1.4 Background of the Project (Environmental Impact Report, Excerpt)

1.4.1 Natural History of Water Hyacinth (*Eichhornia crassipes*)

Water hyacinth (*Eichhornia crassipes*) is a non-native, invasive, free-floating aquatic macrophyte. Water hyacinth is often noted in the literature as one of the world's most problematic weeds (Gopal 1987, Cohen and Carlton 1995, Batcher 2000). Native to the Amazon region of South America, it has spread to more than 50 countries on five continents and is creating significant problems in Africa and Southeast Asia (Cohen and Carlton 1995).

Water hyacinth was introduced into the United States in 1884 at the Cotton States Exposition in New Orleans when display samples were distributed to visitors and extra plants were released into local waterways. By 1895, water hyacinth had spread across the Southeast and was growing in 40-km long mats that blocked navigation in the St. Johns River in Florida (Cohen and Carlton 1995).

Water hyacinth was first reported in California in 1904 in a Yolo County slough. It spread gradually for many decades, and was reported in Fresno and San Bernardino Counties in 1941 and in the Delta in the late 1940s and early 1950s. There were increased reports of water hyacinth in the Delta region during the 1970s, and by 1981, water hyacinth covered 1,000 acres of the Delta, and 150 of the 700 miles of waterways (U.S. Army Corps of Engineers 1985). The invasion of water hyacinth in the Delta was slower than in the southeast, probably due to water flow stabilization and the more temperate climate in the Delta (Toft 2000).

Water hyacinth is characterized by showy lavender flowers and thick, highly glossy leaves up to ten inches across. These features have made water hyacinth a favorite in ornamental ponds and it can be readily purchased at aquatic nurseries. The plant grows from 1 ½ to 4 feet in height, and the floating portion of a single plant can grow to more than four feet in diameter. As much as 50 percent of a single water hyacinth's biomass can be roots, which extend to a depth of up to two feet in the water (Batcher 2000).

Water hyacinth grows in wetlands, marshes, shallow ponds, sluggish flowing waters, large lakes, reservoirs, and rivers (Batcher 2000). Water hyacinth often forms monospecific mats across sloughs and other waterways (Batcher 2000, Cohen and Carlton 1995). The mats are dispersed by winds and currents (Batcher 2000). In the Delta, water hyacinth is found in sloughs, connecting waterways, and tributary rivers. The growing season for water hyacinth in the Delta is typically from March to early December. Plants die back or reduce growth during the cold winter months. However, the majority of plants do not die, and carry-over plants begin to grow in spring as the weather warms. Plants can tolerate extremes of water level fluctuation and seasonal variations in flow velocity, extremes of nutrient availability, pH, temperature, and toxic substances (Gopal 1987).

Water hyacinth reproduces both vegetatively and sexually. Seeds often sprout along the muddy shorelines, and drop into the water with high tides. In vegetative reproduction, short runner stems (stolons) radiate from the base of the plant to form daughter plants (Batcher 2000). Nursery areas include slow moving waterways, temporarily isolated oxbow lakes, tule stands along channel margins, and stagnant, dead-end sloughs. Small colonies of plants separate and form floating mats that drift downstream, infesting new areas. When water hyacinth extends into faster channels, or when higher flows occur, plants are torn away from their mats and moved by currents and wind until they encounter obstructions such as marinas, irrigation pumps, or backwater areas (U.S. Army Corps of Engineers 1985). Water hyacinth spreads and grows rapidly under favorable temperature and nutrient conditions (warmer temperatures and higher nutrient levels). Mats weigh up to 200 tons per acre and surface area may double in size in six to fifteen days (Harley et al. 1996).

1.4.2 Problems Associated with Water Hyacinth

Water hyacinth creates serious problems in the Delta and elsewhere. The State of Florida, Department of Environmental Protection spent $15 million controlling water hyacinth, hydrilla, and water lettuce for public waters in fiscal year 1998-1999 (Batcher 2000). The California Department of Boating and Waterways has spent approximately $1 million a year for Delta water hyacinth control in recent years. Problems created by water hyacinth fall into three general categories: (1) boating and recreation; (2) agriculture; and (3) ecosystems. This section describes each of these problem areas.

1.4.2.1 Problems Related to Boating and Recreation

In the 1970s and early 1980s, there were a growing number of complaints about water hyacinth by boaters and marina operators in the Delta (U.S. Army Corps of Engineers 1985). Delta marina operations lost an estimated $600,000 in 1981 due to unusable slips and launch ramps, reduced sales, increased rental boat repairs, and labor and equipment to deal with the water hyacinth problem according to the San Joaquin Delta Marina Association (U.S. Army Corps of Engineers 1985).

Water hyacinth clogs waterways and impedes navigation, presents a safety hazard to boating and water-skiing, and leads to hull damage when boats collide with obstructions hidden under water hyacinth (U.S. Army Corps of Engineers 1985). Many Delta boat harbors and marinas have been forced to restrict operations because water hyacinth blocked facilities and damaged boats. Boats are unable to launch due to closed ramps and boat motors are damaged by overheating when water cooling systems become plugged with plant material. The houseboat rental industry and other marina businesses have reported reductions in the use of their facilities due to water hyacinth (U.S. Army Corps of Engineers 1985).

After halting the control program in 2000 in response to the Deltakeepers lawsuit, the California Department of Boating and Waterways (DBW) received new complaints from marina operators that were unable to launch boats and were losing revenue due to water hyacinth.

Merced and Fresno counties recently reported that water hyacinth is spreading rapidly in the San Joaquin and Merced Rivers.

Without a coordinated effort by the DBW to treat water hyacinth, the potential presently exists for private citizens and marina operators to utilize their own control methods. These *ad hoc* treatments result in: 1) potentially inappropriate selection of control methods that may not be efficacious; 2) improper application rates for aquatic herbicides; and 3) associated significant adverse impacts to fish, wildlife, and water quality.

1.4.2.2 Problems Related to Agriculture

Water hyacinth has significant negative impacts on agriculture and water conveyance systems in the Delta. The plant blocks pumping facilities, including those at the Delta Mendota Canal, the Tracy Pumping Plant, and the California Aqueduct near Clifton Court Forebay (U.S. Army Corps of Engineers 1985). In the early years of the control program, the Bureau of Reclamation estimated that the DBW program saved the Bureau $400,000 a year in reduced operating and maintenance costs associated with removing water hyacinth from just the Tracy Pumping Plant (DBW 1991).

Water hyacinth also interferes with pumping at numerous smaller water diversion structures. There are approximately 1,800 irrigation intakes throughout the Delta with the potential for clogging by water hyacinth, resulting in inefficient pumping, increased pumping costs, and possible mechanical failure of pumps. In a letter to the U.S. Army Corps of Engineers in 1981, the San Joaquin Farm Bureau Federation stated that growers were facing increased costs from efforts to open clogged channels where water hyacinth was decreasing the flow of water to pumps and clogging screens. Water hyacinth also spreads into irrigation and drainage systems (U.S. Army Corps of Engineers 1985), and impairs the use of fish protective devices such as fish screens (CALFED, Vol. 1 ERP 2000).

The Army Corps of Engineers report also noted that water hyacinth interferes with swimming, fishing from banks in infested areas, and the aesthetic enjoyment of the waterway. In addition, real estate values in areas adjacent to water hyacinth covered waterways are reduced (U.S. Army Corps of Engineers 1985).

1.4.2.3 Problems Related to Ecosystems

The Delta ecosystem is a critically important part of California's natural environment and the ecological hub of the Central Valley. In addition, it is probably the most invaded ecosystem worldwide, with over 200 invasive non-native species (Cohen and Carlton 1995). Cohen and Carlton found that non-native species accounted for 40 to 100 percent of common species at many sites (Cohen and Carlton 1995). Water hyacinth is part of a nationwide invasion of non-native species.

Water hyacinth is labeled as an invasive habitat modifier. It provides a structurally complex canopy – roots in the water column and leaves above water provide habitat for both native and non-native species. The CALFED Ecosystem Restoration Program Plan states that "these weeds

[water hyacinth] are extremely dangerous because of their ability to displace native plant species, harm fish and wildlife, reduce foodweb productivity, or interfere with water conveyance and flood control systems" (CALFED, Vol. 1 p. 462). Similarly, the U.S. Fish and Wildlife Service (USFWS) notes that excessive water hyacinth growth outcompetes native vegetation and clogs waterways, impeding and impairing aquatic life (USFWS 1995). The dense mats block sunlight, inhibiting photosynthesis in algae and submersed vascular plants (CALFED Vol. 1 ERP 2000, USFWS 1995). Water hyacinth increases sedimentation and accretion of organic matter, inhibits gaseous interchange with the air, reduces water flow, and depletes oxygen, all of which harm other aquatic organisms (CALFED Vol. 1 ERP 2000). In addition, organic fallout can influence the benthic zone (Toft 2000) and alter ecosystem processes such as nutrient cycling, hydrologic conditions, and water chemistry (CALFED Vol. 1 ERP 2000).

In the Stone Lakes National Wildlife Refuge in Sacramento County, the USFWS found that fish and wildlife habitat would be "greatly degraded or lost completely on shorelines, shallow water, and deepwater areas" if water hyacinth was allowed to grow unchecked (USFWS 1995). Even smaller infestations of water hyacinth along shorelines can prevent ducks, turtles, snakes, and frogs from seeking shelter (USFWS 1995).

Toft found significant differences in insect densities in water hyacinth and pennywort (a native aquatic plant), with increased taxa richness and diversity of invertebrates in pennywort in the early summer. While water hyacinth had a greater number of species later in the summer, there were fewer native species (Toft 2000). Water hyacinth increases mosquito habitat by providing larval breeding sites where mosquito predators cannot reach (CALFED, Vol. 1 2000), creating microhabitats for the vectors of malaria, encephalitis, and schistosomiasis (USFWS 1995). Water hyacinth also competes with native plants, including Mason's lilaeopsis, a special status species (CALFED, Vol. 1 ERP 2000).

Toft and others have found lower levels of dissolved oxygen under water hyacinth canopies. Average spot measures were below 5 mg/L in water hyacinth (the minimum level for fish survival) and above 5 mg/L in pennywort (Toft 2000). These results were supported by a study in Texas which found lower dissolved oxygen in water hyacinth compared to other aquatic weeds, and a University of California Davis study which found dissolved oxygen levels of as low as 0 mg/L below a solid water hyacinth mat (Toft 2000). Toft hypothesizes that the lower dissolved oxygen levels explain the absence of epibenthic amphipods and isopods beneath the water hyacinth canopy at one of the test sites (Toft 2000).