PL 84-99 Rehabilitation and Inspection Program (RIP)
January/April 2006 Flood Event, California/Nevada

25 October 2006

US Army Corps
of Engineers®
Sacramento District

Background: *New Year's 2006 Flood Event*

A series of storms struck Northern California and Nevada in late December and early January. The Sacramento River, Truckee River and several tributaries reached flood stage. In addition to high flows, high tides and winds were experienced in the Sacramento San-Joaquin Delta. The Sacramento Weir was opened for the first time since 1998 to reduce water levels near the City of Sacramento. A Federal Disaster Declaration was issued for 31 counties in California and six in Nevada for the severe storms, flooding, mudslides and landslides.

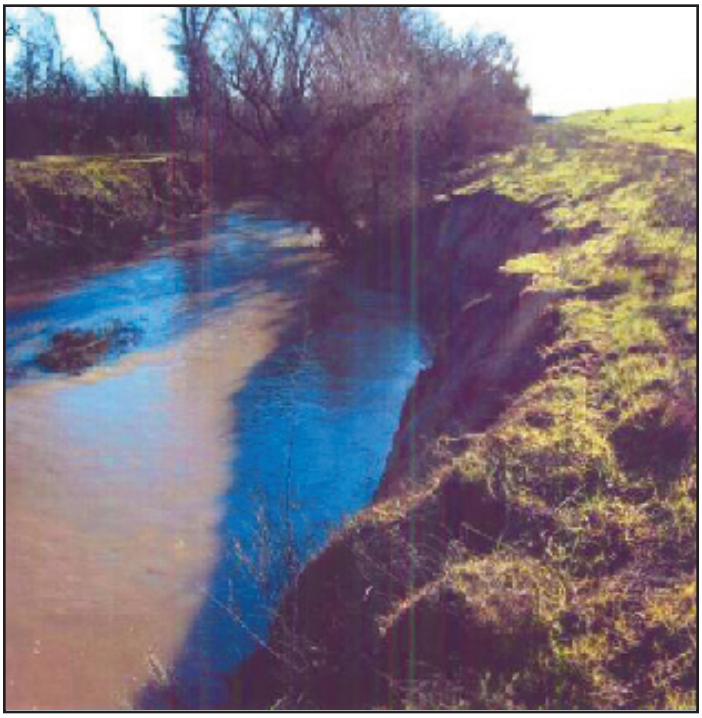
A Notice to Public Sponsors dated February 2, 2006 was distributed seeking requests for rehabilitation assistance on eligible flood control projects damaged during the period of December 28, 2005 through January 9, 2006. Water levels remained high during the application period which was extended until April 3 to allow sponsors additional time to identify damages. Water levels rose for a second time in April extending through June in some parts of the system further stressing the already damaged levees. The U.S. Army Corps of Engineers, Sacramento District received 43 requests for assistance, which encompass more than 300 sites distributed throughout Reclamation Districts (RD) and Maintenance Areas (MA) in northern California and the state of Nevada . An initial evaluation of the requests indicated that many of them are eligible for assistance under the PL 84-99 Program.

[See New Year's Flood Event Maps, Plates 1-3]

Sacramento River at RD 3

Riverside levee slope erosion up to 12-feet high with loss of existing rock protection at RD 150

Sacramento River RD 551



Bank erosion along levee slope at RD 10

Background: *Spring 2006 Flood Event*

Following the flood events of late December and January, another series of storms struck southern Sierra Nevada and San Joaquin Valley beginning April 2006. The reservoirs on the San Joaquin River system have limited abilities to release water quickly because of restricted channel capacity below the reservoirs. Faced with rapidly filling reservoirs, officials were left with little choice but to release more water downstream as inflows continued high. In the following days, part of the San Joaquin River system exceeded design capacity, increasing the strain on levees and elevating the risk of levee failures. With the snowmelt season following just on the heels of this heavy precipitation event and the snow pack well above normal, high flows continued on the San Joaquin River system for quite some time. Some areas experienced high water through mid-June. Releases from upstream reservoirs had remained elevated to make room for the impending snowmelt, which usually peaks in late May or early June. A Federal Disaster Declaration was issued June 6, 2006, for 16 counties for the severe storms, flooding, mudslides and landslides.

A Notice to Public Sponsors dated June 16, 2006, was distributed seeking requests for rehabilitation assistance on eligible flood control projects damaged during the period of March 28, 2006, through June 1, 2006. The U.S. Army Corps of Engineers, Sacramento District, received nine requests for assistance. These nine requests encompass more than 90 sites distributed throughout nine Reclamation Districts (RD) and Maintenance Areas (MA) in central California.

[See Spring 2006 Flood Event Maps, Plates 1 and 2]

RD 755 Site 001

RD 17 Site 11 at the water's edge looking downstream

RD 17 Site 15

Field Inspections:
Order 1 and Order 2 Sites

Sacramento District Engineers have developed criteria to categorize the sites by severity of damage and impact to life and property. Using these criteria, all eligible damage sites identified in the requests for assistance have been separated into five categories. Order 1 site damages are severe enough that they may lead to loss of the levee before the next flood season. These levees are protecting urban areas where lives are at risk or where there may be a large economic impact. Order 2 site damages are severe enough that they may lead to loss of the levee before the next flood season. These levees are protecting areas with less development.

In June and again in September, teams comprised of representatives from the Corps and DWR inspected more than 400 sites. These teams coordinated with each of the individual Reclamation Districts to ensure attendance and active participation by the local proponent. The sites of most concern are the sites that were classified as Order 1 and 2.

Along the Sacramento River System, the 36 Order 1 sites total approximately 9,287 linear feet of damage with an estimated repair cost of $50.5 million and the 44 Order 2 sites total approximately 27,821 lin. ft. with an estimated cost of $110 million. These costs are comparable to the ongoing $220-plus million erosion repair effort underway along the Sacramento River. A lack of contractors and barges, and the higher price of fuel and rock used to repair the levees, are currently inflating the costs for completing repairs.

Also, there are four Order 1 sites in the San Joaquin River System totalling approximately 3,760 lin. ft. of damage with an estimated repair cost of $9 million and nine Order 2 sites totalling approximately 7,100 lin. ft. with an estimated cost of $28 million.

Technical Criteria - Order 1 and 2 sites:

- Vertical cut in the levee slopes higher than 10 feet
- Vertical cut close to the levee crown with high traffic on the paved road on the levee crown (i.e. Hwy 160)
- Slides in the waterside or landside levee slope close to the levee crown that may lead to progressive failure of the levee
- Sand boils removing material from the levee foundation that may lead to collapse of the levee due to piping

10-foot high vertical cut of the levee slope at BALMD

Field Inspections:
Order 3, 4 and 5 sites

Based on the site visits in June and September, all sites were categorized into five orders of damage severity. The sites of most concern were the 93 Order 1 and Order 2 sites. The remaining 223 classified sites fall under Order 3, 4, or 5.

While Order 3, 4, and 5 damages will need to be repaired eventually, they have been determined to be less critical for the upcoming flood season. Order 3 damages remain severe, but are less likely to cause a levee breech this flood season. The type of damages include erosion of the levee toe between 5 and 10 feet in depth, loss of riprap and erosion measuring betweeen 4 to 8 feet in depth on the levee slope, small slides of the levee toe, and wave wash between 3 and 5 feet. Order 4 damages are minor and may be exacerbated during the next flood. The type of damages include wave wash less than 3 feet into the levee slope, erosion measuring less than 3 feet of the levee toe, and damages to the levee patrol road. Order 5 damages are the least severe and considered minor. This category includes any remaining flood damages.

The 148 Order 3, 4, and 5 sites in the Sacramento River System total approximately 60,336 lin. ft. of damage with an estimated repair cost of $190 million.

The San Joaquin River System has additional sites as well. There are 75 Order 3, 4, and 5 sites in the San Joaquin River System totaling approximately 22,926 lin. ft. of damage with an estimated repair cost of $64 million.

Technical Criteria - Order 3 sites:

- Vertical cut of the levee toe at least 5 feet but less than 10 feet
- Loss of riprap and erosion 4 to 8 feet into the levee slope
- Small slides of the levee toe
- Wave wash 3-5 feet and erosion of the levee toe

Technical Criteria - Order 4 sites:

- Wave wash less than 3 feet into the levee slope
- Erosion less than 3 feet of the levee toe
- Seepage with clear water not carrying material from the levee foundation or levee embankment
- Damages to the crushed rock of the levee patrol road

Technical Criteria - Order 5 sites:

- All other minor damages that will not affect the functionality of the levee and are not critical for the levee embankment

Sacramento River East Levee, Sutter Maintenance Yard, North of Colusa