Brief Summary of Findings from Environmental Studies of Calancan Bay related to Surface Disposal Dumping of Mine Tailings into the Bay from the Tapian Pit of the Marcopper Mine

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1) The geochemistry of the Tapian ore body is such that acid drainage and metal leaching from exposed tailings, such as those in the causeway, must be expected. **The sulphide mineral nature of the Tapian ore body, which is linked to acid drainage and metal leaching is well-documented.**

> ***"The principal sulphide copper mineral is chalcopyrite. (...) Pyrite [iron sulphide] is intimately associated with the chalcopyrite..."*** (The Philippine Mining Journal: October 1969)

Furthermore, the highest concentrations of metals are found in the fine tailing fraction, which was deposited into Calancan Bay.

2) SYNERGISTICS CONSULTANTS INC.

Environmental Impact Assessments dated 1975, 1978, 1979, 1980, 1981, 1982, 1983, 1982-83 (Final Report), 1987, 1988, 1989.

These studies primarily studied the **physical impact** of the tailings on the corals and seagrasses of the bay and on the marine biota and on fishing.

- In **1975** baseline data was collected.

- In **1978** after three years of dumping: **"Changes since 1975 in the quality and the quantity of the flora and fauna of the study stations are quite apparent. These changes are reflected both in the reduction of the number of species as well as in the population frequencies of each species."** (p.16)

- In **1979** the dramatic impact on the biota in the bay cause SCI to conclude that Submarine Tailings Disposal would be a better solution. **"This year's survey has shown the advance of the effects of the mine tailings with the extension of the causeway and outfall. In order to minimize the dispersion of the tailings, Marcopper Mining Corporation should seriously consider extending the outfall some depth below the surface."** (p. 24)

- **1980**: **"The results of the present survey have shown the progressive degradative effects of siltation with the farther extension of the tailings causeway and outfall seawards. The effects of the siltation on both the intertidal and subtidal communities have become apparent in even the farthest study stations in Sta. Cruz and Trapichihan Points."** (p. 37).

- **1981, 1982** and **1983** continue to document increasing damage to corals and seagrasses and impacts on species numbers and varieties.

- **1982-83** Final Report: This report summarizes: **"The primary impact area stations (all within Calancan Bay) showed the least species diversity, fish abundance, and catch per unit effort**

(gill nets) compared to secondary and least affected area stations (outside Calancan Bay). The higher magnitude and bigger aerial extent of tailings deposition on marine benthic organisms (corals and plants) have destroyed fish habitats in the bay. Turbid waters in the bay could not be tolerated by many fish species except by a few, now dominant species in the East and West Calancan Bay." (p. 5)

This report also indicates for the first time that metal contamination studies are being done by Marcopper itself but are not yet available. **"The data on heavy metal contents (Zn, Cd, Ca, Pb) of the mine tailings, sea water, fishes, oysters and mangroves at different stations done by Marcopper are presently being reduced and analyzed."** (p. 8)

- **1987** This report continues documenting physical damage and adds that **"Bioassays on the heavy metal contents of representative fish samples should also be undertaken regularly, e.g. monthly"** (p.45)

- **1988** This study is interesting in that after again documenting increasing damage to the bay and to biota in the bay the SCI lists under recommendations **"2. Development of alternative livelihood projects for the adversely affected barangays within the Calancan Bay."** (p. 40).

3) RESCAN ENVIRONMENTAL SERVICES LTD.

Rescan (from Vancouver) was brought in by Placer Dome in the early 1970s when it became apparent that the tailings deposition in the mountains would need to be moved to get at the ore body below it (what later became the San Antonio pit). It was at this time that the consideration to dump tailings into the sea was first made. By accounts from other sources, Rescan advised for Submarine Tailings Disposal (STD) off the coast of Torrijos where there is a deep sea shelf. As we know, Placer management chose to use the nearer shallow waters of Calancan Bay where STD failed and the company resorted to surface disposal. Rescan was brought in again in 1981 when Placer Dome faced the first Cease and Desist order against the dumping in Calancan Bay, in order to provide proof that the dumping was not causing significant environmental damage. Even though the 1981 Rescan document is highly protective of Placer Dome/Marcopper it still indicates problems with both physical damage and metal contamination. This study was a **paper review** of Marcopper's own metal analysis not a primary study. In 1989 Rescan prepared another Environmental Impact Assessment for Placer Dome/ Marcopper related to the proposed San Antonio mine. Because the plan was to continue dumping tailings into Calancan Bay, Rescan discusses existing impacts.

- **1981: "While copper levels in oysters are apparently elevated, inconsistencies in sampling and inadequate analytic technique do not allow confirmation. A similar situation exists for lead in fish tissue."** (p.1) Rescan makes recommendations for metal testing and adds **"If aquaculture, producing relatively standard fish, is developed, these should be analyzed for trace metals."**(p.79)

  This study also insists on the need for a submerged system to minimize further damage to the bay. **"However, it is not unreasonable to accept that a local fisherman from Botilao [village on Calancan Bay] could have noted a change in the fishery within the Calancan inner Bay since the tailings causeway was built in 1975. The causeway now extends from the shore of Calancan Bay to beyond Banot Island, bisecting the bay into east and west and thus significantly altering the water circulation patterns within the inner bay. This change could have a consequence on the fishery."** (p. 18).

"In our opinion continuation of the present surface discharge with or without extension of the causeway presents a risk of extended coral impact. (...) Accordingly, our opinion is that long-term continuation of the existing surface disposal system or even a shallow discharge system holds the risk of extended coral reef losses, and whatever consequences to fisheries which follow from reef damage." (p.53, 56)

Under **Recommendations** the report notes **"1. Determining the feasibility of a deep discharge for slimes and, if feasible, complete design work by October 31, 1982 (the annual renewal date for the permit) with full operation by October 31, 1984." (p.ii)**

- **1989: "Oysters exhibit elevated concentrations of copper and zinc, which are above the guidelines of Health and Welfare, Canada."** (p. vi)

  A graph on p. 6-13 shows that **lead levels in oysters from East Calancan Bay exceed Canadian H&W guidelines.**

4) PETER J. RUBEC, PH.D.

Peter Rubec is a marine biologist who used to work for Fisheries Canada. He was commissioned to do an independent review of the 1989 Rescan Report. This again was a paper review based on information provided in the Rescan text with no on site research. He concluded that with respect to **oysters**: **"Zinc and lead levels were high enough to be of concern in comparison to guidelines."(p.27)** and with respect to **fish: "Mean lead levels ranging from 0.5-0.8 mg/kg may be of concern where fish is a major dietary component (permissible Canadian level should not exceed 0.5-1.0 mg/kg)."** (p.27)

5) DR. FRANCISCO FELLIZAR

Dr. Fellizar was commissioned by the Calancan Bay Rehabilitation Program (a program set up by President Aquino in 1988 after she personally overrode the advice of her environmental ministry and allowed the continuation of surface dumping into Calancan Bay) to review the findings of various studies done by the CBRP program since 1988, and to provide critique and recommendations of how they should spend the remaining funds. It is important to know that the Department of Environment and Natural Resources headed up this program and conducted the studies. Fellizar conducted this work with a team of 7 scientists who had access to these studies. Here are some of the findings based on their review. From **"Evaluation and Assessment of the Calancan Bay Rehabilitation Program (CBRP) Final Report, March 1997."**

P. 43. "The importance of knowing the partitioning of heavy metals within the coastal ecosystem is one of the most critical aspects in this rehabilitation program. (...) Considering that cadmium, copper, lead, mercury, and zinc are present in the discharge materials, the possibility that these heavy metals may reach man through the food chain is not negligible. (...) Based on the latest data available (1995) the concentration of the heavy metals in water is within background levels. (...) On the other hand, the concentration in the sediment coming even from areas far from the causeway had elevated heavy metal concentration (...) This implies that dispersion and distribution of heavy metals occurred through movement of water or even biota. (...) In 1995, the heavy metal present in the sediment was relatively higher (Max. is 540 ppm) than in 1993 with highest levels observed nearer the center of the causeway than the shore."

P.46. “Although it is generally accepted that the area within the vicinity of the causeway is contaminated, it is probably surprising that areas perceived to be far and therefore will not be affected by tailings, have appreciable heavy metal levels. If we consider our system to be in constant motion, affected very much by water circulation and biotic movement, it is perhaps understandable that the effect will be extensive. (...) Several fish species showed elevated levels for lead (highest in *Gerres abbreviatus* or Manabonat 4.577 ppm). Compared with the allowed average daily intake of world Health Organization (WHO/Tasmania (Table 18), the average lead concentrations for two major groupings (based on feeding behaviour) were relatively high. Average zinc body burden of bottom dwellers or those that feed on benthic macroinvertebrates were generally higher than those of carnivores.”

P. 57. “For those depending on the causeway for their daily food, their exposure may be likened to chronic exposure to “sublethal” concentrations. Most of them have been exposed when they were still in the womb and up to now they are still consuming fishery products with elevated levels of heavy metals.”

P. 59. “Moreover, since the goal is to determine the toxicity of the effluents on the different biota, there should have been an initial characterization of the mine tailings that will be used in each test. Actually, the effluents are considered toxic because of three possibilities: presence of toxic heavy metals, suspension of fine particles may cause physical damage; and the high pH may also be a stressor. Because of the combined effects of these parameters, the toxic potential is relatively great.”

Under “Recommendations”

p. 77. “Owing to the questionable quality of water and marine resources in Calancan Bay, alternative livelihoods must be land-based, depending only very minimally, if at all, on Calancan Bay waters.”

P. 85. “CBRP has not been able to introduce effective measures to mitigate the threat of heavy metal contamination in Calancan Bay. EMB’s bio-assay results in 1994 showed that levels of cadmium, copper, zinc, lead, and/or mercury in some fish and marine species were high and therefore may pose some threat to the health of locals who constantly feed on these fishes and marine life.”

P. 88 “Studies made in 1993, using samples from 13 offshore stations in Calancan Bay showed that trace metal concentration of copper, zinc, cadmium, and mercury water were within the 1990 DENR Revised Water Quality Criteria. Oyster tissue analysis revealed trace metal concentrations exceeding standards for cadmium, zinc, and copper. Five fish species were found to have been contaminated with lead, while four others were contaminated with high mercury content.” [I asked Fellizar what “studies” were referred to here and he said the EMB studies conducted on behalf of the CBRP.]

p. 89 “The impact of heavy metal contamination to the local communities can be better appreciated when one considers that these communities are exposed to this environment every day, as well as consume these contaminated fishes daily. There is thus a real threat of accumulation and magnification of these heavy metals in the human body. CBRP has not been able to mitigate the health-related negative impacts of the dumping of mine tailings in the bay. (...) Further studies are also needed to identify the best way of mitigating the heavy metal contamination in the area. For instance, some specific fish species may be banned from capture and/or consumption, or the entire Calancan Bay may be closed from fishing.”