APPENDIX D

REASONABLE WORST CASE ANALYSIS
INJURY TO SURFACE WATER

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1.0 INTRODUCTION

Injury to the surface water resource can be assessed by several means. For the Lavaca Bay Superfund Site, potential for injury to plankton and surface water quality were considered. Injury to plankton populations could result from direct exposure to elevated levels of mercury (predominantly inorganic mercury) in the surface water column. Water column mercury in concentrations in excess of applicable water quality criteria would constitute injury.

The injury assessment for this category used a Reasonable Worst Case (RWC) approach. That is, comprehensive field studies were not performed to measure injury in Lavaca Bay. Analytical chemistry samples were collected during the Remedial Investigation (RI) to determine the nature and extent of mercury contamination in the water column of Lavaca Bay. Additionally, historical water quality data from the Lavaca Bay system were reviewed (TNRCC, 1996). These data were compared with the results of studies conducted for other sites and promulgated water quality criteria (Texas Water Code §307.6 & 63 Fed. Reg. 237).

2.0 PLANKTON INJURY

Plankton is a diverse group of organisms inhabiting the water column that are transported by water movement and lack the ability to move against currents. As described by Levinton (1982), plankton includes three major groups of organisms: bacterial plankton, zooplankton (animals), and phytoplankton (plants). Zooplankton can be further subdivided into two groups: holoplankton, that spend their entire lives in the water column, and meroplankton, that spend larval stages in the water and later inhabit sediments. The dominant members of the zooplankton are copepods that primarily feed on phytoplankton and small organic detrital particles with associated bacterial populations. Holoplankton are typically short-lived, fast growing organisms.

Bacterial plankton and phytoplankton are important components in the estuarine food web. Phytoplankton take energy from sunlight by photosynthesis although some are also capable of utilizing dissolved organic carbon sources for energy. Bacteria also take up dissolved organic carbon but are primarily found in the plankton associated with suspended detrital particulate matter. Bacteria derive energy from decomposition of this detritial material. The phytoplankton and bacteria associated with detrital particles are consumed by small zooplankton that "graze" in the water column. These grazing zooplankton are consumed by larger zooplankton that, in turn, can be fed upon by higher trophic level organisms such as planktivorous fish, or filtered out of the water column by filter-feeding benthic organisms. The types of services that are provided by plankton include:

- Food and Production: Phytoplankton and bacteria produce biomass from sunlight, dissolved, and/or particulate organic carbon. This biomass becomes available to grazing zooplankton, which are in turn fed upon by higher trophic levels within the water column or by filter-feeding benthic organisms.

- Decomposition and Nutrient Cycling: Bacteria in the plankton decompose organic matter, releasing nutrients that are required by phytoplankton in photosynthesis.

A review was conducted to identify mercury concentrations in the water column that may pose both "potential" and "probable" service losses. In conducting this analysis, the Trustees used acute and chronic endpoints (see below). Intensive sampling was conducted in the immediate vicinity of the Chlor-Alkali Process Area (CAPA) ground water influx zone during the RI. The results of this investigation indicate that the areal extent of the elevated mercury concentrations in the water is extremely small. This further suggests relatively rapid removal of most mercury to the sediment, which is the major depository for mercury in seawater (Sadiq, 1992). Unlike benthic organisms, plankters are not associated with a particular area but move with the currents. As such, the duration of exposure for these organisms to high levels of mercury would be relatively limited. For purposes of this assessment, meroplankters are considered benthos during the period when they are associated with bedded sediment, and these potential injuries are considered in the Benthos RWC document.

Mercury in the estuarine water is highly particle reactive. Mercury in the water rapidly attaches to sediment particles entrained in the water column and those particles settle to the bay bottom. Thus, water masses (with which the plankton are associated) rapidly lose mercury to the sediments as they move away from the contamination source. These organisms are exposed to mercury in the water column for a relatively brief period. This is demonstrated by the small size of the area of the water column that had elevated mercury levels despite a continuing source of mercury from contaminated groundwater (Alcoa, 1999). The CAPA hydraulic containment system went into operation in May 1998, and subsequent monitoring efforts revealed that the water column mercury concentrations in the Alcoa channel had been reduced to acceptable levels by June 1998. Therefore it is reasonable to focus on endpoints that are associated with rapid, rather than gradual effects. However, many studies do not report acute endpoint sensitivity values, and in those cases the chronic values are discussed.

For bacteria, Bringmann and Kuhn (1980) report a sensitivity of 10 µg/L (ppb), which was interpreted as a chronic endpoint sensitivity value for cell replication. No separate acute values were available. For phytoplankton, there is wide variation in reported chronic endpoint sensitivities and no reported separate acute endpoint sensitivities. The values range from 10 µg/L for reductions in chlorophyll a and growth to 960 µg/L for reduction in population growth. For zooplankton, LC_{50} values, an acute sensitivity endpoint, range from 10 µg/L to 230 µg/L.

3.0 COMPARISON TO CRITERIA

The chronic ambient water quality criteria (AWQC) for mercury is 0.94 µg/L for filtered seawater (63 FR 237). The chronic Texas Surface Water Quality Standard for mercury in filtered saltwater is 1.1 µg/L (TWC §307.6). RI data indicate that the mercury contamination in the ground water is inorganic in nature. These water quality criteria are appropriate for this comparison as these surface water quality criteria are based on exposure to inorganic mercury. Data from the RI revealed that mercury concentrations in the water column were below State and federal water quality criteria. No further evaluation of the water column was determined to be necessary because there was no indication of injury to this resource.

4.0 SUMMARY

The assessment process relied on supporting information from the Remedial Investigation of the Lavaca Bay Superfund Site, the results of studies of mercury effects on planktonic organisms (reviewed in Alcoa, 1997; Beckvar et al.,1996) and promulgated water quality criteria to assess the potential for injury to water column resources. This information indicates that no significant injury to water column resources of Lavaca Bay due to releases from the Site is likely to have occurred.

5.0 REFERENCES

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