Chapter 7. Public Health

Public health issues evaluated for the proposed alternatives are public nuisances associated with mosquitos and diseases transmitted to humans by mosquitos. This chapter describes mosquito breeding conditions and production levels present in the HAAF, SLC, and BMKV parcels and potential impacts on public health and safety associated with mosquitos that may occur with implementation of project alternatives.

Information presented in this chapter and used to conduct the analysis of potential project impacts is based on the following data sources:

- draft Hamilton Wetlands Conceptual Restoration Plan (Woodward-Clyde 1998),
- revised draft final Bel Marin Keys Unit 5 EIR/EIS (Environmental Science Associates 1993),
- draft EIR/EIS for the Delta Wetlands project (Jones & Stokes Associates 1995),
- literature on mosquito ecology and control methods, and
- unpublished information from and conversations with representatives of the Marin-Sonoma Mosquito Abatement District.

Affected Environment

Mosquito Breeding Conditions

All species of mosquitos require standing water to complete their growth cycle; therefore, any body of standing water represents a potential mosquito breeding site. Because areas that pond surface water that are flushed by daily tides are not stagnant for periods sufficient for mosquito larvae to mature, such areas are not mosquito production sources (Keith pers. comm.).

Water quality affects the productivity of a potential mosquito breeding site. Typically, greater numbers of mosquitos are produced in water bodies with poor circulation, higher temperatures, and higher organic content (and therefore with poor water quality) than in water bodies having good circulation, lower

temperatures, and lower organic content (Collins and Resh 1989). Additionally, irrigation and flooding practices may influence the level of mosquito production associated with a water body: Typically, greater numbers of mosquitos are produced in water bodies with water levels that slowly increase or recede than in water bodies with water levels that are stable or that rapidly fluctuate (Jones & Stokes Associates 1995).

Mosquito larvae prefer stagnant water and the protected microhabitats provided by stems of emergent vegetation. Therefore, if not properly maintained, ditches can be major producers of mosquitos. Periodic dredging of ditches substantially reduces mosquito production by enhancing water circulation and preventing encroachment of emergent vegetation into ditch channels. Mosquitos are adapted to breed during periods of temporary flooding and can complete their life cycles before water evaporates and predator populations become well established. Poor drainage conditions that result in ponding water and water management practices associated with agriculture and creation of seasonal wetlands for waterfowl use result in the types of flooding that can produce problem numbers of mosquitos. (Jones & Stokes Associates 1995.)

Permanent bodies of open water that have good water quality (good circulation, low temperatures, and low organic content) typically sustain stable nutrient content and support rich floral and faunal species diversity, including mosquito predators and pathogens. Wave action across larger bodies of water physically retards mosquito production by inhibiting egg laying and larval survival (Jones & Stokes Associates 1995).

Two broad types of mosquito production sources are present in the project areas: habitats where water ponds permanently and habitats where water ponds seasonally.

Habitats in the project areas where water ponds permanently include the Landfill 26 mitigation wetland borrow pit pond, a portion of Pacheco Pond, and low-lying portions of the perimeter drainage ditch in the HAAF parcel and portions of drainage ditches in the BMKV parcel. However, these habitat areas support populations of mosquitofish and probably other mosquito predator populations, such as backswimmers and dragonflies, that assist in suppressing mosquito production by feeding on mosquito larvae at the water's surface (Environmental Science Associates 1993).

Habitats that seasonally pond water in the project area include brackish marsh, seasonal wetlands, borrow pit ponds, drainage ditches, and portions of cultivated fields that may pond water during the wet season. Table 7-1 shows the estimated acreages of potential mosquito breeding habitat in these areas. (Environmental Science Associates 1993).

In the project areas where mosquitos breed, mosquito production diminishes substantially during the cool season (typically late October through April) (Jones & Stokes Associates 1995).

Table 7-1.
Estimated Acreages of Existing Potential Mosquito Breeding Habitat in the Project Areas

Habitat Type	HAAF	SLC	Subtotal	BMKV	Total
Brackish marsh	4.1	0.0	4.1	27.0	31.1
Seasonal wetland	19.5	16.0	35.5	2.0	37.5
Agriculture	0.0	0.0	0.0	1,314.0	1,314.0
Total	**23.6**	**16.0**	**39.6**	**1,343.0**	**1,382.6**

Marin-Sonoma Mosquito Abatement District

The project area is in the jurisdiction of the Marin-Sonoma Mosquito Abatement District (MSMAD). Mosquito abatement districts (MADs) are governmental organizations formed at the local level that are responsible for controlling specific disease vectors within their jurisdiction. MADs receive most of their revenue from property taxes and are primarily responsible for controlling mosquitos as pest species and as disease vectors. California law requires that if a problem source of mosquito production exists as a result of human-made conditions, the party responsible for those conditions is liable for the cost of abatement. The law is enforced at the discretion of the responsible MAD (Cal. Health and Safety Code Section 2200 et seq.).

Because MADs do not have jurisdiction on state and federal lands, MSMAD does not have jurisdiction in the HAAF and SLC parcels but does have jurisdiction in the BMKV parcel.

Criteria for Determining the Need for Control at a Mosquito Source

State laws and regulations require that mosquitos be controlled if diseases transmitted by mosquitos are identified in or near human populations, or if surveillance of mosquito populations for the incidence of mosquito-transmitted diseases indicates the likelihood of transmission (Jones & Stokes Associates 1995). The decision to control mosquitos as a nuisance to human populations is at the discretion of each MAD. Factors influencing this decision may include the number of service calls received from a given locality, the proximity of mosquito sources to population centers, the availability of funds for abatement, the density of mosquito larvae present in a mosquito production source, and the number of adult mosquitos captured per night in light traps (Jones & Stokes Associates 1995). Once a recurring mosquito production source has been identified, abatement schedules are often adopted and maintained for that source (Jones & Stokes Associates 1995).

Mosquito Control Methods

Compared with the historical levels of mosquito-borne diseases in humans, levels of mosquito-borne diseases in California are low. These diseases, including encephalitis and malaria, however, are still present or could be readily reintroduced. (Bohart and Washino 1978, Sacramento-Yolo County Mosquito Abatement and Vector Control District 1990.)

To reduce mosquito populations and, consequently, the likelihood of disease transmission to humans, MADs use a combination of various abatement procedures, each of which may have maximum effectiveness under specific habitat conditions or periods of the mosquito life cycle (Jones & Stokes Associates 1995). Mosquito control methods used by MADs include use of biological agents (e.g., mosquitofish, which are predators on mosquito larvae) in mosquito breeding areas, source reductions (e.g., drainage of water bodies that produce mosquitos), pesticides, and ecological manipulations of mosquito breeding habitat.

Mosquito Habitat Conditions and Abatement Requirements in the Project Areas

In the project areas, MSMAD mosquito abatement efforts are primarily focused on controlling mosquitos that can transmit malaria and several types of encephalitis or cause a substantial nuisance in surrounding communities. Three mosquito species that are found in the project area potentially are vectors of these diseases.

The encephalitis mosquito (*Culex tarsalis*) breeds in areas that pond fresh water. This species is the primary carrier in California of western equine encephalitis, St. Louis encephalitis, and California encephalitis and is considered the most important disease vector in the state (Sacramento-Yolo County Mosquito Abatement and Vector Control District 1990).

The mosquito *Aedes dorsalis* breeds in intertidal marshes and is a suspected vector of California encephalitis (Bohart and Washino 1978). *Aedes squamiger* also breeds in intertidal marsh; however, it is unknown whether the species is a vector of mosquito-borne diseases to humans. These mosquito species, however, tend to be present in very low numbers and have not been of sufficient concern to MSMAD to warrant the implementation of abatement actions (Keith pers. comm.).

Of the wetland habitats in the project areas, only brackish marsh and seasonal wetlands are considered to have the potential to produce problem numbers of mosquitos. Table 7-1 summarizes the acreage of wetlands in the project areas with the potential to produce problem numbers of mosquitos. On average for the past 5 years, MSMAD has annually treated approximately 91 acres of land in and near the project areas, requiring an average of approximately 65 hours of effort to inspect potential mosquito breeding sites and control mosquitos at problem production sources (Table 7-2). MSMAD's abatement efforts are

focused on controlling mosquito larvae at breeding sites using several types of approved pesticides (Keith pers. comm.).

Table 7-2.
Area of Mosquito Breeding Habitat Treated and Level of Abatement Effort Expended by MSMAD to Control Mosquitos in the Project Areas from 1993 through 1997

Year	Area Treated to Control Mosquito Larvae (acres)	Effort Expended on Mosquito Abatement Activities (hours)
1993	2.2	23
1994	24.9	51
1995	60.0	51
1996	226.3	84
1997	141.3	116
Average	90.9	65

Environmental Consequences and Mitigation Measures

Approach and Methods

Analytical Methods

Changes in mosquito abatement requirements for the project areas were evaluated through comparison of predictions of future mosquito breeding conditions under the project alternatives with existing mosquito abatement requirements. Predictions of future mosquito breeding conditions are based on predicted future habitat conditions, which are described in Chapter 8, "Biological Resources".

Impact Mechanisms

Impact mechanisms include conversion of areas that do not provide breeding habitat for problem numbers of mosquitos (e.g., grasslands and developed areas) to wetland habitats that have characteristics suitable for producing problem numbers of mosquitos, and changes in water management practices resulting from implementation of project alternatives.

Thresholds of Significance

In this analysis, an alternative would be considered to have a significant impact if habitat changes would necessitate increasing levels of mosquito abatement programs to maintain mosquito populations at preproject levels. Habitat changes that could result in a substantial decline of available mosquito breeding habitat or greater efficiency of MSMAD's abatement program would be considered beneficial impacts.

Impacts and Mitigation Measures of Alternative 1: No Action

No impacts on the level of mosquito production or MSMAD's abatement program would occur under Alternative 1 because the HAAF and SLC parcels would remain in caretaker status. The Army would continue to maintain existing facilities, flood control operations, and security systems in the HAAF parcel. The SLC would continue with its current management and operation of the SLC parcel.

Impacts and Mitigation Measures Common to Alternatives 2, 3, 4, and 5

Tables 7-3 and 7-4 compare the predicted acreages of habitats that could produce problem numbers of mosquitos to be restored under Alternatives 2, 3, 4, and 5 with acreages under Alternative 1: No Action 50 years after project implementation.

All public health impacts of Alternatives 2, 3, 4, and 5 are common to the four alternatives.

Impact 7.1: Increase of Potential Mosquito Breeding Habitat

Approximately 134, 145, 118, and 129 acres of brackish marsh and seasonal wetlands would be restored with implementation of Alternatives 2, 3, 4, and 5, respectively. These acreages would represent an increase of approximately 94, 138, 78, and 122 acres, respectively, of potential mosquito breeding habitat from the acreage under Alternative 1: No Action. During construction, but before the perimeter levee is breached to establish tidal flow to portions of the site, surface water may pond in depressions created in portions of the work site as a result of excavation, filling, and grading activities. Areas that pond water for periods sufficient to allow production of adult mosquitos could also be temporary sources of mosquito production. Therefore, an increase in mosquito production would likely occur with implementation of Alternative 2, 3, 4, or 5.

The adjacent New Hamilton Partnership housing development would also increase the number of people potentially exposed to mosquitos produced on the site. Therefore, this impact is considered significant.

To reduce this impact to a less-than-significant level, the Coastal Conservancy and the Corps shall implement Mitigation Measure 7.1.

Mitigation Measure 7.1: Coordinate Project Activities with MSMAD. The Coastal Conservancy and the Corps shall consult and coordinate with MSMAD during design, implementation, and operations phases of the project. The Coastal Conservancy will be responsible for coordination with MSMAD regarding mosquito control measures for the project area following completion of project construction. Consultation and coordination with MSMAD shall include the following actions:

- Consult with MSMAD during the project design phase to incorporate design elements of nontidal wetland habitats to reduce the mosquito production potential of the project. Measures considered should include designing water delivery and drainage systems in nontidal habitats to allow for rapid manipulation of water levels in wetlands.

- Consult with MSMAD to develop and implement feasible measures to reduce the likelihood of ponding of surface water on the project area during the construction period and to implement other mosquito abatement measures that are compatible with construction activities.

- Permit MSMAD to have access to the project area to monitor or control mosquito populations.

- Regularly consult with MSMAD to identify mosquito management problems, mosquito monitoring and abatement procedures, and opportunities to adjust water management practices in nontidal wetlands to reduce mosquito production during problem periods.

- ~~Consult with MSMAD to identify annual mosquitofish stocking requirements in nontidal wetlands.~~

- If it is necessary for MSMAD to increase mosquito monitoring and control programs beyond preproject levels, consult with MSMAD to identify opportunities for the Coastal Conservancy to share costs or otherwise participate in implementing mosquito abatement programs.

Potential Issues and Resolutions under the Bel Marin Keys V Scenario

The Coastal Conservancy and Corps are considering this alternative at a programmatic level in the event that the BMKV parcel could be acquired for restoration before one of the other project alternatives could be implemented. Conceptually, the habitat types to be restored and the methods used to restore the habitats would be same as proposed under Alternative 5.

Table 7-5 compares the predicted quantities of habitats restored under the BMKV Scenario with Alternative 1: No Action 50 years after project implementation.

Potential issues and resolutions under the BMKV Scenario are the same as those described for Alternative 5, except that approximately 203 acres of additional potential mosquito breeding habitat would be created.

Table 7-5.
Estimated Acreage of Potential Problem Mosquito Breeding Habitats Restored and Net Change in Habitat Acreages under the BMKV Scenario 50 Years after Project Implementation

Habitat Type	Acreage in HAAF, SLC, and BMKV Parcels	BMKV Scenario	
		Estimated Acreage of Restored Habitat Area	Net Change in Acreage from Alternative 1: No Action
Brackish marsh	31.1	0[a]	-31.1[a]
Seasonal wetland	37.5	313.5[b]	+276[b]
Tidal pannes[c]	0	80.3	+80.3
Total	68.6	393.8	+325.2

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[a] An unknown quantity of brackish marsh will develop as inclusions within restored seasonal wetland habitat areas.

[b] Will include an unknown quantity of brackish marsh and brackish open water habitat area.

[c] Tidal pannes are located at the highest elevations in coastal salt marshes and are shallow depressions that pond shallow water received during periods of extreme high tides and from freshwater runoff.