An hourglass-shaped graphic with a globe inside. The top bulb is dark blue, and the bottom bulb is light blue. The globe is a darker shade of blue. The hourglass is centered on the page.

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February 2, 2009

Congressional Research Service

Report RL33682

*Sacramento Flood Control and Folsom Dam: Recent Action  
and Current Issues*

Nicole T. Carter, Charles V. Stern, and Betsy A. Cody, Resources, Science, and Industry Division

October 6, 2006

**Abstract.** This report outlines recent major federal involvement in flood control in the Sacramento region of California, with particular attention to recent changes and developments in the construction of projects at Folsom Dam. It outlines recent congressional and agency actions intended to strengthen flood control in this region, and provides an update on the status of these actions.

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## **Sacramento Flood Control and Folsom Dam: Recent Action and Current Issues**

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# Sacramento Flood Control and Folsom Dam: Recent Action and Current Issues

## Summary

Sacramento, California, is among the U.S. cities most vulnerable to flooding, and regional growth is increasing the potential losses from flooding. A major flood could inundate developed and agricultural areas, disrupting the economy and damaging infrastructure and property. How to reduce flood risks in developed and developing areas is a problem faced by communities nationwide, and is receiving increased attention as the reliability of existing infrastructure is reevaluated in the aftermath of Hurricane Katrina.

Sacramento's flood protection system, which includes levees on the American and Sacramento Rivers as well as Folsom Dam on the American River, has been crucial in protecting the city over the last 50 years. Storms in 1986 and 1996 prompted increased attention to Sacramento flood concerns from the federal government, which subsequently has contributed efforts to reduce the city's flood vulnerability.

Beginning in 1987, Congress authorized and appropriated funds for several studies by the U.S. Army Corps of Engineers (Corps) to investigate flood protection in the Sacramento area. These studies showed that the city's flood damage reduction system provided less than 100-year flood protection (i.e., a greater than 1% annual chance of flooding). The studies suggested a number of options to augment flood protection, including improvements to local levees, various changes and additions to the federally constructed Folsom Dam, and a dam upstream from Folsom Dam on the American River (Auburn Dam).

Since 1992, Congress has authorized a variety of actions, including improving levees and modifying Folsom Dam. Although Congress authorized plans to expand Folsom Dam's capacity to regulate larger floods, some planned activities have become problematic due to changes in cost estimates. Current studies are exploring additional potential options addressing flood control in the area. Congress is likely to revisit issues relating to authorization, cost, and oversight of Sacramento flood protection projects. Reconsideration of Auburn Dam on the American River (also known as the Auburn-Folsom South Unit) or another dam near the Auburn site also may be debated.

In addition to structural changes at Folsom Dam, Congress also has authorized and implemented dam operational changes. Some actions to rehabilitate and improve levees on the American and Sacramento Rivers are currently under construction; others have been delayed and are undergoing reevaluation.

This report briefly outlines recent major federal involvement in flood control in the Sacramento region of California, with particular attention to recent changes and developments in the construction of projects at Folsom Dam. It outlines recent congressional and agency actions intended to strengthen flood control in this region, and provides an update on the status of these actions.

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# Sacramento Flood Control and Folsom Dam: Recent Action and Current Issues

## Introduction

The city of Sacramento is located northeast of San Francisco Bay in California at the confluence of the American and Sacramento Rivers. The city's<sup>1</sup> location puts it among the U.S. cities most vulnerable to significant flooding. Potential flood losses grow as development in the area places more lives and properties in harm's way. As illustrated by disasters like Hurricane Katrina, flood damage reduction infrastructure cannot protect all areas, control all floods, and be completely reliable. To reduce flooding risks in Sacramento, local, state, and federal entities have built dams, levees, and other structures, including the federally constructed Folsom Dam on the American River. These entities currently are studying and pursuing ways to improve the reliability, capacity, and operations of the existing infrastructure as well as construction activities to modify and build flood damage reduction infrastructure. Whether and how to combine nonstructural methods (e.g., building restrictions and codes, insurance premiums) and structural methods (e.g., levee strengthening, dam modification, new dam construction) for managing flood risks is the subject of some dispute among stakeholders.

Following a significant flood threat in 1986, Congress in 1987 authorized the U.S. Army Corps of Engineers (Corps) to study additional flood damage reduction measures (e.g., dam and levee improvements, construction of new structures, adoption of operational improvements). Since then, Congress has authorized and appropriated funding for studies and construction of specific flood damage reduction measures. This report outlines the status of these studies and measures, with particular attention to measures at Folsom Dam.<sup>2</sup>

**Historical Efforts to Reduce Flood Vulnerability.** Sacramento has historically been prone to flooding. As shown in **Figure 1**, the American River descends the Sierra Nevada crest from the northeast down to the city of Sacramento, where it meets the largest river in California, the Sacramento River. On occasion, warm and wet West Coast storm patterns deliver rain in the nearby mountains, which can create very large flows on the American River; the American River water then

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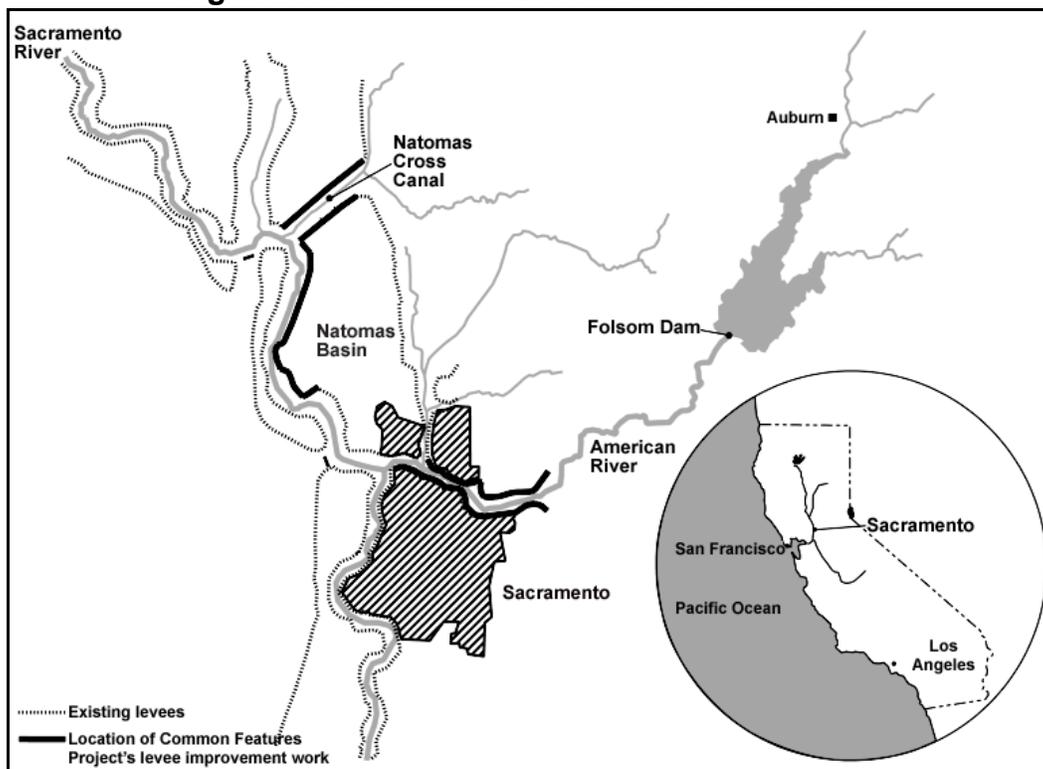
<sup>1</sup> For the purposes of this report, the term "city of Sacramento" refers to the City of Sacramento, portions of Sacramento County near the American River, and the Natomas Basin (which is located in the City of Sacramento and Sacramento and Sutter Counties).

<sup>2</sup> Additional nearby regional floodwater management projects have been authorized by Congress, but are not the subject of this report. These include West Sacramento (Sacramento River and Yolo Bypass levees), Sacramento County (South County Streams Group) and Sutter and Yuba Counties (Yuba River Basin Project on the Feather and Yuba Rivers).

combines with the formidable flows of the Sacramento River, producing a high flood threat to the greater Sacramento area. Sacramento historically suffered significant damage during these storms. Soon after the city's founding in 1839, local efforts were undertaken to reduce the city's flood damages. A complex set of levees, dams, and related facilities were built near and within the city on both the Sacramento and American Rivers.

Levees were built to keep flood waters confined to the river, and out of the floodplain where the city is located. **Figure 1** shows levees lining both sides of the American River from its intersection with the Sacramento River upstream for 17 miles. Levees also completely surround the Natomas Basin, a historically agricultural area just north of Sacramento and east of the Sacramento River.

**Figure 1. Sacramento Levees and Folsom Dam**



These levees work in combination with Folsom Dam, which operates to capture flood waters and for other purposes (e.g., hydropower, irrigation, and municipal/industrial uses). Congress authorized construction of Folsom Dam 29 miles northeast of Sacramento, at the confluence of the North and South Forks of the American River (shown in **Figure 1**), in the Flood Control Act of 1944 (P.L. 78-534). The Corps completed construction of the 340-foot high structure in 1956. The dam was designed to regulate floodwaters by capturing heavy inflows from the upper American River watershed in the dam's reservoir. After construction, dam operations were transferred to the Bureau of Reclamation (Bureau) as part of the Central Valley Project.<sup>3</sup>

<sup>3</sup> As part of the Central Valley Project, dams provide hydroelectricity, irrigation, and (continued...)

Other major multipurpose dams considered along the American River included Auburn Dam on the American River (see **Figure 1**). After decades of study by state and federal agencies, a dam at the Auburn site and substantial distribution facilities (commonly known as the Auburn-Folsom South Unit) were authorized in 1965 (P.L. 89-161). Although the primary purpose of the dam as authorized was to provide new and supplemental water supply for irrigation and municipal and industrial needs, another long-sought purpose of the project was to provide flood control benefits for the lower American River. Construction on the dam began in 1965, and was halted in 1975 due to seismic safety concerns.

Some stakeholders continue to promote discussion of a dam at the Auburn site as an attractive alternative for managing floodwaters on the American River. Efforts to authorize construction of such a dam were unsuccessful in 1992, 1996, and 1999. (For more information, see “Studies” and “Other Considerations,” below; for some history of Auburn Dam, see out-of-print CRS Report 96-447 ENR, *Auburn Dam on the American River: Fact Sheet*, by Betsy A. Cody, Steve Hughes, and Shelley Price, available upon request from the authors.)

**Evolving Understanding of Flood Risk.** Sacramento is facing a problem confronting communities nationwide as they update their flood hazard maps for the National Flood Insurance Program. Local agencies responsible for flood control have to demonstrate that their protection meets the 1% threshold (i.e., a greater than 1% annual probability of a flood). The 1% standard is used for imposing building restrictions and insurance requirements under the National Flood Insurance Program.

Sacramento’s flood risk has been periodically reevaluated as understanding and factors affecting its components change. Flood risk is the composite of three factors:

- threat of an event (e.g., probability of flood flows of different sizes affecting the region);
- consequence of an event (e.g., property damage, loss of life, economic loss, environmental damage, reduced health and safety); and
- vulnerability that allows a threat to cause consequences (e.g., level of protection provided by levees and dams, and their reliability).<sup>4</sup>

In designing Folsom Dam and other flood control projects to reduce Sacramento’s vulnerability to flooding, Corps engineers used historic rainfall records, river flows, runoff data, land use information, and statistical tools available at the time. The initial design of Folsom Dam was for a dam with levees to protect against the threat of the largest documented flood in the watershed, which at the time was the flood of 1862; that design was soon adjusted to protect against a higher threat.

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<sup>3</sup> (...continued)

municipal and industrial water supplies throughout California. During a flood, the Corps prescribes flood operations while the Bureau continues to physically operate the facilities.

<sup>4</sup> For a discussion of flood threat, consequence, and vulnerability, see CRS Report RL33129, *Flood Risk Management: Federal Role in Infrastructure*, by Nicole T. Carter.

Large storms in 1955, 1964, 1986, and 1996 produced rainfall in excess of any previous storm on record for the region. The floods in 1950 and 1955 and additional analysis following construction suggested that the dam and levees would provide less protection than originally estimated; in 1961, the Corps lowered its estimate of the city's protection level to protection from a 120-year event (i.e., a storm creating floodwaters that have a 0.83% annual probability of occurring).<sup>5</sup>

Then in 1986 (and again in 1996), the volume of flood waters came within 90% of Folsom Dam's flood operation capacity. The 1986 storm produced record inflows into Folsom Dam's reservoir, resulting in dam operators releasing floodwaters into the American River at a rate exceeding 115,000 cfs (cubic feet per second), which is the safe conveyance capacity for outflow on the river's channel below the dam. Portions of the city were nearly flooded as the American River came within inches of overtopping the levees; a major disaster for threatened areas was avoided only by abating storm conditions. A subsequent National Research Council report concluded that operational carelessness led to errors in dam operation during the 1986 flood that contributed to the flood threat that the city was exposed to.<sup>6</sup>

Recent studies using a more comprehensive picture of the city's flood risk place the city's flood protection at less than the 100-year level (i.e., a greater than 1% annual probability of a flood affecting the city). This revised estimate of protection is based on an improved understanding of the city's vulnerability that considers both the level of protection provided by levees and dams and the reliability of those structures. In particular, decreased confidence in levee reliability contributes to higher flood vulnerability estimates (i.e., lower estimates of the level of flood protection); confidence that levees can perform up to their full design capacity has decreased in the wake of levee failures in the region and weaknesses (using current standards) identified in levee construction and foundations. Some observers raise additional concerns about the city's level of protection; they note that storm and climate variability, as well as runoff patterns that can result from land use changes such as conversion of agricultural land to residential and urban land uses, may contribute to a higher flood threat than is currently assumed.

Large storms could have a particularly catastrophic impact on Sacramento. A decade-old estimate of damages from an over 500,000 cfs peak inflow into Folsom Dam reservoir (400-year flood, or 0.25% modeled annual likelihood) indicated that Sacramento would suffer \$16 billion in residential, commercial, industrial, and public property damage, in addition to the disruption of government and transportation networks, and the loss of lives.<sup>7</sup> Recent growth in the Sacramento area may increase flooding damages.

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<sup>5</sup> For a discussion of risk analysis and flooding, see National Research Council, *Risk Analysis and Uncertainty in Flood Damage Reduction Studies* (Washington, DC: 2000).

<sup>6</sup> National Research Council Committee on Flood Control Alternatives in the American River Basin, *Flood Risk Management and the American River Basin* (Washington, DC: 1995).

<sup>7</sup> This estimate is from U.S. Army Corps of Engineers and State of California Reclamation Board, *Supplemental Information Report, American River Watershed Project, California* (Sacramento, CA: March 1996). Unless otherwise indicated, costs in this report have not been adjusted for inflation.

## Recent Efforts to Reduce Flood Vulnerability

Following the 1986 storm, the Corps, the California Reclamation Board, and the Sacramento Area Flood Control Agency (SAFCA) formed a partnership to find ways to reduce flood vulnerability and losses. Since 1992, Congress has authorized construction of physical modification projects to improve flood protection around Sacramento and Folsom Dam, including (1) the Common Features Project that consists of levee improvements on the American and Sacramento Rivers; (2) the Folsom Dam Modification that entails changes to the flood gates and spillway of Folsom Dam; and (3) the Folsom Dam Raise that elevates the concrete and earth portions of the dam, provides for the construction of a permanent bridge, and authorizes other related measures.<sup>8</sup> Construction of the Common Features, the Dam Modifications, and the Dam Raise as currently planned would raise the flood protection for Sacramento to a 1 in 233-year flood (0.4% annual chance of flooding). These projects would improve levee reliability and permit higher releases from Folsom Dam. The non-federal partners for these projects are the State of California and the Sacramento Area Flood Control Agency.

It should also be noted that Congress has authorized several operational changes to Folsom Dam, including forecast-based operations and variable storage. Re-operation is important in achieving the shared goals of the federal, state, and local partners. Forecast-based operations, authorized in the Department of Defense Appropriations Act of FY1993 (P.L. 102-396), allow for the release of waters from Folsom Dam in advance of anticipated floodwaters. Variable storage was originally authorized in the Water Resources and Development Act of 1996 (WRDA 1996, P.L. 104-303), and provides for additional flood storage capacity in Folsom Reservoir depending on the levels of other reservoirs in the American River watershed. Depending on the results of analyses underway, implementing re-operation may require congressional action. Since the focus of this report is on structural modifications to flood control structures, operational changes will receive little additional treatment here.

**Studies.** After Sacramento nearly flooded in 1986, the Corps with state and local partners initiated a reconnaissance study of the need to provide additional flood protection to the city.<sup>9</sup> Based on the reconnaissance study, a feasibility study was authorized in Continuing Appropriations for 1987 (P.L. 99-591). The feasibility study was directed to define flood risks and develop potential projects to increase flood protection in the American River watershed.

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<sup>8</sup> Congress also authorized levee improvements and related project features for the Natomas basin. This CRS report does not address these improvements because they are not located on the main stem of the American River. For more information on the history and status of the Natomas levee improvements, see the Corps' fact sheet on the project, available at [[http://www.spd.usace.army.mil/projectfacts/ca/civ/AmericanRiverWatershedNatomas/factsheet/78\\_9211.htm](http://www.spd.usace.army.mil/projectfacts/ca/civ/AmericanRiverWatershedNatomas/factsheet/78_9211.htm)].

<sup>9</sup> The basic authority for the Corps to study flood control needs in the American River basin is the Flood Control Act of 1962 (P.L. 87-874; §209).

The Corps' resulting 1991 Feasibility Report<sup>10</sup> analyzed six flood protection options designed to protect the region from flood levels produced by 100 to 400 year events. The report recommended building a 508-foot dry dam on the American River at Auburn, CA. A dry dam is a dam built for use only in a flood; the Auburn Dam that was halted in 1975 was not a dry detention dam, but a multi-purpose facility with a permanent reservoir. The Administration did not support the Corps' proposal, and Congress instead authorized construction of levee improvements in the Natomas Basin in 1993. Congress also requested additional information on flood prevention alternatives in a supplemental report.<sup>11</sup>

The resulting Corps 1996 Supplemental Report<sup>12</sup> identified three separate plans for greater flood protection in the Sacramento region: (1) the Folsom Modification Plan; (2) the Stepped Release Plan; and (3) the Detention Dam Plan at the Auburn site. The first two plans modified Folsom Dam's release and storage capacity, while the third plan called for a dry dam at the Auburn site. While the Folsom Dam alternatives had lower federal costs than the Auburn site alternative, their estimated flood damage reduction benefits were lower because they would provide lower flood protection levels than a detention dam at the Auburn site. Estimates at the time indicated that the Folsom Modification Plan would provide 180-year flood protection (0.55% chance of flooding annually) and the Stepped Release Plan would provide 250-year protection (0.4% chance); the detention dam at the Auburn site was estimated to provide 400-year protection (0.25% chance).<sup>13</sup>

**Common Features.** Recognizing the contentious nature of the three proposed plans, Congress approved in §101 of the Water Resources Development Act (WRDA) of 1996 (P.L. 104-303), a basic set of levee improvements on the American and Sacramento Rivers that were common to all three plans. Congress subsequently authorized several miles of additional levee improvements, as well as an increase in the federal funding cap, in §366 of WRDA 1999 (P.L. 106-53). **Figure 1** shows the location of the levee improvements relative to existing levees. Together, the 1996 and 1999 WRDA levee improvements became known as the Common Features Project; these improvements primarily consisted of constructing cut-off walls<sup>14</sup> to increase the reliability of the flood protection structures in the Sacramento area. The fortified levee system would allow for increased conveyance capacity of the river channel, thus permitting larger releases from Folsom Dam during a flood.<sup>15</sup>

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<sup>10</sup> U.S. Army Corps of Engineers and State of California Reclamation Board, *Feasibility Report, American River Watershed Investigation*, California (Sacramento, CA, Dec. 1991).

<sup>11</sup> Authorization for the 1996 supplemental study and improvements to the Natomas Basin levee system were provided in the Department of Defense Appropriations Act, 1993 (P.L. 102-396; §9159).

<sup>12</sup> U.S. Army Corps of Engineers and State of California Reclamation Board. *Supplemental Information Report, American River Watershed Project, California*, (Sacramento, CA: March 1996).

<sup>13</sup> At the time, the peak of the inflow design flood for these three projects were modeled at 370,000 cfs, 440,000 cfs, and over 500,000 cfs.

<sup>14</sup> Cut-off walls are an impermeable mixture of soil, cement, and clay that is inserted into a levee and its foundation to prevent water seepage and resulting structural weaknesses.

<sup>15</sup> While conveyance has historically been limited to 115,000 cfs of flow from the dam, the  
(continued...)

**Figure 2. Folsom Reservoir and Dam**

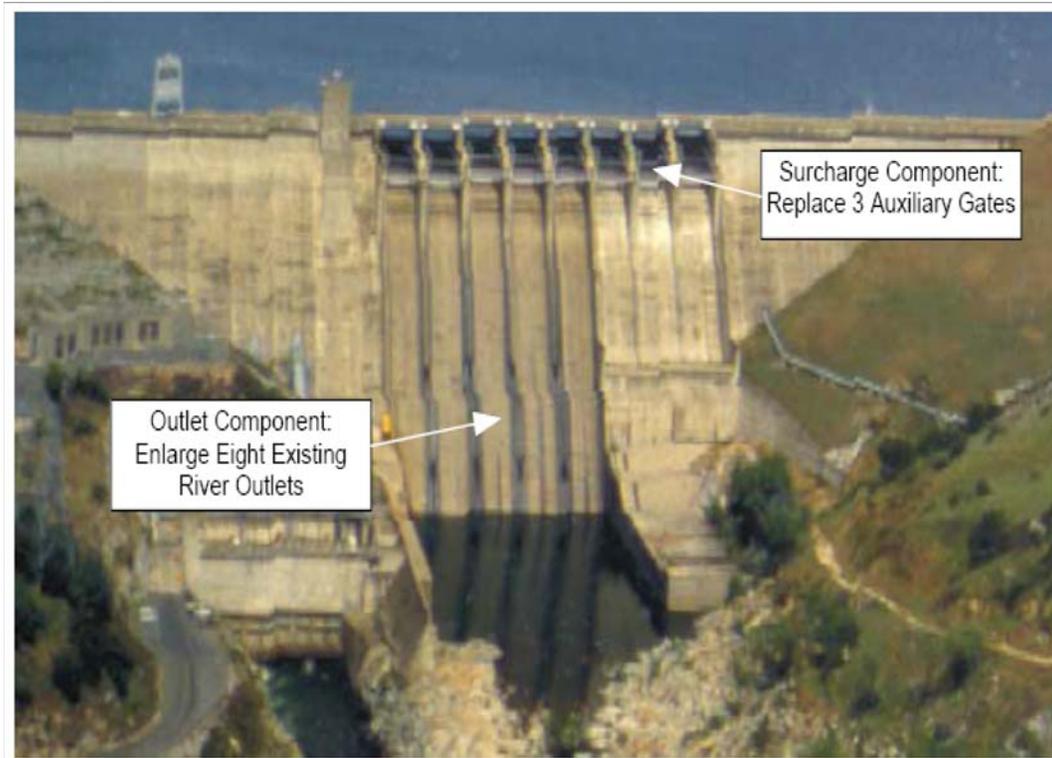
**Source:** U.S. Army Corps of Engineers. *Post Authorization Decision Document: American River Watershed Project, Folsom Dam Raise, Folsom Bridge* (Sacramento, CA: May 2006).

**Modification Plan.** Section 101 of WRDA 1999 authorized the Folsom Dam Modification Project. The modification project would increase the maximum safe releases from the dam while also allowing increased storage at Folsom Reservoir (shown above in **Figure 2**) by four feet (720,000 acre-feet). It would do this primarily by expanding existing dam outlets and replacing emergency gates.<sup>16</sup> At the time of passage, these improvements were thought to raise flood protection levels to the 140- to 160-year level. Selected components of the Folsom Dam Modification Project having to do with alterations to the dam are shown below in **Figure 3**. Additional studies to improve flood storage capacity were authorized in §566 of WRDA 1999.

<sup>15</sup> (...continued)

Common Features improvements make possible releases of 145,000 cfs (i.e. a 26% increase in release capability). See U.S. Army Corps of Engineers. *Post Authorization Decision Document: American River Watershed Project, Folsom Dam Raise, Folsom Bridge*, (Sacramento, CA: May 2006).

<sup>16</sup> The auxiliary gates on top of the dam are opened when the lake's excess flood storage capacity, or *surcharge capacity*, is filled. Portions of the modification plan dealing with increasing this capacity are commonly known as the "surcharge components."

**Figure 3. Folsom Dam Modification: Selected Dam Alterations**

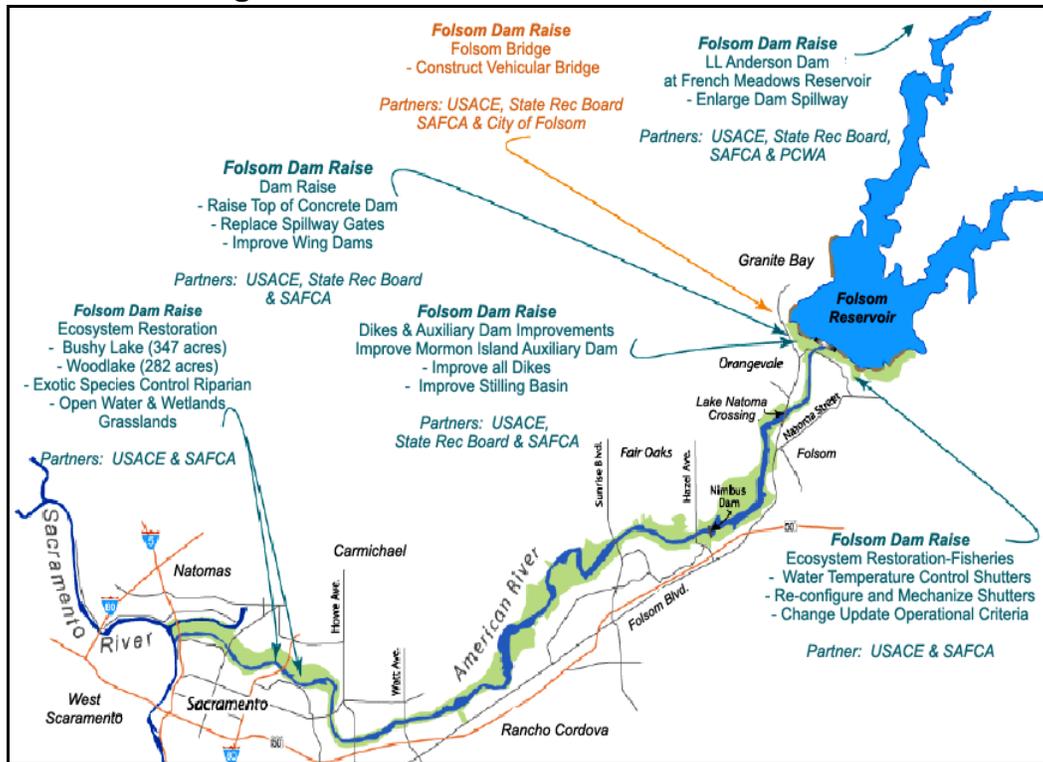
**Source:** U.S. Army Corps of Engineers.

**Dam Raise.** Based on studies to expand the flood storage capacity authorized in WRDA 1999, in 2002, the Corps recommended the Folsom Dam Raise Plan.<sup>17</sup> Congress authorized the raise in §129 of the Energy and Water Development Appropriations Act of FY2004 (P.L. 108-137). The current plan shown in **Figure 4** would raise the concrete part of Folsom Dam approximately seven feet. It also would raise the eight dikes around Folsom Reservoir and other dam infrastructure.<sup>18</sup> Additionally, the dam raise plan also includes measures related to ecosystem restoration and environmental protection on the lower American River floodplain. The construction of a permanent bridge below the dam is a related component of the plan authorized in the Energy and Water Development Appropriations Act for FY2004.<sup>19</sup>

<sup>17</sup> U.S. Army Corps of Engineers and State of California Reclamation Board. *Final Supplemental Plan Formulation Report* (Sacramento, CA: 2002).

<sup>18</sup> Estimates of project performance at the time indicated that the Dam Raise would raise the peak inflow design flood of the Folsom Dam Modification Project and thus raise its aforementioned flood protection levels to 213-year level of modeled performance.

<sup>19</sup> The bridge was originally authorized in WRDA 1999 as a temporary means for diverting traffic from the dam during construction, but as a result of concerns relating to security and increased traffic, it was subsequently authorized as permanent structure in 2004. An additional \$30 million on top of the original \$36 million authorization for the permanent bridge was authorized and appropriated in §128 of the Energy and Water Development Appropriations Act, 2006 (P.L. 109-103).

**Figure 4. Folsom Dam Raise: Current Plans**

**Source:** U.S. Army Corps of Engineers. *Post Authorization Decision Document: American River Watershed Project, Folsom Dam Raise, Folsom Bridge*, (Sacramento, CA: May 2006).

## Current Status

**Status of Authorized Projects.** A summary of the authorized construction projects is provided in **Table 1**. The table shows that the Corps has undertaken construction on many of the Common Features improvements on the American River and Sacramento Basin levees, but has not yet begun construction on the other authorized construction projects.

As of May 2006, the Corps estimated a completion date of 2007 for the American River components of the Common Features Project.<sup>20</sup> However, the Natomas Basin levee improvements portion of the project is under reevaluation because of structural problems with the levees, which have thrown into question how to proceed, what will be the cost of addressing the problems, and if there is sufficient authority to conduct the repairs.<sup>21</sup>

<sup>20</sup> U.S. Army Corps of Engineers, Sacramento District. *Post Authorization Decision Document: American River Watershed Project, Folsom Dam Raise, Folsom Bridge* (Sacramento, CA: May 2006).

<sup>21</sup> Although outside the scope of this report, problems with design and cost estimates have plagued the levee improvements and are the subject of a 2003 Report. (U.S. Government Accountability Office, *Improved Analysis of Costs and Benefits Needed for Sacramento Flood Protection Project*, GAO Report GAO-04-30 (Washington, DC: Oct., 2003).

**Table 1. Sacramento Area: Major Authorized Flood Control Projects**

Project	Description/Components	Authorization	Current Est. Flood Protection <sup>a</sup>	Status (as of July 2006)
Common Features Improvements	Construction of new levees; addition of cut-off walls to current levees.	WRDA 1996 (P.L. 104-303) WRDA 1999 (P.L. 106-53)	100-year	Under construction <sup>b</sup> , estimated completion unavailable
Folsom Dam Modifications	Enlargement of existing outlets; construction of additional outlets; stilling basin construction; dike construction; raise auxiliary spillway gates.	WRDA 1999 (P.L. 106-53)	130-year	Design is on hold
Folsom Dam Raise	Raise dam 7 feet; enlarge existing spillway gates; raise wing dams, auxiliary dam, and dikes; conduct ecosystem restoration; install automated temperature shutters.	Energy & Water Development Appropriations of FY2004 (P.L. 108-137)	200-year	Pre-Construction engineering and design phase, estimated completion unavailable
Folsom Bridge <sup>c</sup>	Construction of permanent bridge replacing old bridge over Folsom Dam.	Energy & Water Development Appropriations of FY2004 (P.L. 108-137) and of FY2006 (P.L. 109-103)	—	Pre-Construction engineering and design, estimated completion in 2008

**Source:** U.S. Army Corps of Engineers. FY2007 Budget Justifications: Civil Works Budget for the U.S. Army Corps of Engineers. [[http://www.usace.army.mil/civilworks/cecwb/just\\_states/just\\_2007/fy2007\\_j-sheets.pdf](http://www.usace.army.mil/civilworks/cecwb/just_states/just_2007/fy2007_j-sheets.pdf)].

<sup>a</sup> These estimates assume re-operation of Folsom Dam..

<sup>b</sup> As previously discussed, portions of the levee construction are on hold for a number of reasons.

<sup>c</sup> Construction of the Folsom Bridge is funded separately from the three flood protection projects, and is thus considered separately here.

The Dam Modification Project is currently on hold. After pre-construction engineering and design was complete in 2005, private sector estimates of the construction costs were significantly higher than the Corps' initial estimates.<sup>22</sup> Because these revised estimates involved changes to the previous benefit-cost analysis of the project, they precipitated a Reevaluation Report and a Post-Authorization Change report by the Corps for the dam modification project.<sup>23</sup>

The Folsom Dam Raise project remains in the pre-construction engineering and design stage. Elements of the plan could be delayed, depending on the status of the Dam Modification Plan. Currently, design of the dam raise is scheduled to take place through 2011, with construction occurring from 2011 to 2017.<sup>24</sup> Notably, the Folsom Bridge component of the project is progressing on an expedited schedule due to traffic congestion and the need for a connection to replace the old road over Folsom Dam, which has been closed since 2003 because of security concerns. The estimated construction schedule for the bridge shows completion by December 2008.

## Other Considerations

Ongoing problems with currently authorized projects have led to the consideration of several other options relating to Folsom Dam and flood control for Sacramento. While it is unclear whether Congress will consider any of the projects in this section for authorization, recent developments suggest that they may be part of the congressional debate in the future.

**Proposed Auxiliary Spillway.** The aforementioned revisions to cost estimates for the authorized dam modifications presented the Corps with several problems which it is attempting to address. The normal process precipitated by the cost revisions would involve a Reevaluation Report, which generally takes three to five years to complete, before a final Post-Authorization Change Report could be presented to Congress. This would have significantly delayed construction of the dam modifications.<sup>25</sup> Therefore, instead of conducting the Reevaluation Report, the Corps decided in the fall of 2005 to jointly evaluate with the Bureau of Reclamation five alternatives that exceeded or met current project objectives for both agencies through a Project Alternative Solutions Study (PASS).<sup>26</sup> The first PASS report (PASS I)

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<sup>22</sup> The major discrepancy between Corps and private sector estimates appears to have been the construction risks involved in modifying an active flood control project.

<sup>23</sup> For more on the status of these reports, see the "Auxiliary Spillway" section below.

<sup>24</sup> U.S. Army Corps of Engineers, Sacramento District. *Post Authorization Decision Document: American River Watershed Project, Folsom Dam Raise, Folsom Bridge*, (Sacramento, CA: May 2006).

<sup>25</sup> Personal Communication with Jason Fansalau, Public Relations Officer, U.S. Army Corps of Engineers, Sacramento District (Sacramento, CA: August 8, 2006).

<sup>26</sup> In accordance with the Reclamation Dams Safety Act of 1978 (P.L. 96-578), Reclamation had previously been evaluating its own improvements relating to dam safety. PASS is the mechanism with which the Bureau evaluates alternative project possibilities; the Corps took  
(continued...)

identified a 1,700-foot concrete auxiliary spillway on the south side of the dam (shown in **Figure 5**) and related actions as the most promising of the five potential options, and the second PASS Report (PASS II) has estimated this option to have a lower cost (\$1.36 billion compared to \$1.73 billion), with construction complete by 2017 instead of 2023.<sup>27</sup>

Currently, it remains to be seen whether the spillway and the related actions laid out in the PASS II report will be adopted by the Corps. This will be determined when the Corps issues its Post-Authorization Change (PAC) Report, scheduled for completion in May 2007.<sup>28</sup> The Corps has indicated that its PAC Report will compare current federally-authorized projects with additional potential alternatives such as the auxiliary spillway, and recommend a preferred option.<sup>29</sup> Depending on which is the preferred alternative, current authorizations may be sufficient or additional congressional authorization may be necessary before proceeding with construction.

**Auburn Dam Renewed Debate.** The congressional debate over Sacramento flood protection continues to include Auburn Dam. Congress approved additional appropriations in the Energy and Water Development Appropriations Act of FY2006 for an updated study on Auburn Dam (often referred to as the Auburn-Folsom South Unit), reviving debate on this subject. In §209, Congress appropriated \$1.0 million to the Bureau of Reclamation to complete an updated cost-benefit analysis of Auburn Dam.<sup>30</sup> Whether to pursue a dry dam or a multi-purpose storage facility at the Auburn site continues to be discussed in debates over the Corps' annual appropriations. Current issue in the debate over the utility, urgency and feasibility of Auburn Dam is the identification of a non-federal sponsor to share the project's cost. Because of its large size and cost, potential environmental and recreational effects, and seismic history, discussion of continuing construction on Auburn Dam or authorizing another dam at the Auburn site continues to be controversial.

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<sup>26</sup> (...continued)

the unusual step of combining its Reevaluation Report with the PASS study for the sake of expediency. The study was conducted with the same state and local sponsors as previously worked with the Corps and the Bureau.

<sup>27</sup> U.S. Bureau of Reclamation, et al. *Folsom Dam Raise and Auxiliary Spillway Alternative, Project Alternatives Solutions Study (PASS II), Final Report*, (Sacramento, CA: June 2006). [ftp://ftp.spk.usace.army.mil/pub/incoming/General/PASS/PASS%20II%20FINAL%20REPORT.pdf].

<sup>28</sup> With the recent completion of the PASS joint project analysis, the Corps will now complete its PAC Report, and the Bureau will complete its own decision document, known as a Modification of Dam Report (MOD) for submission to Congress. U.S. Army Corps of Engineers, et al. *Folsom Joint Federal Project, Engineering Status Report* (Sacramento, CA: June 2006).

<sup>29</sup> Personal Communication with Jason Fansalau, Public Relations Officer, U.S. Army Corps of Engineers, Sacramento District, (Sacramento, CA: August 8, 2006).

<sup>30</sup> For more information on appropriations, see CRS Report RL33346, *Energy and Water Development: FY 2006 Appropriations*, coordinated by Carl E. Behrens.

**Figure 5. Potential Auxiliary Spillway**

**Source:** U.S. Bureau of Reclamation, et al. *Folsom Dam Raise and Auxiliary Spillway Alternative, Project Alternatives Solutions Study (PASS II), Final Report* (Sacramento, CA: June 2006).

## Concluding Remarks

How to reduce flood risks in developed and developing areas is a problem being faced by communities nationwide, and is receiving increased attention as the reliability of existing infrastructure is reevaluated in the aftermath of Hurricane Katrina.

In the last half century, the dam and levee system around Sacramento has proved crucial in protecting the city from flooding. The Folsom Dam is an important component in this flood protection. Recently, the federal government has authorized three major flood protection improvement projects in the Sacramento area. These include improvements to Folsom Dam's operational rules, improvements to the American and Sacramento Rivers and Natomas Basin levees, as well as modifications to Folsom Dam's flood gates and a raise of the dam itself.

Some of the federally authorized improvements involving fortification of the American and Sacramento River levees are under construction or completed, while others are undergoing reevaluation. Other plans, which would increase the capacity and flow levels at Folsom Dam and improve its ability to provide flood protection, remain in the pre-construction engineering and design stage, and have encountered setbacks to construction because of high cost estimates. A recent plan jointly authored by the Corps and the Bureau suggests that an auxiliary spillway to the south of Folsom Dam could achieve the objectives of prior authorizations on an enhanced timetable and at a reduced cost, but this option has not yet been officially endorsed by the Corps. A revised course of action will be suggested in the Corps' PAC Report,

due in December 2006. Additional congressional authorization may be required if Congress chooses to adopt the auxiliary spillway alternative.

Issues for Congress include whether, and if so, how, to modify authorization and appropriations for improvements to the management of floodwaters at Folsom Dam and in the American River Basin. In reconsidering these, Congress has a range of options; for example, it may consider less expensive alternatives to current projects, such as the auxiliary spillway, or undertake a full review of Sacramento flood control policy, including unauthorized alternatives such as Auburn Dam.