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SPECIAL REPORT: Project Delivery Methods

California's Fragile Gem

By Rob Vining, M.S.A.M.E., and Gen. Barry R. McCaffrey, USA (Ret.)

California's Sacramento-San Joaquin Delta is many things to many people. It is home to 52 mammals, 22 reptile and amphibian species, 225 birds and 54 fish, including 130 listed endangered species. It is the source of potable water for two-thirds of California's population. It also is the lifeline for the nation's largest agriculture industry, which produces as much as 25 percent of the nation's food supply.

Yet, outside of California and the engineering community, few people are aware of the Sacramento-San Joaquin Delta and its critical role in the world economic market and to national security. The delta is in a state of crisis that puts California, the eighth-largest world economy, at significant risk. Absent timely remedies to address key ecological and water conveyance problems, a doomsday scenario may become reality.

A House of Cards

If a series of delta levees were to simultaneously fail, the impact to California,

the United States and the world would be staggering. Some experts predict the California agricultural industry could be permanently destroyed by a major flood. In fact, California's Department of Water Resources (DWR) indicates that in a failure scenario "the export of fresh water from the Delta could be interrupted for about 18 months."

In addition to crippling California's \$27 billion agriculture industry, a major flood would ruin water quality for Southern California's 25 million residents. Lack of potable water for 18 months would spiral the region into a sanitation crisis.

California's civil infrastructure also would be severely affected. The delta stores natural gas to accommodate peak wintertime demands, while electricity and gas transmission lines crisscross the region. Vital roads, including Interstate 5, state Route 4 and state Route 12, and several rail lines pass through the delta, as do the deepwater shipping channels leading to ports at Stockton and Sacramento.

As the April 2010 eruption of Icelandic

Soil subsidence, seismic activity, species decline and increased salinity at the Sacramento-San Joaquin Delta are placing a delicate ecosystem, water supply and national food supply at risk.

The Suisun Marsh, the largest brackish marsh on the West Coast, lies immediately west of the Sacramento-San Joaquin Delta.



Photo courtesy HNTB Corp.

volcano Eyjafjallajökull demonstrated, natural disasters can have a devastating effect on supply chains critical to global commerce. One recent study analyzed the economic consequences of multiple levee failures caused by a large earthquake. It predicted, among other calamities, shipping to the Port of Stockton would shut down, and disruptions of power and road transportation lines would occur. The total cost to the economy, over five years, was estimated at \$30 billion to \$40 billion.

The Four S's

The Sacramento Delta levees have become increasingly unstable. Unfortunately, with more than 200 existing federal, state and local agencies claiming jurisdiction over delta issues, remediation response has been painfully slow. Yet, a consensus has emerged citing "Four S's" as the cause of delta problems: seismic, subsidence, species and salinity.

Seismic. One of the most significant threats is seismic activity; and seismic forecasts are alarming. According to DWR, "A seismic event is the single greatest risk in the Delta Region." The DWR's Delta Risk Management Study goes further to indicate that "a major earthquake of magnitude 6.7 or greater in the vicinity of the Delta Region has a 62 percent probability of occurring sometime between 2003 and 2032."

Subsidence. Subsidence, or loss, of soil around the levees is a concern in the delta because it undermines structural integrity and increases water pressure on levees, thus increasing the probability of failure. The earthen levees, many built during the 1860s, are comprised of peat soil and material dredged from local rivers and canals, which is now known to be susceptible to subsidence. As a result, more than 50 of the delta's marsh islands are sinking at a rate of 1-in to 3-in every year.

Species. Once-thriving native plants and wildlife are diminishing due to through-delta conveyance, according to The Nature Conservancy. Native fish species like the delta smelt and Chinook salmon are at an all-time low. These declines ripple through the natural ecosystem and critically affect commerce. For example, partly due to low river levels, commercial salmon fishing off the coasts of California and Oregon has been shut down for the past two years, causing losses of nearly \$300 million

and devastating fishing communities.

Salinity. Salinity threatens the potability and taste of water supplies, the productivity of farmland and the viability of organisms within aquatic ecosystems. A levee failure during low flow conditions could allow salt water to flow up the delta from the San Francisco Bay and destroy the region's ecosystem and freshwater supply. During one incident, an island was flooded under low-flow conditions, and chloride levels reached 440-parts per million (ppm) at the Contra Costa Canal intake—a measure well above the California standard for drinking water of 250-ppm.

Walking a Tightrope

Fervent debate among issue groups has slowed progress. With many plants and wildlife under protected status, levee system repairs are constrained and challenging. To further mitigate the impact to endangered species, some groups are advocating for increased limitations on water diversions to the south. On the economic front, reduced water conveyance has driven unemployment in many agricultural areas as high as 27 percent, according to California labor force data.

There is no silver bullet to repairing the Sacramento Delta's environment or creating sustainable conveyance. There are, however, currently three project options under consideration to address the water conveyance issue:

- **East Conveyance Alignment:** The eastern alignment conveyance option runs along the eastern edge of the delta and includes 19 new bridges, 49-mi of canals, four short tunnels, eight siphons and 730 acres of forebay.
- **West Conveyance Alignment:** The western alignment conveyance option runs along the western edge of the delta and includes 20 new bridges, 34-mi of canals, 17-mi of long tunnels, 12 siphons and 720 acres of forebay.
- **All-Tunnel System:** Some argue that the all-tunnel system, which would divert water through a 43-mi-long tunnel under the delta to south of the San Francisco Bay, would best protect the environment and secure California's fresh water supply. Advocates say it leaves a smaller footprint and is more economically feasible than the east and west conveyance proposals.

Bridging Troubled Waters

Given California's budget crisis, financing delta improvements could prove difficult as constituencies compete for scarce resources. While economic interests such as sport fishing and agriculture advocate for enhanced conveyance, environmentalists, pitted against each other, argue for preservation of plants and animals. Representatives from the state and federal governments must answer to each constituency.

Despite the rancor, California's legislature took a step in the right direction in passing the "Comprehensive Water Package," which set requirements for future delta governance, enacted conservation policy, triggered groundwater elevation monitoring and improved delta water diversion accountability. This package also memorialized the "Co-Equal Goals" for reliable water supply and ecosystem conservation.

A Collaborative Approach

A collaborative approach—from policymaking to funding—will be critical to saving California's San Joaquin Delta. On the federal side, advocates must work with federal officials to identify suitable grants and appropriations. At the state and local levels, flood management agencies must work together to coordinate funding requests and promote policy that meets the state's goals for water infrastructure programs. It also will be critical to develop economic incentives to encourage private investment.

Water departments must make the case to their customers that restoring the delta should be a top priority through public involvement and educational outreach programs. Given the dire consequences of inaction—irreversible environmental damage, loss of drinking water for 25 million people, compromise of the world's eighth-largest economy, transportation interruptions and loss of land, homes and possibly even lives—the United States and the state of California cannot afford to delay. **TME**

Rob Vining, M.S.A.M.E., is National Water Resources Practice Leader, and Gen. Barry R. McCaffrey, USA (Ret.), is a member of the Board of Directors and National Security Expert, HNTB Corp. They can be reached at 703-253-5905 or rvining@hntb.com, or 703-824-5160 or brm@mccaffreyassociates.com, respectively.