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# SLUDGE IN SANTA MONICA BAY

The ecological effects of the sludge issuing from the Hyperion 7-mile outfall are a matter of considerable public as well as scientific interest. Therefore, we have recently reexamined the bottom in the outfall area and analyzed samples of the sediments for pollutants and for marine life.

The Hyperion 7-mile outfall is operated by the City of Los Angeles as a means of disposing of certain solids remaining from wastewater treatment. The pipe is 61 cm (2 feet) in diameter and terminates in water 100 meters deep at the head of the Santa Monica submarine canyon. The effluent, which contains 7,800 mg/liter (0.78 percent) suspended solids, has the following composition:

1.3 mgd of screened digested (primary treatment) sludge
1.0 mgd of waste-activated (secondary treatment) sludge
2.5 mgd of secondary effluent
4.8 mgd average daily discharge

We were generally aware of the size and shape of the area of, the canyon affected by this discharge from samples taken in past years. With that as a guide, we established a new grid with 43 stations at 400-meter intervals (shown in Figure 1) and resampled the area around the end of the outfall to determine the present situation and to see if any substantial changes in conditions had occurred.

Our principal sampling tool was the chain-rigged Van Veen sampler, which has been shown to take repeatable undisturbed samples in conditions like those found in the Canyon (see Page 189). The grab takes a 0.1-sq-m sample in soft sediments to a depth of about 15 cm; the usual volume of the sample is about 20 liters. The results described here are from samples taken in 1976 on 25 March (27 stations) and 23 June (43 stations--analyses of these samples are only partially completed at this time).

As each sample was brought aboard, it was checked for sulfide smell, and a subjective determination of the general sediment type was made. Subsamples were taken for laboratory analyses for percent volatile solids and content of eight trace metals; the subsamples to be analyzed for mercury were immediately frozen, and the remainder were refrigerated. The remaining part of most samples was then screened through 4-, 2-, and 1-mm mesh, and the animals thus removed were preserved for identification and counting.*

Previous measurements in Santa Monica Bay served as controls and permitted us to estimate the natural background for comparative purposes. Our 1976 findings are as follows:

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*In the March survey, four samples—each representing a different sediment type—were screened for animals; all of the samples taken in June were screened.

- Three of the samples from stations beyond the end of the pipe appeared to be entirely composed of organic material and smelled very strongly of hydrogen sulfide. The sediments in this area are obviously composed largely of waste solids.
- In samples from 12 other stations, a moderate or faint odor of hydrogen sulfide could be detected. (The human nose is an excellent instrument for such work; it has been shown to be able to detect hydrogen sulfide at a level of 2 parts per million.) The subsequent laboratory analyses confirmed that these stations, and the three mentioned above, defined the area principally affected by the outfall (Figure 1).
- A relatively high percentage of volatile solids in a sample is another indication that organic material from the outfall is present. Figure 2 shows the area in which volatile solids were above the 3 percent background level. Contours enclose the areas of 10, 20, and 30 percent volatile solids.
- Copper, chromium, lead, cadmium, nickel, maganese, silver, and mercury levels in the sediments collected in the March survey have been determined. Figure 3 shows copper and lead values, which we believe to be significant and representative. Table 1 gives a summary of the results for other metals.
- Generally, in the area affected by the outfall, the number of species of benthic infauna present was somewhat reduced and the number of individuals was greatly increased (Table 2). This observation is in agreement with the result of an earlier experiment* in which samples of sludge-dominated sediments and a sample taken in an unaffected area of the canyon were sifted for benthic infauna on a 1-mm screen. The sludge yielded 24 species and 16,800 individuals per square meter; the control yielded about 50 species and only 1,200 individuals per square meter.

In the past 5 years, we have made other observations in the canyon area. We summarize them here for the sake of perspective:

- The maximum thickness of the bottom deposits of sludge is about 0.3 meters; there are pockets of natural cobble in the canyon--particularly on the south wall and at the immediate end of the outfall—that show little or no buildup.

*Jack Word, Project staff, personal communication.

- •The current flow appears to be predominantly down the canyon and away from shore.
- • Rockfish are numerous in the area; they appear to be attracted both by the pipe (and its attached life) and by the food in the discharge. •In a 5.5-hour hook-and-line fishing test, 47 fish representing 6 species and weighing 22.7 kg were caught in the affected area; this is well above the catch in unaffected areas.
- •Dover sole (a bottom-feeding flatfish) is relatively abundant in the vicinity of the sludge discharge. Of the specimens taken by trawl in this area between 1971 and 1974, 10 percent have a fin erosion disease that appears to be related to waste discharge.

In summation, we believe the size of the area of bottom containing a significant amount of sludge is about 2 sq km, or about 1 percent of Santa Monica Bay. This area is in water over 100 meters deep and 12 km offshore at the head of a submarine canyon. The sludge discharge has changed the ecology by increasing the number of fish and benthic animals and by decreasing the number of species of benthic animals.

We do not find that this material is moving as a body in any direction. However, it must be constantly dissipating, probably through the consumption of organic materials by animals and the drift of small particles offshore into deeper water. These recent measurements show that the situation is stable, apparently not having changed substantially for at least the last 5 years.

REFERENCE

Coastal Water Research Project. 1973. The ecology of the Southern California Bight: Implications for water quality management. TR 104, El Segundo, Calif.

**Table 1. Metal concentrations (ppm) in Hyperion 7-mile outfall effluent and Santa Monica Canyon sediments.**

| Metal | 7-Mile Effluent | Estimated Background, Santa Monica Bay Sediments* | Outfall Area** | |
|---|---|---|---|---|
| | | | Maximum | Average |
| Cadmium | 113.6 | 0.22 | 65 | 21.3 |
| Lead | 200 | 7 | 597 | 136 |
| Nickel | 300 | 15 | 231 | 63.8 |
| Chromium | 1,136 | 62 | 864 | 216 |
| Mercury | 10.4 | 0.043 | 6.1 | 1.71 |
| Silver | 28.2 | 0.71 | 41.8 | 8.8 |
| Copper | 1,631 | 13 | 1,010 | 302 |

*Values from Coastal Water Research Project 1973.
**Data from 26 stations.

**Table 2. Numbers of benthic animals per square meter in samples from Santa Monica Bay near and away from the 7-mile sludge outfall.***

| No. of Individuals | Background | | Sludge Outfall Area | | |
|---|---|---|---|---|---|
| | Sand | Silt | Clayey Silt | Sand | Sludge |
| Polychaetes | 150-2,000 | 1,000-3,500 | 1,620 | 1,380 | 1,020 |
| Molluscs | 150-2,000 | 150-2,000 | 9,960 | 15,600 | 0 |
| Arthropods | 50-100 | 50-100 | 0 | 780 | 2,220 |
| Echinoderms | 60-225 | 60-200 | 0 | 0 | 0 |
| Total | 550-2,200 | 150-2,000 | 11,580 | 30,180 | 3,240 |

*Outfall area samples were collected on 25 March 1976; all samples were sifted on a 1-mm screen.

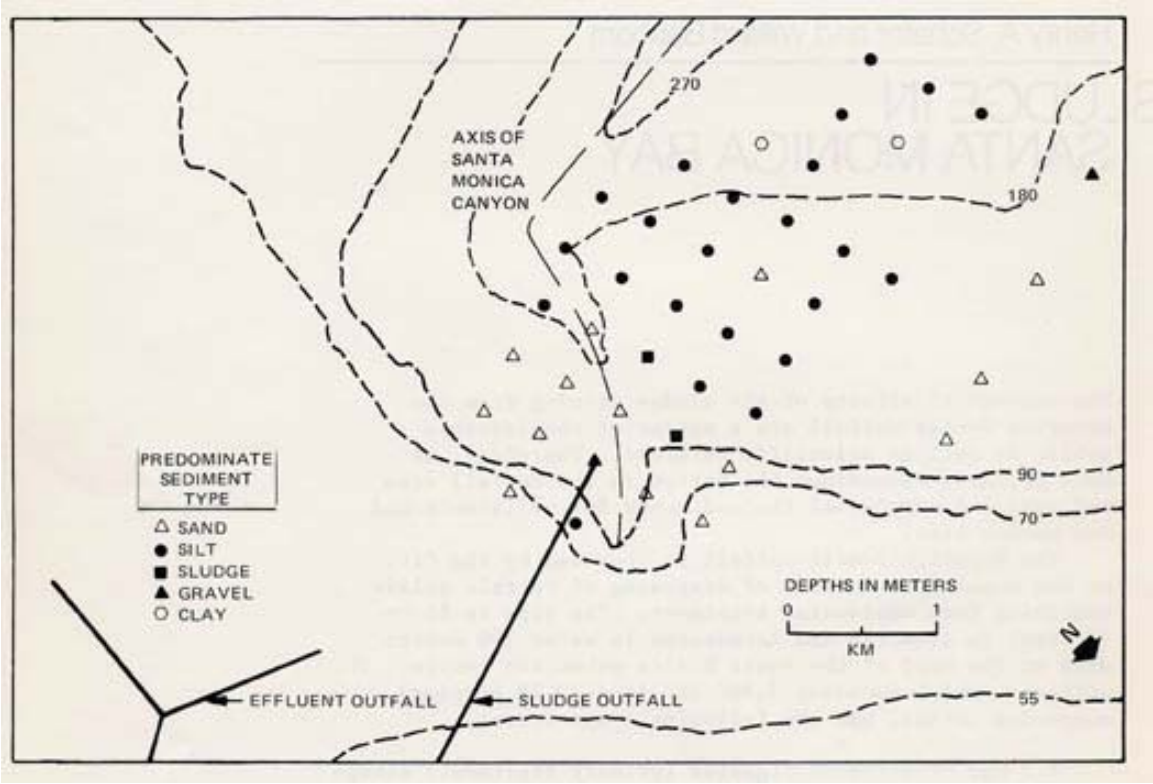


**Figure 1. Stations for the survey of bottom conditions around Hyperion's 7-mile outfall in Santa Monica Canyon.**

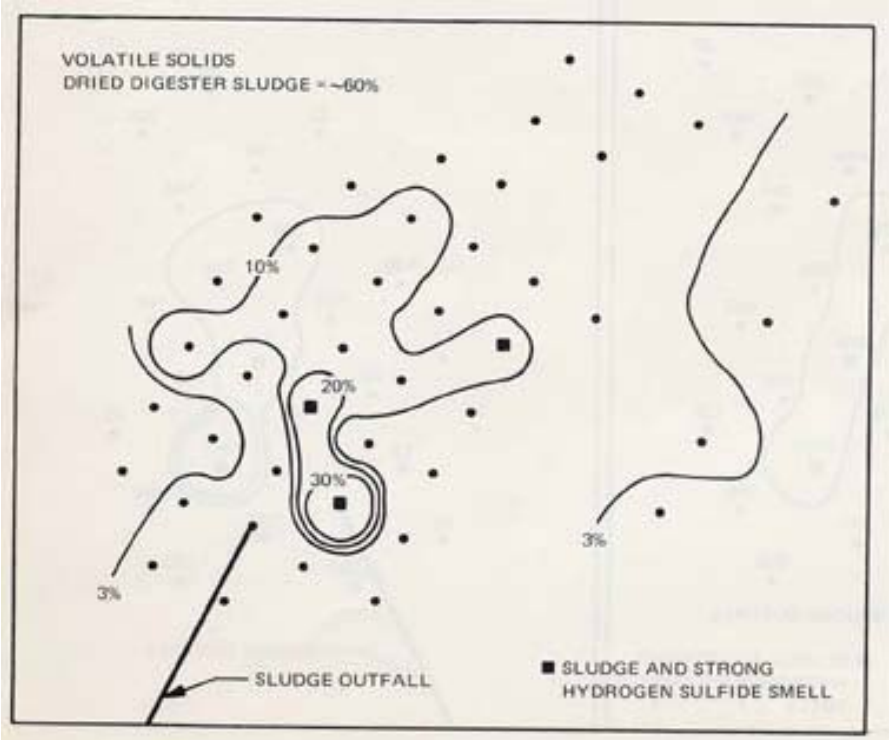


**Figure 2. Percent volatile solids in bottom sediments of Santa Monica Canyon, March and June 1976.**

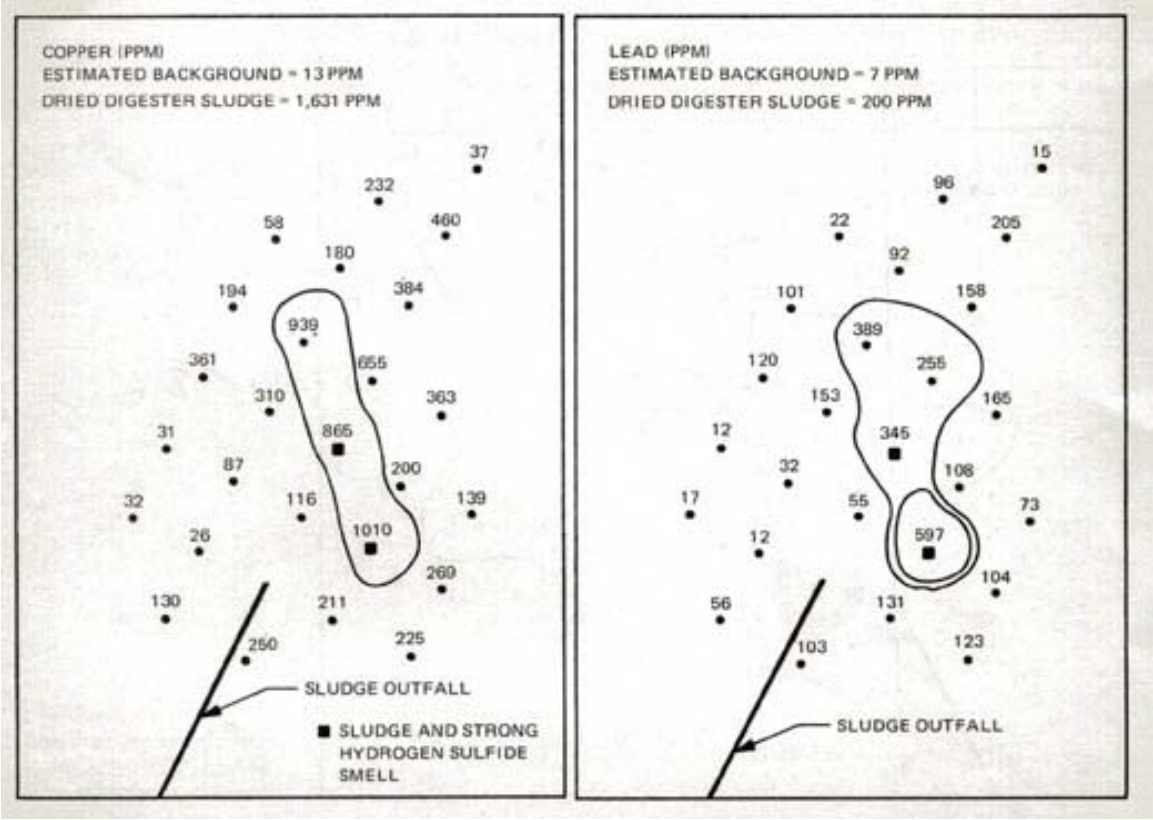


**Figure 3. Copper and lead in bottom sediments of Santa Monica Canyon, March 1976.**