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RP:0055

Mr. Steve Chang
Environmental Permit Branch
Department of Health
645 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Chang:

Zone of Mixing Monitoring Data
Marine Cultural Enterprises
Kahuku, Oahu

In response to your request of November 29, 1985, we have reviewed the water quality monitoring data for the Zone of Mixing (ZOM) granted to Marine Culture Enterprises. Our review has been prepared with the assistance of Stephen Smith, Hawaii Institute of Marine Biology; Keith Chave, Edward Laws, and Frank Sansone, Oceanography; and Walington Yee, Environmental Center.

Zones of Mixing have been established by State regulations to permit a variance from the applicable state water quality standards so as to allow the discharge of certain types of waste. It should be noted that in accordance with the regulations (Chapter 37A Section 4 and 9.3 (E)) the discharge cannot violate certain basic standards applicable to all waters (Section 4 (A-F), and is to have received the "best degree of treatment or control." We have analyzed the monitoring data provided in the context of these ZOM regulations.

We assume that the basic purpose for the monitoring requirements for the ZOM are to assure that: 1) the effluent is contained within the ZOM, ie. state water quality standards are met outside of the designated ZOM; and 2) that no significant deleterious effects to organisms are occurring within the ZOM.

1. Boundaries of ZOM

To address the first issue, we note that monitoring stations have been established both within and outside the ZOM and monthly samples have been taken at several of these stations since August 1984. Since no analyses of this data were provided, it is difficult to evaluate the adequacy of the monitoring program.

Nearshore: At the sampling frequency indicated, once/month on the average, it is not clear if the variability within the station may be as great or greater than the variability between stations. With the exception of station CE, the stations show little difference from each other. For example, a plot of the copper values shows considerable variability at stations CE, NW6, and SE1 but relatively little difference at stations NW1, SE2 and SE4. Since the samples do not correspond in all cases to the same dates it is not clear if the variability at stations NW6 and SE1, as compared to the other coastal stations, (except for CE) is due to short term natural variation in coastal water conditions, influence of the discharge, or longer term seasonal (monthly) effects. Evaluation of the data for each of the parameters measured might lend insight into the basis for the distributions observed.

It is probable that the stations most distant from the discharge point (NW6 and SE4) could be eliminated from further sampling. However, without examination of specific time series graphs for each of the variables, it is not possible to make a firm recommendation at this time for discontinuence of sampling at any one station. The seasonal effect on the distribution of the effluent is unknown. We note that the aerial photos were all taken under typical trade wind conditions (22-24 mph at 69° to 71° E-NE) and at a time of minimal tidal change. The effects of Kona winds, waves and tides on the distribution of the effluent should be known before major changes are undertaken in the monitoring program. The data should be plotted as to time trends and a clear distinction made between data obtained before and after the discharge began. The distributions in time should be mapped on the sample site map which in turn should also be combined with Figure 1. Station NW6 is missing from the station map, as are the locations of the Grounds and Culvert stations.

We note that samples at the "Grounds" (effluent ditch near brood-stock ponds) and "Culvert" (effluent ditch at road bridge) were confined to one sample each for copper and formaldehyde. The later was an undated sample. We again stress the need for frequent systematic monitoring of the effluent, prior to its mixing with the receiving waters. This monitoring should be more frequent than once a month if treatments with formaldehyde and cutrine-plus do not occur on a continuous basis.

Monitoring of the dissolved organic nutrients, with the exception of ammonia, does not appear to be too informative. They show little variation in time, little cause for alarm to the biota, and presumably little potential effect on man. Monitoring of the inorganic nutrients, pH, turbidity, chlorophyll a, formaldehyde, and copper should definitely be continued on a monthly basis until the characteristics of their distribution with time, location, tide and meteorological conditions can be established.

Offshore: From the aerial photos it would appear that only stations CE, SE1M and SE2M should be affected by the discharge. Yet SE1M and SE2M show very close similarity to other offshore stations except for station NW20-1 which is high in Nitrate/Nitrite, Ammonium, and Total Nitrogen. Furthermore, copper values in the offshore samples are slightly higher on the average than the near shore samples. At present there is insufficient data to determine whether or not the effluent is modifying the receiving water outside the ZOM. Since copper seems to be traceable in the offshore samples and may even be above ambient in the stations outside the ZOM it would be advisable to continue the monitoring of the offshore stations. Formaldehyde should also be measured in the offshore samples.

There is no indication of the frequency or depth of sampling of the offshore stations. It appears that all samples may have been taken on September 18, 1985. Basic physical oceanography data should be included with the offshore samples such as time, tide, wind direction, estimated wave conditions, and depth of sample. Other qualitative observations such as the location of nearby rip currents would also be helpful.

2. Effects of Effluent on Biota of the ZOM

The second issue of concern relates to the possible effects of the discharge on the biota. In this regard the work of Richard Brock is of interest. We would expect that the attached benthic fauna would be more likely to exhibit effects of the discharge, depending of course on the depth of its influence. In this regard the macroalgae bed near station CE should be examined on a regular schedule (quarterly?) to determine its areal extent and the general characteristics of its macrofauna. We also suggest that both fish and filter feeding molluscs should be examined for bioconcentrations of copper. It is our understanding that fish bioconcentrate copper in the muscle tissue up to 1000 times and some molluscs by 5000 times (p. 248, Water Quality Criteria, 1972, EPA R3-73-033, March 1973).

Depending on the attached benthic species available and their accessibility, we suggest that an indicator species be selected to serve as a monitor for copper concentrations, in addition to the water quality samples, at stations CE, SE1M, or SE2M, and SE20 along with a control station well outside the influence of the discharge. The concentrations of copper in the water quality stations outside the ZOM appear to indicate that effluent is transversing the ZOM boundaries. Further analysis of the other parameters of the raw data and the attached benthic fauna may clarify this apparent observation. More emphasis should be placed on establishing control stations well outside the ZOM, against which the various water quality parameters can be measured.

Thank you for the opportunity to review the monitoring data.

Yours truly,

Jacquelin M. Miller

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Stephen Smith
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