Chapter 4, part E. SUBSIDENCE ON DELTA ISLANDS

CALFED GOALS AND OBJECTIVES

Reducing and reversing Delta island subsidence relates to the objectives of the Water Quality and Ecosystem Restoration Programs and more indirectly affects the Levee System Integrity program. Subsidence control measures could change the concentrations and quality of organic carbon in Delta water exports, thus affecting drinking water quality. In addition, the feasibility of wetland rehabilitation of subsided land depends on restoring its elevation to sea level. In the longer term, reducing and reversing island subsidence affects emergency management in the Delta islands since the consequences of a levee breach become more severe as the islands continue to subside.

CONCEPTUAL MODEL

The problem of controlling subsidence on Delta islands can be divided into five subject areas:

1. **Effects of Subsidence on Land Use and Water Quality** – As islands subside, the rate of water seepage through the levees increases. Increased seepage increases pumping costs, and can affect levee stability and increase the loads of dissolved organic carbon (DOC) and disinfection byproduct precursors (DBPP) in drainage water pumped back into the channel. The current amount of seepage and the effects of island subsidence on seepage, levee deformation, and water quality have not been quantified.

1. **Causes and Rates of Subsidence** – Subsidence of Delta peat soils is primarily caused by microbial oxidation of soil organic matter and secondarily by peat soil consolidation. Accurate estimates of present-day subsidence rates and prediction of future subsidence rates are important for determining where subsidence control efforts should be focused. Previous estimates are out-of-date.

2. **Peat Thickness**– Since the oxidation of peat results in land subsidence, the thickness of the peat determines future potential land subsidence. The available data are based on land-surface elevations determined in 1974 and 1975 and are out-of-date and inaccurate.

3. **Priority Areas for Subsidence Control** – Priority areas identified for subsidence control efforts are out-of-date and need to be reassessed based upon current subsidence rates and measures of peat thickness.

4. **Land- and Water-Management Practices for Reducing and Reversing Subsidence** – Oxidation of soil organic matter is dependent on soil moisture, temperature and organic matter content. Possible land- and water-use options for reducing, stopping or reversing subsidence include permanent shallow flooding, reverse flooding, deep flooding to create open-water habitat, saturated pasture, accretion of the land surface with imported biomass, and mineral capping of peat soils. Studies are presently under way to evaluate some of these options.

MONITORING AND RESEARCH ELEMENTS

Following are the monitoring and research recommendations for better quantifying, understanding, and controlling subsidence on Delta Islands and its effects on water quality:

Future Effects of Subsidence on Land Use and Water Quality

- Quantification of hydrologic inputs and outputs for Delta islands, including

seepage, drainflows, irrigation diversions and crop consumptive use.
- Effects of current and future seepage on levee stability.
- Effects of future subsidence on levee deformation.
- Economic consequences of continued subsidence on agricultural production.
- DOC and DBPP loads (concentration times volume) in drainage water from Delta islands.
- Quantification of the increased amount of sea water that could intrude onto Delta islands after levee failure as a result of continued island subsidence.

Causes and Rates of Subsidence
- Present subsidence rates for peat soils throughout the Delta need to be quantified.
- Improved quantification of soil consolidation and microbial oxidation, the processes causing subsidence.
- Organic matter content of soils in Delta.

Peat Thickness
- Peat thickness for soils in the Delta.

Priority Areas for Subsidence Control
- Identify priority areas for future data collection and subsidence control based on present-day subsidence rates and peat thickness and organic matter content.

Land- and Water-Management Practices for Reducing and Reversing Subsidence
- Effects of different vegetation and water-management practices on biomass accretion.
- Long-term biomass and land-surface accretion rates.
- Feasibility of large-scale application of biomass accretion.
- Effectiveness of other practices that can be used to control subsidence such as reverse flooding and wet pasture.
- Feasibility of using dredge materials for reversing the effects of subsidence and reducing microbial oxidation of peat soils.
- Effects of applying dredge material to peat soils.
- Effectiveness of sediment transport onto Delta islands for reversing the effects of subsidence.
- Utility of areas capped with dredge material.
- Effects of subsidence control efforts on water quality.

LINKAGES

The reduction and reversal of subsidence on Delta islands is strongly linked with the monitoring and research needs of the Levee System Integrity Program, Water Quality Program and Ecosystem Restoration Programs.

Delta Levees –The Levee System Integrity and Delta island subsidence control programs are interested in rates of subsidence, results of efforts to reverse subsidence, the extent of peat soils, and seepage rates through the levees.

Water Quality— Most of the water that seeps (or is siphoned as irrigation water) onto the islands must be pumped back into the channels. This water contains DOC and DBPPs derived from peat soils and crops. The concentrations of DOC and DBPPs in Delta island drainage water are of interest to both island subsidence and water quality programs.

Ecosystem Restoration – Islands with sunken interiors are not part of the natural landscape of the delta. Continued subsidence of islands coupled with high levees makes it difficult to find locations for wetland restoration efforts with normal water-flow dynamics from the rivers and tides. New knowledge gained from subsidence reduction and reversal efforts could benefit the Ecosystem Restoration Program. Permanent shallow flooded wetlands (ponds) on Twitchell Island have been shown to cause net-increases in biomass accretion.