Testimony of Dr. Willis E. Pequegnat

at the

Hearing of the Committee on Merchant Marine and Fisheries

U. S. House of Representatives

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My name is Willis E. Pequegnat. I reside in College Station, Texas where I have just completed 17 years of service as Professor of Oceanography in Texas A&M University and 10 years as President of TerEco Corporation, which provides consultants in oceanography to both government and the private sector. It is in the latter capacity that I have directed field studies at the Mud Dump and Sewage Sludge dumpsites in the New York Bight. At the outset I wish the Committee to know that I have long maintained a deep-seated concern for the welfare of both terrestrial and marine ecosystems, as evidenced in part by the fact that I was a ranger-naturalist in Yosemite National Park as early as 1937 and began teaching marine ecology in Laguna Beach, California in 1940. Even so, I frequently recommend that the disposal of some chemical wastes should be disposed in appropriate parts of the ocean rather than on land.

TerEco personnel carried out test monitoring of the disposal of dredged material during July and August of 1978, under support of the Environmental Protection Agency and the Environmental Effects Laboratory, U. S. Army Engineer Waterways Experiment Station, and again in June and July of 1979, under support of the Corps of Engineers, New York District.

Both studies consisted of two parts, viz., (1) a traditional taking and chemically analyzing samples of sediments and organisms inside and outside of the Mud Dump, and (2) the use of a new monitoring technique called the Biotal Ocean Monitor System (BOM System), developed by TerEco with financial assistance from the Marine Protection Branch of EPA. The BOM System is essentially a combined field/laboratory bioassay system consisting of two parts: (1) devices in which introduced or indigenous species of organisms are maintained in the test and control environments under study, (see illustrations in attached paper), and (2) laboratory analysis of both sets of organisms for selected contaminants - be they trace metals, chlorinated

pesticides and PCBs, or petroleum hydrocarbons, and, more importantly, for changes in selected metabolic enzymes that respond to stresses placed upon the organisms by contaminants and for changes in the energy charge system that provides a signature of the general health of the organism. This technique is on the forefront of the state of the art.

I shall now address some of the specific points carried in my letter of invitation from Chairman John M. Murphy:

a) Environmental Impact at the Mud Dump due to Dumping of Dredged Material. Using the term impact as synonymous with effect, our study showed the following:

1. Fine Sediment Texture. An apparent change of sediment texture from sands to finer materials with the usual expectations of shift of biological community structure and greater carrying capacity for heavy metals. Both effects are occurring outside the site quite as much or more so than inside.

2. Mounding. In places there are build-ups of mounds of sediment because of an earlier tendency to dump in a very limited part of the dumpsite. This has some advantages in that it structures the water column and attracts selected organisms such as lobsters.

3. Trace Metals. The average concentrations of trace metals in the sediments of the Mud Dump are lower than in sediments taken from the adjacent western and northwestern boundaries of the dumpsite except for manganese and lead. We found that samples taken from the Hudson Shelf Valley had higher trace metal levels than those in the Mud Dump, except for manganese and copper. These findings are consistent with the fact that most materials dumped here are fine grained and with what we assume to be the general circulation of water in the Bight Apex.

Organisms held in BOMs in the water column did not accumulate increased burdens of metals; however, there was evidence that some introduced species acquired burdens of metals when held on the bottom at the Mud Dump for 7 days. Data seem to indicate that the level of body burden is by some factor proportional to the level in the sediments.

4. Petroleum Hydrocarbons. The Mud Dump and Hudson Shelf Valley sediments are moderately contaminated with hydrocarbons. The petroleum origin of the hydrocarbon contamination is substantiated by the high concentration of the aromatic fraction, the relative composition of the alkane fractions, and the presence of a relatively large unresolved complex mixture envelope in the chromatograms. To place it in perspective, the total aromatic hydrocarbons of the Mud Dump are about one-third of the values obtained in offshore Louisiana oil fields. Yet one of this nation's major offshore fisheries is in offshore Louisiana.

5. PCBs. The PCB Aroclor 1254 was found at all of our stations in the Bight Apex. Its concentration in sediments ranged in tenths of a part per million. The greatest concentration of Aroclor 1254 was found at stations between the Mud Dump and the Sewage Sludge Site. PCBs were detected in organisms living in the Bight, but our limited data showed little correlation with the levels in sediments from which the organisms were captured.

b) Irreversibility of Impact:

For the most part the impacts on organisms that we observed were not acute but were more characteristic of chronic effects. Judging from some of our enzyme studies, the effects are reversible.

c) Environmental conditions at Mud Dump Compared to Other Areas in the New York Bight.

One finds a gradual improvement in the environmental conditions as he samples eastward well beyond the Mud Dump and Sewage Sludge site but on the latitude of the Mud Dump. The obvious reasons for this are:

1. Moving eastward places sampling stations beyond the influence of the outflow, especially the Hudson River plume, from the New York Harbor complex.

2. Beyond the Sewage Sludge site the clockwise gyre or circulation of Bight waters has less influence on transport of contaminants.

3. A station mounted by TerEco some 35 miles east of the Sewage Slude site was much cleaner in all respects than the western part of the Bight.

d) Measurements Indicative of Environmental Health:

TerEco Corporation has been evaluating the applicability of the adenylate energy charge ratio (E.C.) to the development of an effective monitoring program. Thus far we have applied the technique to problems in the New York Bight and off the coast of Louisiana for LOOP, Inc. Enzyme functions in any cell are thought to be regulated by adenylate control. Thus, the general health of an organism can be gauged or calibrated by analysis of the energy charge ratio. The E.C. of a healthy cell approximates 0.85. Only near or above this level can growth and reproduction occur. Viability is sustained at levels between 0.8 and 0.5, but cells die if the level falls below 0.5. Halogenated hydrocarbons such as PCBs act as inhibitors of the electron transport system enzymes; hence, their effect will be readily observed as a lowering of the E.C. ratio in test organisms. In our 1979 work in the New York Bight we found the E.C. of bottom organisms to approximate 0.80 and to be slightly higher (0.81) in organisms held in the water column. We found no significant differences in E.C. between organisms exposed at the Mud Dump and Gravesend Bay.

Thus, although these organisms were exposed to substantial levels of trace metals and halogenated hydrocarbons, their E.C. indicated only moderate stresses.

e) Research Needs for Measurement of Marine Environmental Impact:

It is my belief that the E.C. ratio shows sufficient promise as an environmental monitoring tool, along with assays of selected metabolic enzymes, to warrant further support from the environmental regulatory groups. As a result of presenting a paper on this subject at an environmental symposium on Helgoland, Germany in September 1979, I have colleagues in Australia, England, and Germany who are testing our technique. TerEco has had excellent support from EPA in this development but a much more extensive data base is needed before one can be certain that the techniques is ready for regulatory usage.

f) Risk Posed by PCBs to the Marine Environment:

At the present level of our knowledge, one would be foolish to minimize the potential deleterious effects of PCBs in the marine environment. However, various investigators have found that PCBs are usually tightly bound to dredged sediments so that only limited amounts are present in the sediment interstitial water. Also, there is evidence that PCBs were not released into the water column in significant amounts from dredged sediments, containing high levels, by means of barge or hopper dredge upon disposal. Sediments may be an important sink not only for chlorinated hydrocarbons but also for trace metals. Moreover, in the event of undue concern with PCB levels, any highly contaminated material can be disposed and covered with clean dredged material.

g) Field observations of Bioaccumulation and Biomagnification of Contaminants

TerEco's work in the New York Bight showed that some species of organisms did acquire higher levels of metals when exposed

to sediment/water complexes having levels above those of the control. The principal route of uptake appears to be from water through the gills and other epithelial surfaces, rather than through dietary sources. The E.C. ratio, however, appears to indicate that such uptake was not stressing the organism unduly.

Trophic level biomagnification, the process by which tissue concentrations of bioaccumulated chemical residues increase as these materials pass up a food chain, is not of as common occurrence as once thought from work on DDT. This is particularly true of the benthic fauna. This is because most animals can rid themselves of excess body burdens of trace metals and PCBs by excretion. If such depuration can occur within a few days, there is every likelihood that biomagnification will not occur.

h) Adequacy of COE-EPA Ocean Dumping Regulations

At this time I see very little need for significant changes in the ocean dumping regulations. The competent manager of the environment in both the Corps of Engineers and EPA has sufficient control to protect the environment. It may be, however, that not all managers are equally able or inclined to use their tools with equanimity. For instance, I believe that there have been some misuses of bioassay data to handicap one part of the federal establishment by another part. Also, I believe that it may be possible to reduce some impacts of disposal by increasing the amount of material disposed at a given time and then allowing a longer interval before the next dumping. This would allow organisms to depurate. Then, too, the capping process to cover badly contaminated material with clean material seems promising but should only be used when deemed essential by the Manager.