

Figure 1. Current meter and sediment trap stations near the Los Angeles County outfall.

Seasonal and Spatial Variations in Sediment Resuspension

SCCWRP has been using sediment traps moored just above the sediment surface to obtain estimates of the rate of resuspension of sediment particles. Previous measurements in depths of water comparable with major outfalls (30 to 60 m) indicated resuspension flux rates that were one or more orders of magnitude greater than the accumulation rate of sediments (SCCWRP 1987). This difference in rates suggests that particles settling from the water column onto the sediments undergo a large number of resuspensions and redepositions before they become part of the "permanent" sediments. The dynamic nature of these surficial particles can substantially affect the distribution, concentration, and accumulation of effluent particles in the area around an ocean outfall.

In SCCWRP's 1986 Annual Report, Hendricks discussed some preliminary results from these sediment trap studies and the use of this data in a numerical simulation model (SEDP in SCCWRP 1987; the present, updated version is SEDR) of the resuspension, transport, and accumulation of effluent particles. That data represented a limited number of one-month observations from one or two locations in each of four outfall areas. Since that time, we have collected time-series of resuspension fluxes over a two-year period in the vicinity of the Orange

County (Newport Beach) and Los Angeles County (White Point) outfalls. Measurements of the spatial variability in the resuspension rates and particle characteristics have also been made around the White Point outfalls during the summer of 1987. These measurements have provided new insight into sediment resuspension processes and have assisted in evaluating the validity of some of the assumptions contained in the simulation models.

Figure 1 shows the location of sediment trap moorings in the

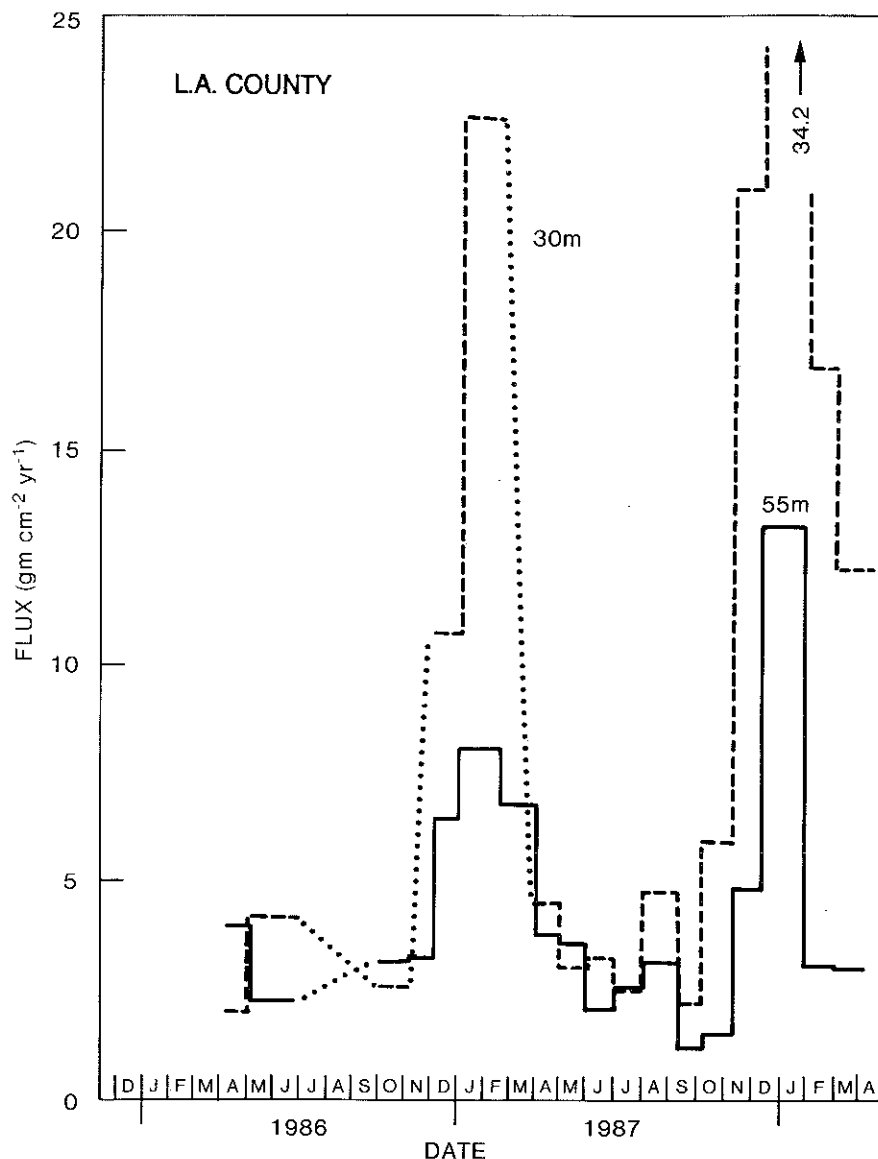


Figure 2. History of sediment trap fluxes near the Los Angeles County outfall at White Point. Dotted lines indicate no data.

White Point outfall area. Long-term time-series were collected at stations 0-30 and 0-52 (and/or 0-60); the remaining stations were only occupied during the summer and fall of 1987.

Figure 2 shows the fluxes of total particle mass collected during approximately one-month sampling periods beginning in April 1986 and extending to April 1988. The solid line represents the fluxes collected in 52 to 60 m of water; the dashed line represents the flux observed in 30 m.

The fluxes at both depths show a seasonal increase during the winter, with the greatest increase observed at the shallower depth. During both the 1986-87 and 1987-88 winters, the largest monthly flux was associated with the largest long-period swell during the winter. In summer, the fluxes collected at the 30- and 60-m depths are comparable. Wintertime fluxes vary from year to year. Maximum rates in the winter were about 23,000 and 34,000 mg cm⁻² yr⁻¹ during the two winters at a depth of 30 m, and about 8,000 to 12,000 mg cm⁻² yr⁻¹ at the 52- to 60-m depths. These rates are deceptive, however, since they are the average flux over the deployment period (typically 32 to 40 days), but most of the trapped particles were probably resuspended during the period of maximum swell (generally less than one day). Thus the "instantaneous" resuspension rates were probably at least an order of magnitude higher during the

swell. The average fluxes over the two-year period were 10,600 and 4,400 $\text{mg cm}^{-2} \text{yr}^{-1}$.

The seasonal variations in the organic content of the material collected in the sediment traps are shown in Figure 3. Concentrations of organic material show an inverse relationship with the flux of total particle mass into the traps. The lowest concentrations occur in the winter; the highest in the spring-summer period. Since the net flow of near-bottom currents is upcoast and offshore flow, this change suggests that the inshore area may contribute a greater fraction of the material collected in the traps during the winter. Average total volatile solids (TVS) at both depths were about 10%.

Figure 4 shows the location of the two sediment trap moorings in the vicinity of the Orange County outfall. Figure 5 shows the seasonal variation in the flux of material into the traps at these stations from December 1985 until April 1988. In contrast to the observations in the White Point area, there is no clear seasonal signal. Average fluxes in 30 and 60 m of water are 2400 and 1100 $\text{mg cm}^{-2} \text{yr}^{-1}$, respectively. These fluxes are only about one-quarter the average fluxes in the White Point area.

The organic content of the material collected in the traps at the Orange County stations showed only a small seasonal effect. Again the highest concen-

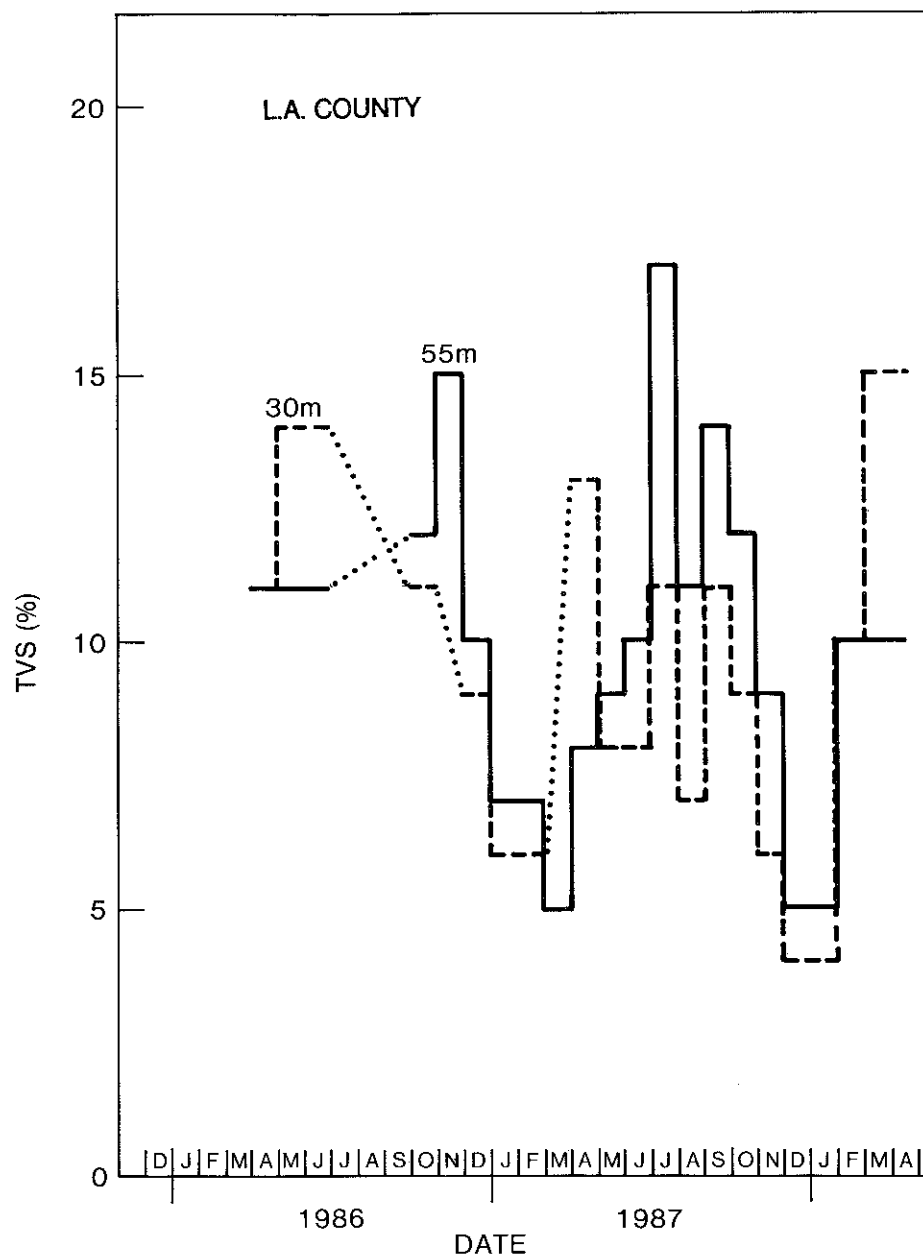


Figure 3. History of TVS collected in sediment traps near the Los Angeles County outfall. Dotted lines indicate no data.

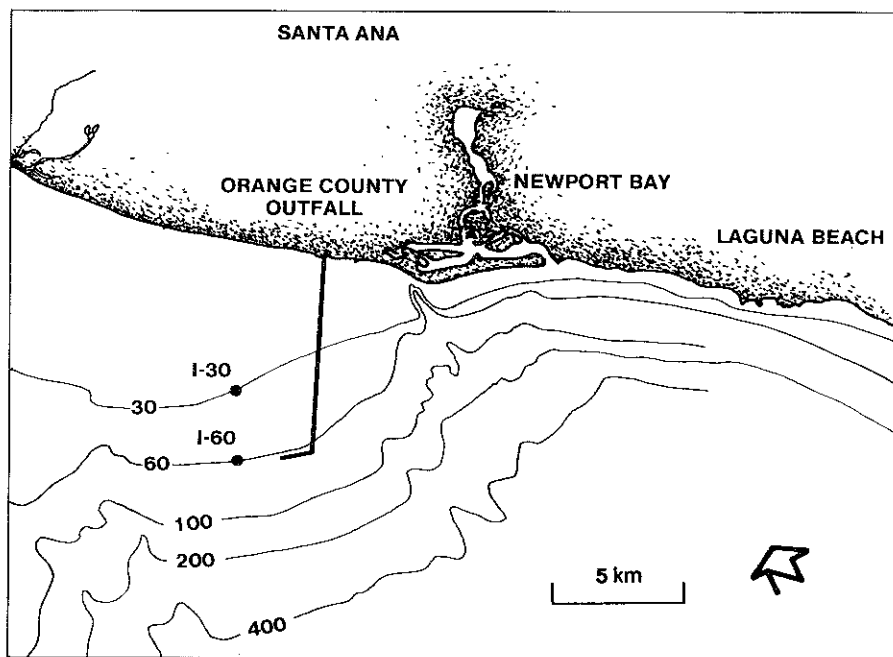


Figure 4. Locations of two sediment trap moorings near the Orange County outfall.

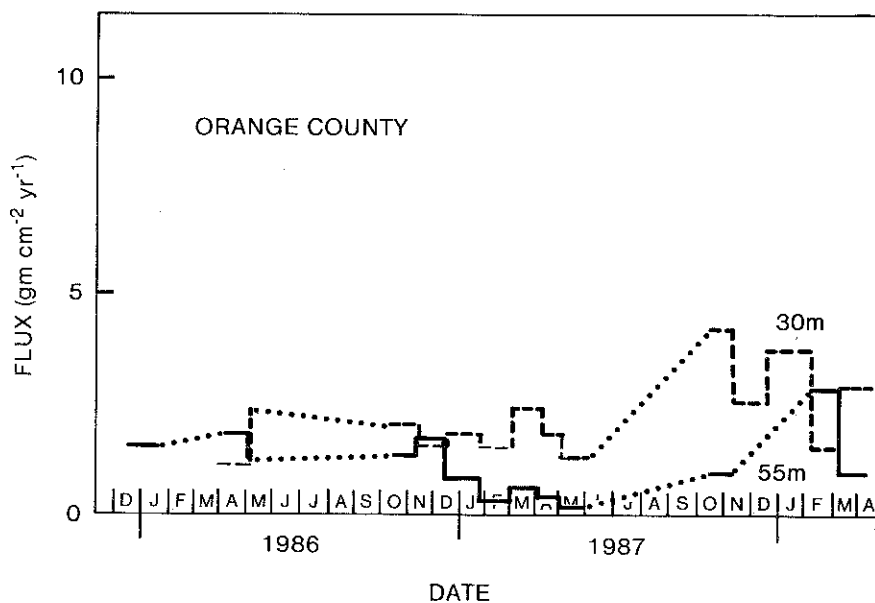


Figure 5. History of sediment trap fluxes near the Orange County outfall.

trations were observed in the summer. The average concentration of organic material in the traps (6%) was about 2 to 3 times that in the surface (0- to 2-cm depth) sediments (2 to 2.5%). This difference is consistent with differences observed in San Diego and Encina (Carlsbad) outfall areas.

Substantial differences in resuspension-redeposition fluxes have been observed between various outfall areas (e.g., White Point and Orange County, discussed above; and SCCWRP 1987). During the late spring to early fall of 1987, we deployed sediment traps at the 7 stations around the White Point outfalls shown in Figure 1 as part of a special study of sediment characteristics. One of the purposes of this deployment was to measure the spatial variability in sediment trap flux rates within a single outfall area.

Figure 6 shows the average resuspension-redeposition flux at each mooring for the period from May 1 until September 14. In 60 m of water, they ranged from about $2750 \text{ mg cm}^{-2} \text{yr}^{-1}$ to about $3210 \text{ mg cm}^{-2} \text{yr}^{-1}$. This variation is within the normal range of variability between replicate traps ($\pm 30\%$). Along the "0" cross-shore transect, fluxes ranged from about $3060 \text{ mg cm}^{-2} \text{yr}^{-1}$ in 30 m of water, to $4020 \text{ mg cm}^{-2} \text{yr}^{-1}$ in 52 m, and about $2850 \text{ mg cm}^{-2} \text{yr}^{-1}$ in 60 m of water--again within normal variability.

There is, however, a significant, persistent, increase in flux at the station in 30 m of water just upcoast from Point Fermin. The source of this increased flux is unknown. A hint of increased flux rates is observed at the nearshore station near Portuguese Point. It was anticipated that increased fluxes might result from a local landslide in this area that terminates at the water's edge.

The fluxes into near-bottom sediment traps are substantially greater than net accumulation fluxes of material in the sediments. Significant variations in resuspension-redeposition fluxes occur between different regions of the coast, although they are relatively constant in 60 m of water over a 7- to 8-km section of the coast off White Point.

Large seasonal variations in the fluxes are observed in the White Point area in both 30 and 60 m of water. The increased fluxes are correlated with the presence of large-amplitude, long-period swells. In contrast, seasonal variations are negligible in both 30 and 60 m of water off Orange County.

The observed spatial and temporal variation in resuspension rates indicate that assumptions incorporated into the sedimentation/resuspension model set are only valid for selected areas and times (e.g., White Point in summer). Additional

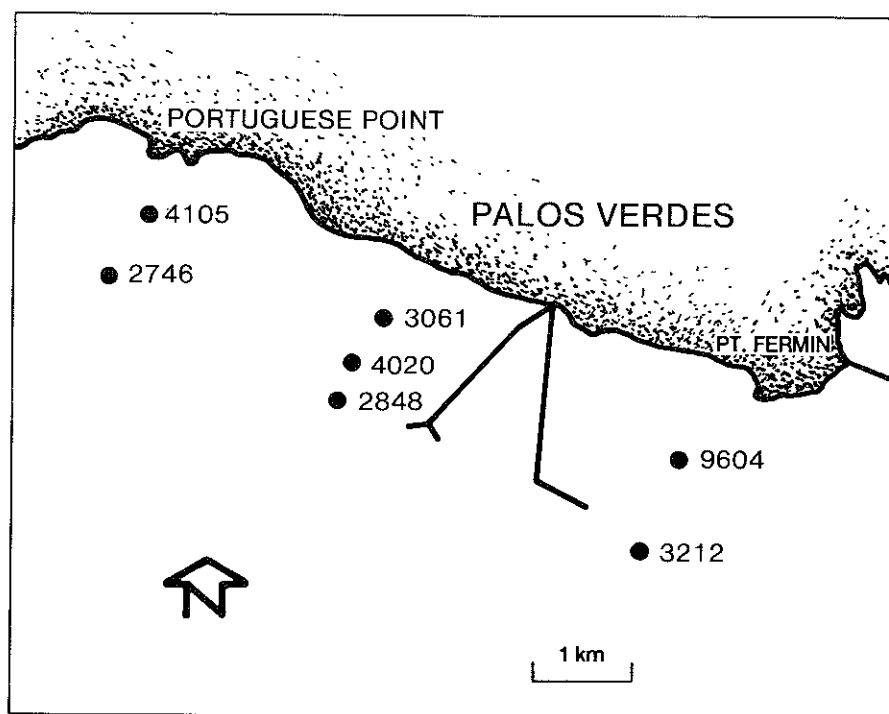


Figure 6. Apparent sedimentation flux ($\text{mg cm}^{-2} \text{yr}^{-1}$) for seven sediment traps near the Los Angeles County outfalls at White Point.

information on resuspension and redeposition mechanisms, the settling character of resuspension particles, and transport by near-bottom currents will be required to permit more universal simulations. Some of these questions will be addressed during the studies we have planned for the coming year.

Reference

- SCCWRP. 1987. Sedimentation, resuspension and transport of particulates, pp. 26-28. In Southern California Coastal Water Research Project Annual Report, 1986. Southern California Coastal Water Research Project, Long Beach, CA.