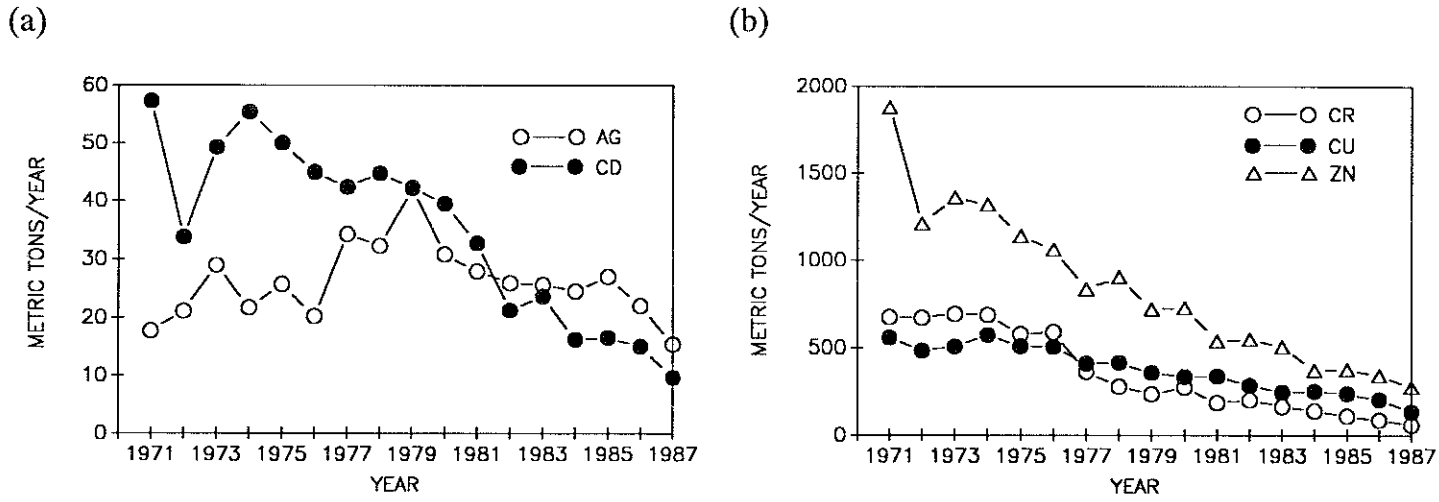

Figure 4. Emissions of (a) silver and cadmium, and (b) chromium, copper, and zinc to the Southern California Bight from seven dischargers from 1971 to 1987.

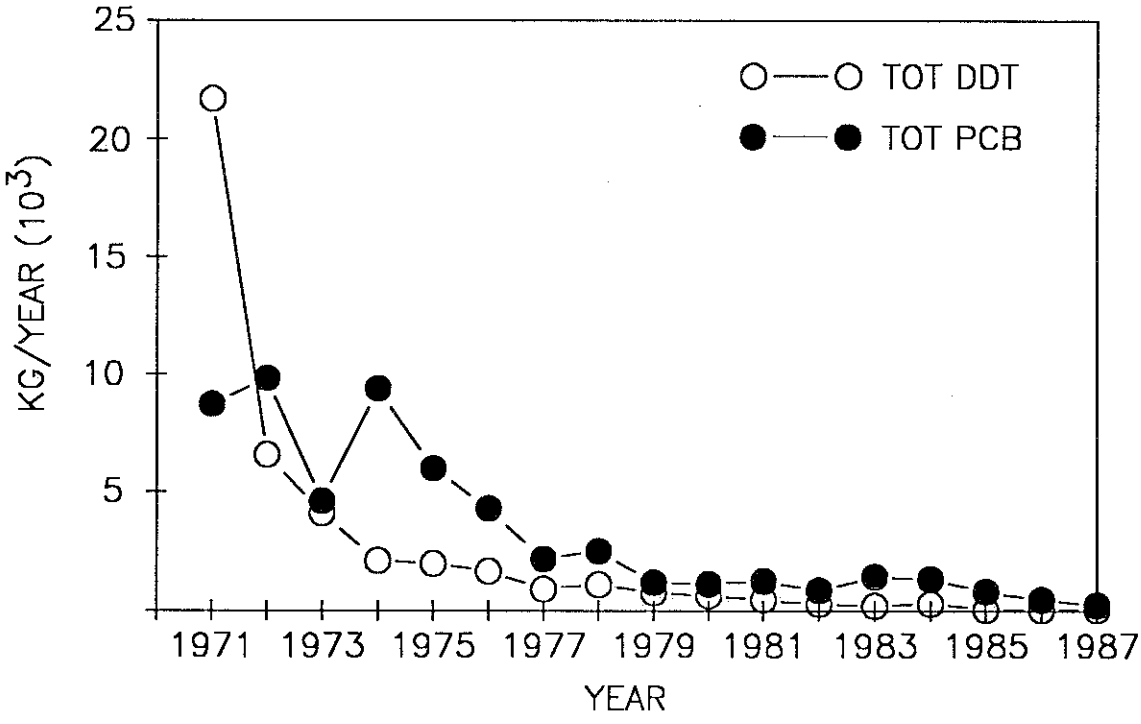

Figure 5. Output of DDT and PCBs to the Southern California Bight. Since 1985, the emission of DDT has remained about the same, but the output of PCBs has been reduced by about 60%.

Table 5. Corrected 1985 data for JWPCP.

Constituent	Average Annual Concentration (mg/L except as noted)		Mass Emissions (metric tons/yr except as noted)	
	Reported	Corrected	Reported	Corrected
NO3-N	1.3	0.48	635	240
NO2-N	0.30	<0.05	150	<25
NH3-N	40.8	37.3	20400	18700
MBAS	5.7	4.1	2850	2050
Toxicity (TU)	2.25	1.30		
DDT	0.1 μg/L	0.07 μg/L	50 kg/yr	35 kg/yr
PCB	0.2 μg/L	0.02 μg/L	80 kg/yr	10 kg/yr
TICH	0.41 μg/L	0.26 μg/L	200 kg/yr	130 kg/yr

The County Sanitation Districts of Orange County (CSDOC) operate the third largest treatment plant in Southern California and reported the largest discharge of PCBs to the bight for each of the last nine years. They report a 60% reduction (660 to 250 kg/yr) between 1985 and 1987. It is not clear how much of this reduction is due to actual reductions in concentrations and how much is due to a change to a more standard method of analysis. For years CSDOC used a unique method of sample preparation for PCB analysis that apparently caused the samples to be prone to laboratory contamination, thus producing much higher values than U.S. Environmental Protection Agency (EPA) methods produced or that other laboratories were able to detect in CSDOC effluent. Since 1986 the CSDOC laboratory has switched to EPA methods.

The reductions in municipal outfall emissions increase the importance of other sources of anthropogenic inputs. To assess these other sources, SCCWRP is investigating runoff and aerial inputs and will be reporting on this information in future publications.