4. CONCLUSIONS AND RECOMMENDATIONS

The four study elements effectively achieved the objectives of the overall Sediment Toxicity Study; to characterize the concentrations and distribution of COCs throughout Pago Pago Harbor. Study Element 1, Sediment Screening, produced sediment data on the distribution of sediment and COC types in the surficial sediment layers in the Harbor. Study Element 2, Seabed Characterization and Mapping, produced high resolution bathymetric and sediment thickness maps which were used by subsequent study elements to target select areas of the Harbor for further investigation. Study Element 3, Detailed Sediment Analysis, provided data on the vertical extent of selected COCs. Study Element 4, Sediment Fate and Transport Analysis, examined the concentrations of COCs in the stream sediments around the Harbor and the concentration of COCs in the Harbor sediment pore water to confirm and enhance the evaluation of contaminant sources, sinks, and potential transport paths.

4.1 Summary Conclusions

The Harbor is dominated by two sediment types which directly reflect the source of the sediments: terrigenous sediments from the watershed derived from relatively recent volcanic soils, and calcareous sediments derived from the fringing coral reefs and the shells of marine organisms. Terrigenous sediments were found in highest abundance the Inner Harbor. Calcareous sediments (marine sediments) dominated the Middle and Outer Harbor (noting that Faga'alu Bay contains elevated amounts of terrigenous sediments from Faga'alu Stream). The distinction in sediment types was evident in the distinct trends in the calcium concentration (increasing) and TOC concentration (decreasing) with distance from the head of the Harbor.

Analyses for a suite of primary COCs was conducted on sediment samples throughout the Harbor. The concentrations of all COCs analyzed are reflected in the apparent sediment sources with higher values consistently in the upper layers of Inner Harbor sediments. The majority of the contaminants are most likely from stream flows entering the Harbor and legacy point sources (municipal, industrial, commercial, and past military installations) adjacent to the Harbor. Fine sediments with associated contaminants are either not introduced into the Outer Harbor, or are flushed from the Outer Harbor prior to settling on the seabed, or a combination of both.

There are no regulatory criteria or water quality standards applicable to marine sediments that are similar to water quality criteria. However, comparing the sediment COC results to various guidance criteria such as NOAA's AET, the sediments in Pago Pago Harbor were determined to be relatively clean, with distinct evidence of anthropogenic influence concentrated in the Inner Harbor. Metals, PCBs, and DDT were the only COCs identified that indicate levels that might be of potential concern.

The concentrations of metals in the Harbor sediments are not of concern in terms of biological or human health. However, metals can bioaccumulate in aquatic organisms, (e.g., mercury, lead, and arsenic), so understanding sources and concentrations of metals in the sediments is desirable. Metals are derived in part from natural sources in the watershed but have apparently been elevated by anthropogenic activities throughout the watershed and from spe-

cific point sources bordering to the Harbor. The point sources appear to be related to the Satala Power Plant, the SW Marine Shipyard, and potentially the abandoned cannery outfalls (particularly for copper and zinc). The implied transport path from west to east, however, masks any definitive conclusion concerning relative contributions. It is likely that some metals may have been introduced through U.S. Navy coaling operations in the Harbor carried out until the early 20th century. Streams are also a source of heavy metals. In general metals appear to be concentrated in the Inner Harbor with little subsequent transport once on the seabed. The maximum concentrations of many metals below the sediment surface may indicate that the inputs occurred in the past. Continuing non-point sources throughout the watershed appear to be an important present day contributor for metals.

DDT appears to be exclusively watershed derived and the data collected indicate the Vialoa and Fagotogo watersheds are actively contributing DDT contaminated sediments at relatively high concentrations.

The origin of the PCBs appears to be associated with the Satala Power Plant, with maximum concentrations just offshore. The extent of contamination appears to be very limited in area. Ship operations at the western end of the South West Marine Shipyard may be responsible for remobilizing contaminated sediments, and making them available for limited transport.

All COCs are elevated in the Inner Harbor, with little contamination in the Outer Harbor. This reflects the overall sources of the COCs and indicates little subsequent transport following sedimentation. This is consistent with the weak tidal and wind driven currents in the Harbor which are not sufficient to mobilize sediments. Most of the Harbor is too deep for wave action to mobilize sediments, except for on the reef flats. Once deposited, except for limited areas of ship operations in shallow water, there is little further mobilization and transport of contaminated sediments and the data appears to indicate that the rate of introduction of contaminants is decreasing. In many cases the maximum COC concentrations are below the sediment surface, indicating possible ongoing natural burial.

4.2 Recommendations

The mobilization of the COCs into the water column has not been detected in the ongoing, long-term, monitoring conducted for the canneries and the American Samoa Power Authority (for the Utulei wastewater treatment plant). No additional sampling appears needed to achieve the overall objectives of the Sediment Toxicity Study. The following points should be considered for future investigation and action:

- The apparent “hot spot’ for PCBs appears to be very limited in extent. It may be prudent to develop a follow-up study to better define the extent and sources of the contamination.

- The issue of DDT delivery by the streams should be addressed and understood.

- Future monitoring for selected COCs (metals, PCBs, DDT) at a few representative stations is indicated. A sampling schedule on a five year or greater time scale should be considered appropriate.