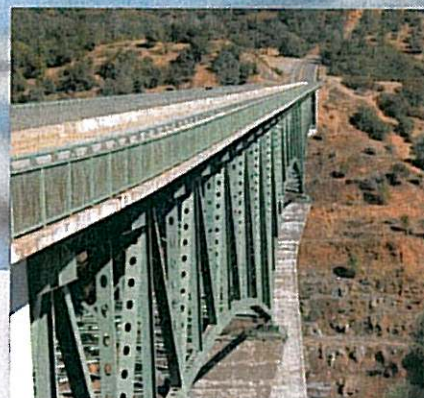
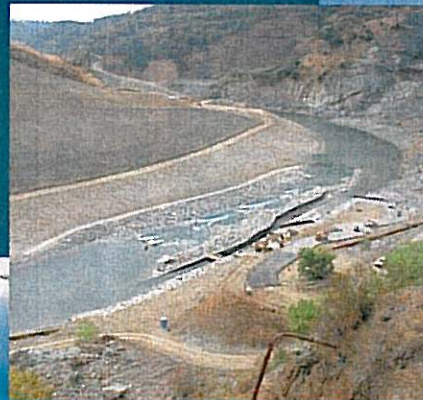


AMERICAN RIVER AUTHORITY

AUBURN-FOLSOM SOUTH UNIT

SUMMARY REPORT

June 2008



CALIFORNIA WATER
CONSULTING, INC.

PETERSON . BRUSTAD . INC
ENGINEERING . CONSULTING



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Prepared by:

California Water Consulting, Inc.

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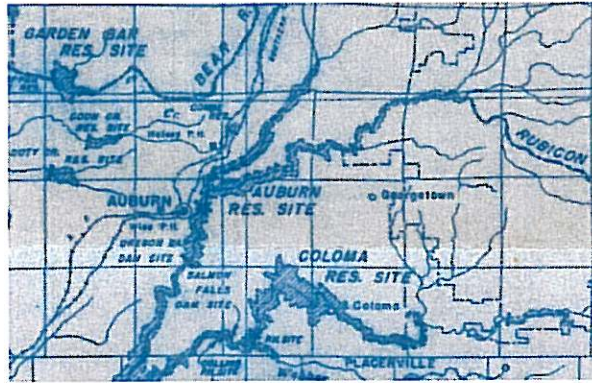
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Map of Auburn Dam, 1944

1.0 INTRODUCTION AND SUMMARY

The Auburn Dam and Reservoir has long been recognized to provide benefits in addressing regional and statewide water resource needs. The Auburn Dam Project was authorized in 1965 and was under construction until halted in 1975. Construction of the Auburn Dam was not re-started due to seismic concerns, engineering redesign, concern for environmental impacts, changing political ideologies, and changing priorities.

The United States Bureau of Reclamation released the *Auburn-Folsom South Unit Special Report Benefits and Cost Update (AFSU Special Report)* in December 2006. The report summarizes an analysis purporting to update the costs and associated benefits of the Auburn Dam and Reservoir. However, the analysis documented in the *AFSU Special Report* was based on an outdated dam configuration, outdated operating assumptions, and outdated benefits assumptions. The report provides estimates of project costs and benefits that are unreliable. As such, the *AFSU Special Report* cannot be relied upon to draw any conclusions as to the viability of the Auburn Dam.

Because the technical assumptions and analyses in the various studies and designs of Auburn Dam are from nearly 30 years ago, when water resources development and management were conducted under a drastically different economic, environmental, legal, and public policy framework, it is impossible to utilize these past studies to estimate the feasibility of an Auburn Dam in tomorrow's world. It is the conclusion of the authors of this report that no valid analysis exists to prove whether a dam at Auburn is either feasible or infeasible.

In light of the potential affects of climate change and the increasing societal and ecosystem demands on the watershed, our opinion is that a new Feasibility Study is warranted. The Feasibility Study should examine alternatives to accommodate the following purposes:

1. Urban water supplies
2. Flood damage reduction
3. Carbon-free power supply, including peaking power and pumped storage operations in conjunction with Folsom Reservoir.
4. Recreation enhancement for both Auburn and Folsom Reservoir areas
5. Ecosystem enhancement, including water temperature management, Lower American River flows, and reservoir fisheries in both Auburn and Folsom Reservoirs
6. Other Statewide benefits

2.0 THE AUBURN DAM PROJECT

The Auburn-Folsom South Unit (AFSU) of the United States Bureau of Reclamation (USBR) Central Valley Project (CVP) was intended to develop the water resources in the American River watershed for multiple beneficial uses. The Auburn Dam was authorized in September 1965 by Public Law (PL) 89-161 as part of the Auburn-Folsom South Unit. As planned, the Auburn-Folsom South Unit consisted of four major components:

1. Auburn Dam, Reservoir and Powerplant
2. County Line Dam and Reservoir
3. Sugar Pine Dam and Reservoir
4. Folsom South Canal

Out of these four components, only the Auburn Dam and Powerplant remains as a potential future addition. The other three items, which are described later in this report, have either already been constructed or are considered infeasible.

The original 1965 authorized Auburn Dam plan called for a high arch dam with a maximum water surface elevation of 1,140 feet above mean sea level (msl) and with a capacity of about 2.5 million acre-feet (MAF). However, due to seismic concerns, the USBR's 1980 *Feasibility Design Summary* revised the dam design to a double curvature concrete gravity dam. This revised dam included a maximum water surface elevation of 1,135 feet above msl and a total capacity of about 2.33 MAF. Most all of the recent figures, drawings and analyses for the Auburn Dam, including the 2006 United States Bureau of Reclamation Auburn-Folsom South Unit Special Report (*AFSU Special Report*), are based on the CG-3 dam design (Figure 1).



Figure 1 – Artist Rendering of the Double Curvature Concrete Arch Auburn Dam (CG-3)

Source: United States Bureau of Reclamation

The Auburn Dam and Powerplant site is located approximately 40 miles northeast of Sacramento, at River Mile 20.1, on the North Fork of the American River upstream of the Folsom Reservoir. The average annual inflow at the Auburn Dam site is about 1.4 MAF. The Auburn Dam would, in conjunction with Folsom, Nimbus and other dams in the watershed, control the flows of the North and Middle forks of the American River. When fully filled, the Auburn Reservoir would inundate about 10,050 acres and about 33 miles of the American River canyon (Figure 2).

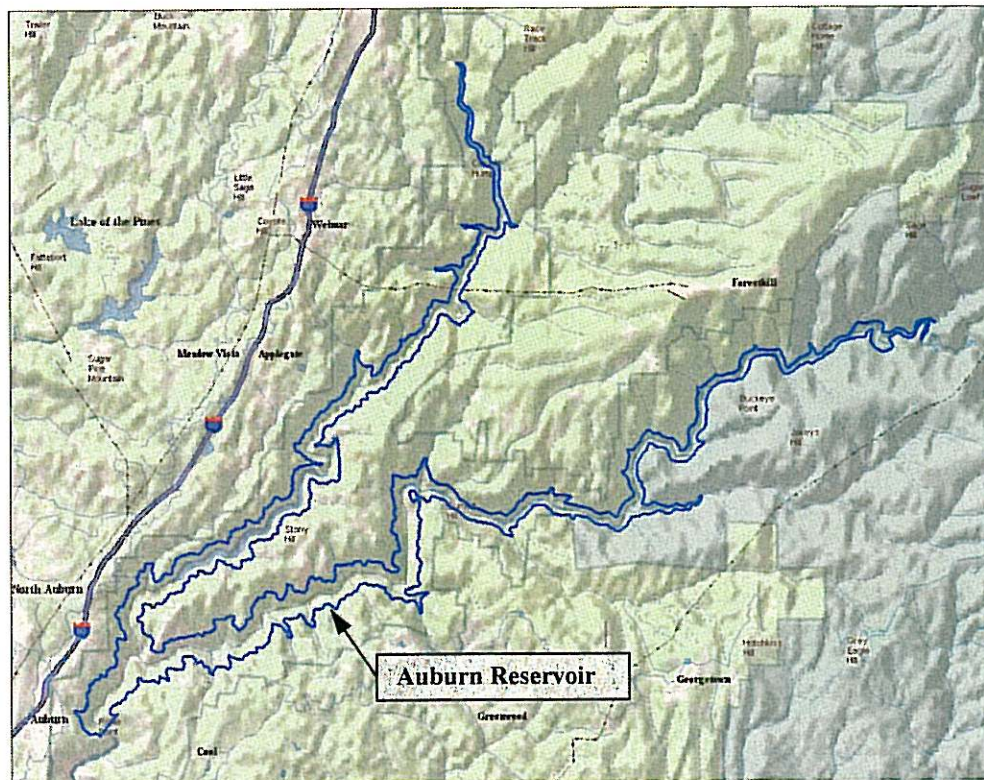


Figure 2 – Projected Auburn Reservoir surface area associated with the CG-3 design.

Source: <http://www.aboutlaketahoe.com/biking/topo-maps/pages/auburn-dam-full.htm>

2.1 Auburn Dam History

Construction of the Auburn Dam was initiated in 1967. However, major construction on the dam was halted in 1975 in order to re-evaluate the design after an earthquake measuring 5.7 on the Richter scale occurred near Oroville, California, about 50 miles northwest of the Auburn site. The earthquake raised concerns over the safety of the thin arch concrete dam proposed at that time.

In 1976, the Association of Engineering Geologists, Seismic Hazards Committee issued a report stating that a moderate earthquake could cause the proposed Auburn dam to fail. In 1977, following the seismic evaluations, two new designs were proposed for consideration: (1) an earth-fill dam and (2) a concrete curved gravity dam (CG-3). The CG-3 dam was selected as the new proposed dam design after it was determined that the structure could safely handle the foundation displacements associated with an seismic event by increasing the base thickness at the center of the dam, and adding zones of higher strength concrete. Even in the extremely unlikely event that the structure cracked from bottom to top, the separate segments would remain in place and, although leakage would occur, the dam would not suffer total catastrophic failure.

The construction site layout for the CG-3 design is shown in Figure 3. A summary of major events surrounding Auburn Dam is provided in Table 1.

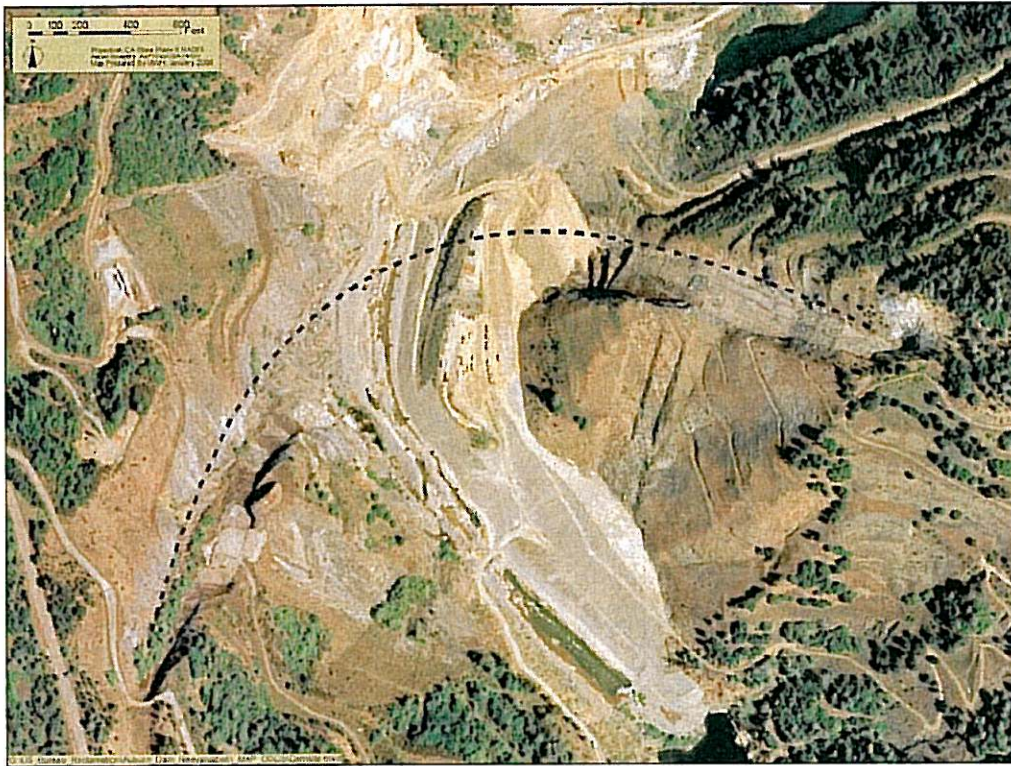


Figure 3 - Aerial View of the Auburn Dam construction site (taken April, 2004).

Source: United States Bureau of Reclamation

Table 1 – Summary of the major Auburn Dam Events by Decade

Decade	Major Events
1960's	The <i>Auburn-Folsom South Unit</i> is authorized and construction is initiated.
1970's	Auburn Dam construction is halted due to seismic safety concerns after an earthquake measuring 5.7 on the Richter scale occurred near Oroville, CA. A series of studies is initiated to examine design alternatives to the thin arch design. The Double Curvature Concrete Gravity Dam (CG-3) design is proposed.
1980's	In 1980, the CG-3 dam design is selected as the revised plan. A report in 1985 (<i>Bechtel</i>) recommends a different, Roller-Compacted Concrete (RCC) dam, as the most efficient design. Sugar Pine Dam is completed. A major flood occurs in 1986 failing the construction of the site coffer dam.
1990's	In 1991, the Corps recommends a 545,000 ac-ft detention dam at the Auburn site for flood protection. After further analysis, the Corps recommends a larger 894,000 ac-ft detention dam at the Auburn site in 1996. Congress rejects the detention dam plan due to the magnitude of opposition and directs work to be completed on downstream levee improvements and improvements to the Folsom Dam (<i>Common Features Project</i>). Another major flood occurs in 1997.
2000's	Construction is initiated on the <i>Folsom Dam Raise Project</i> and the <i>Folsom Modifications Project</i> . Levee improvements continue. In 2006, the USBR releases its AFSU Special Report which documents an estimated cost of \$6-\$10 billion for the CG-3 dam to be built at Auburn.

No construction activities on Auburn Dam has occurred since August of 1975. The Bureau has recently undergone efforts to restore a portion of the Auburn Dam construction site back to a more favorable configuration from an environmental and recreational standpoint. During the restoration efforts, a temporary Placer County Water Agency pump station was removed and replaced with a permanent, 100 cfs station. In addition, the Auburn Dam diversion tunnel was plugged, which allowed a ¾ mile stretch of the river to return to its original channel. There are also future plans to provide public access at the project area. Section 4 of this report provides a chronology of the major milestones associated with the project.

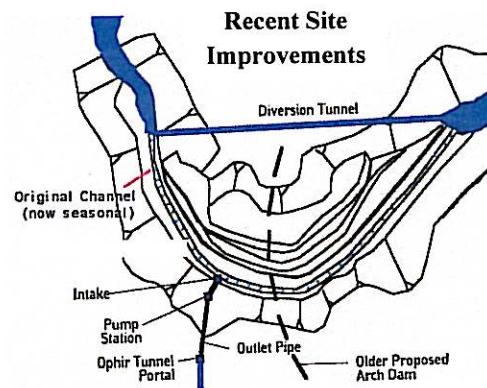


Figure 4 & 5 – The Auburn Dam site showing the restored streambed.

Source: Placer County Water Agency and Protect American River Canyons (PARC)

2.2 Associated Features of the Auburn Dam Project

Powerplant – The original 1965 authorized powerplant had a capacity of about 240 megawatts (MW). The updated powerplant outlined in the *1980 USBR Feasibility Design Summary* (CG-3 design) would have an installed capacity of 800 MW, consisting of four 200 MW generating units. An additional 4 MW generating unit located in the river outlet bay would be used to generate power for the dam itself. The 1980 design locates the penstocks in the center portion of the dam, with two intakes at 800-feet above msl and at 625-feet above msl. It is important to note that the cost benefit calculations for the powerplant are heavily dependent on the cost of natural gas.

Road Relocations – According to the USBR's *2006 AFSU Special Report*, the Auburn Dam project would require the relocation of several county roads and a portion of State Highway 49. Due to National Security concerns, Highway 49 could no longer cross the American River canyon on top of the Auburn Dam, as originally proposed. Alternative relocations were considered by the State of California in the mid-1980's, but any potential relocation will require further analysis. The other major road relocation consists of a two lane road that would extend from Colfax through Foresthill to Greenwood, which would require building two major bridges across the North and Middle Forks. The Auburn Dam project would also require the development of various other minor roads and recreation trails. Future efforts would be needed in order to identify and develop these items in detail.

Diversion Tunnel – The Auburn Dam diversion tunnel was completed in November 1972. It measures 33-feet in diameter and is 2,400-feet in length. The Bureau recently sealed the tunnel due to safety concerns. Re-initiation of dam construction efforts would require unsealing the tunnel.

Placer County Water Agency Pump Station – Along with the Bureau's efforts to restore the Middle Fork of the American River to its original river bed, a temporary Placer County Water Agency (PCWA) pump station was removed and a permanent station was constructed. The new station is designed for 100 cubic feet per second (about 64.5 million gallons per day). Any future Auburn Dam project would need to accommodate continuous water service to PCWA.

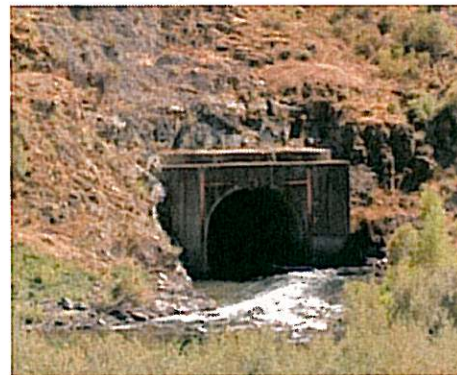


Figure 6 – The 33-ft diameter Diversion Tunnel
Source: D.P. Zecco; <http://www.geoengineer.org>

2.3 Other Features of the AFSU

County Line Dam and Reservoir

The County Line Dam and Reservoir was never constructed. The dam was to be an earthfill dam structure located on Deer Creek about 10 miles south of Folsom Dam. It was planned to be 90 feet high, with a crest length of 585 feet. The County Line Reservoir would have had a capacity of 40,000 acre-feet and would have operated in conjunction with pumping from Folsom Lake to provide water service in the Folsom-Malby area for municipal and industrial (M&I) use. A map of the proposed County Line Dam and associated facilities is shown in Figure 9.

The *AFSU Special Report* excluded the County Line Dam and Reservoir from its analysis, noting that water demands in California have changed dramatically since the original formulation of the Auburn-Folsom South Unit and thus a reformulation of the County Line Dam and Reservoir is needed to determine if it is still economically beneficial and feasible.

Sugar Pine Dam and Reservoir

The Sugar Pine Dam was completed in 1982. It is located in North Shirttail Canyon approximately 7 miles north of Foresthill, California. The dam is an earth and rock-fill structure and the reservoir has a capacity of 6,921 acre-feet. The project was transferred to the Foresthill Public Utility District (FPUD) for operation and maintenance in 1984. Title to the dam and reservoir was transferred to FPUD on November 7, 2003. A photo of Sugar Pine Dam is shown in Figure 7. A map of Sugar Pine Dam and associated facilities is shown in Figure 10.



Figure 7 – Sugar Pine Dam and Reservoir

Source: United States Bureau of Reclamation

Folsom South Canal

The Folsom South Canal was originally designed as a 68.8 mile-long concrete-lined canal that was to be constructed in five different reaches. To date, only the first two reaches of the canal have been built with a total length of 26.7 miles. The canal originates at Nimbus Dam on the American River and runs southward. The two completed reaches of the canal have a bottom width of 34 feet, a maximum water

depth of 17.8 feet, and a capacity of 3,500 cfs. The construction of the canal was suspended in 1973 due to the pending outcome of studies related to minimum fishery and recreation flows in the American River downstream from Nimbus Dam. A photo of the Folsom South Canal is shown in Figure 8.



Figure 8 – Folsom South Canal at Douglas Blvd. looking north.

Source: <http://www.folsomsouthcanal.com/index1.asp>

Completion of the remaining 42.1 miles of the Folsom South Canal would allow for full irrigation service to 28,000 acres, supplemental irrigation service to about 416,000 acres, and water for M&I purposes in Sacramento and San Joaquin Counties. The canal would also help address groundwater

overdraft problems in the two counties. However, the *AFSU Special Report* did not

include completion of the Folsom South Canal in its analysis due to the fact that major changes in water demands have occurred since its original design and a full reformulation would be needed to determine if the canal is still beneficial and feasible. The reformulation would need to consider regional irrigation and M&I water need changes, desired and mandated flows in the American River downstream of the Nimbus Dam, and environmental concerns related to the canal and surrounding area.

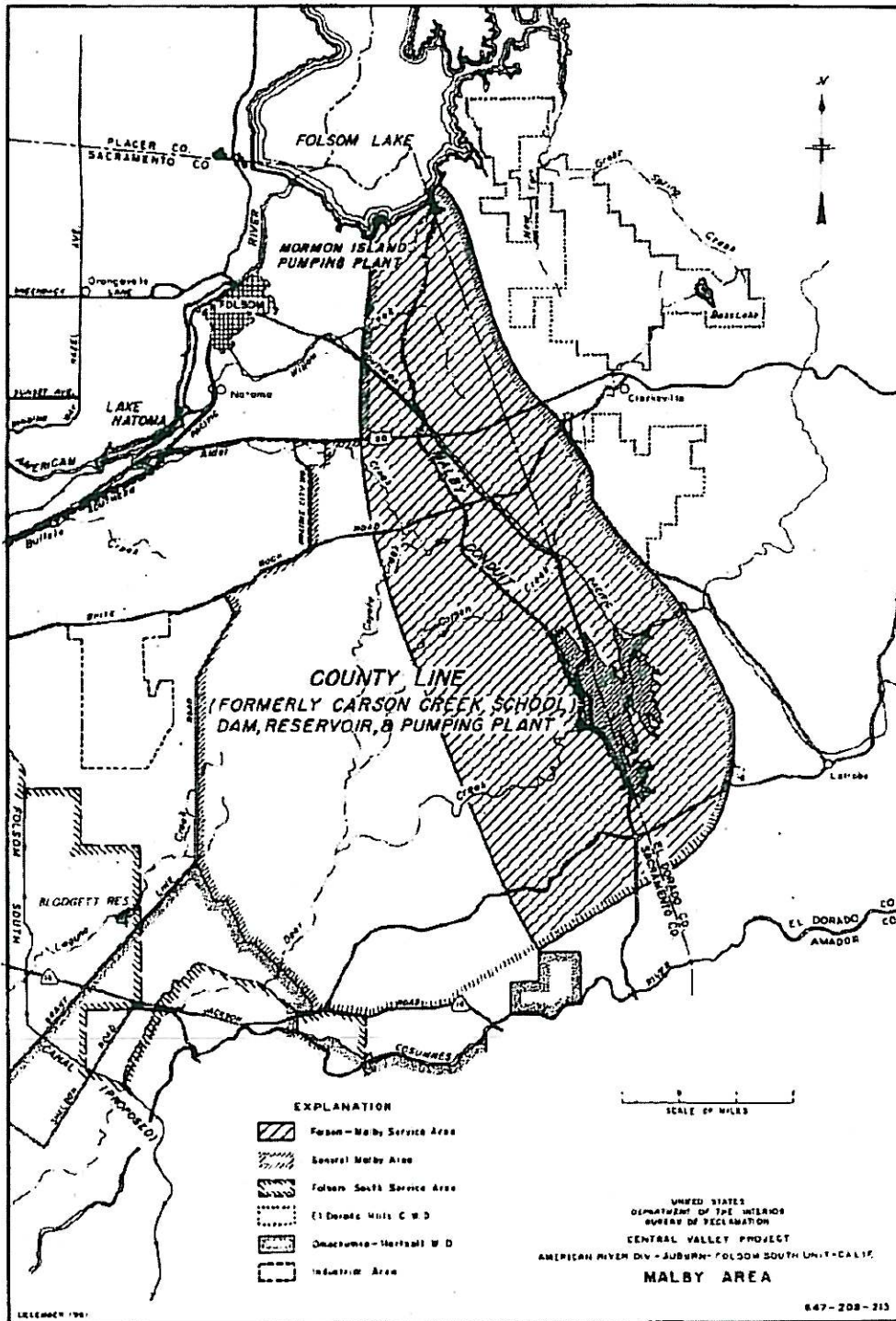


Figure 9 – County Line Dam and Associated Facilities

Source: October 22, 1963, Supplemental Report by the Secretary of the Interior on Auburn-Folsom South Unit

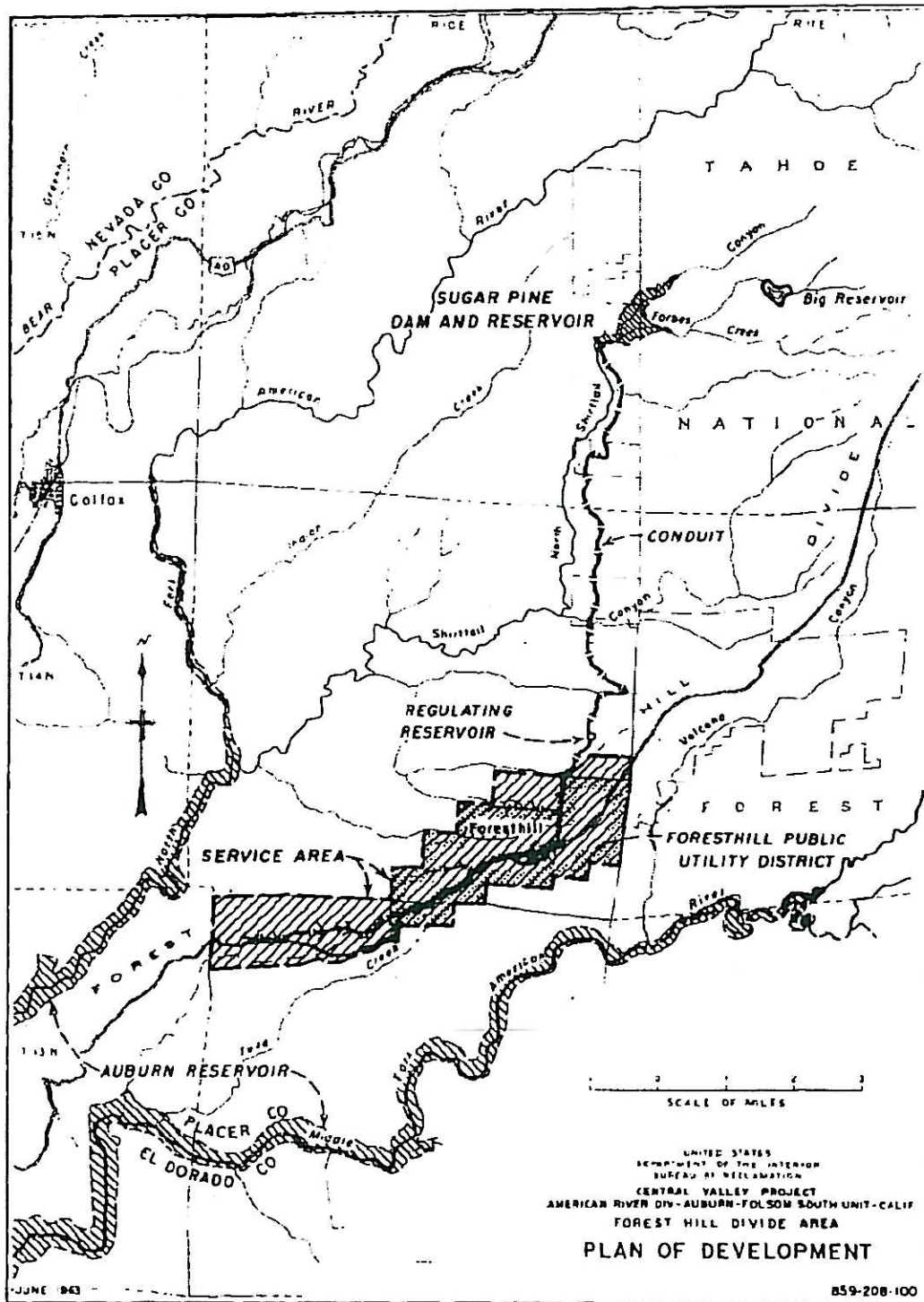


Figure 10 – Sugar Pine Dam and Associated Facilities

Source: October 22, 1963, Supplemental Report by the Secretary of the Interior on Auburn-Folsom South Unit

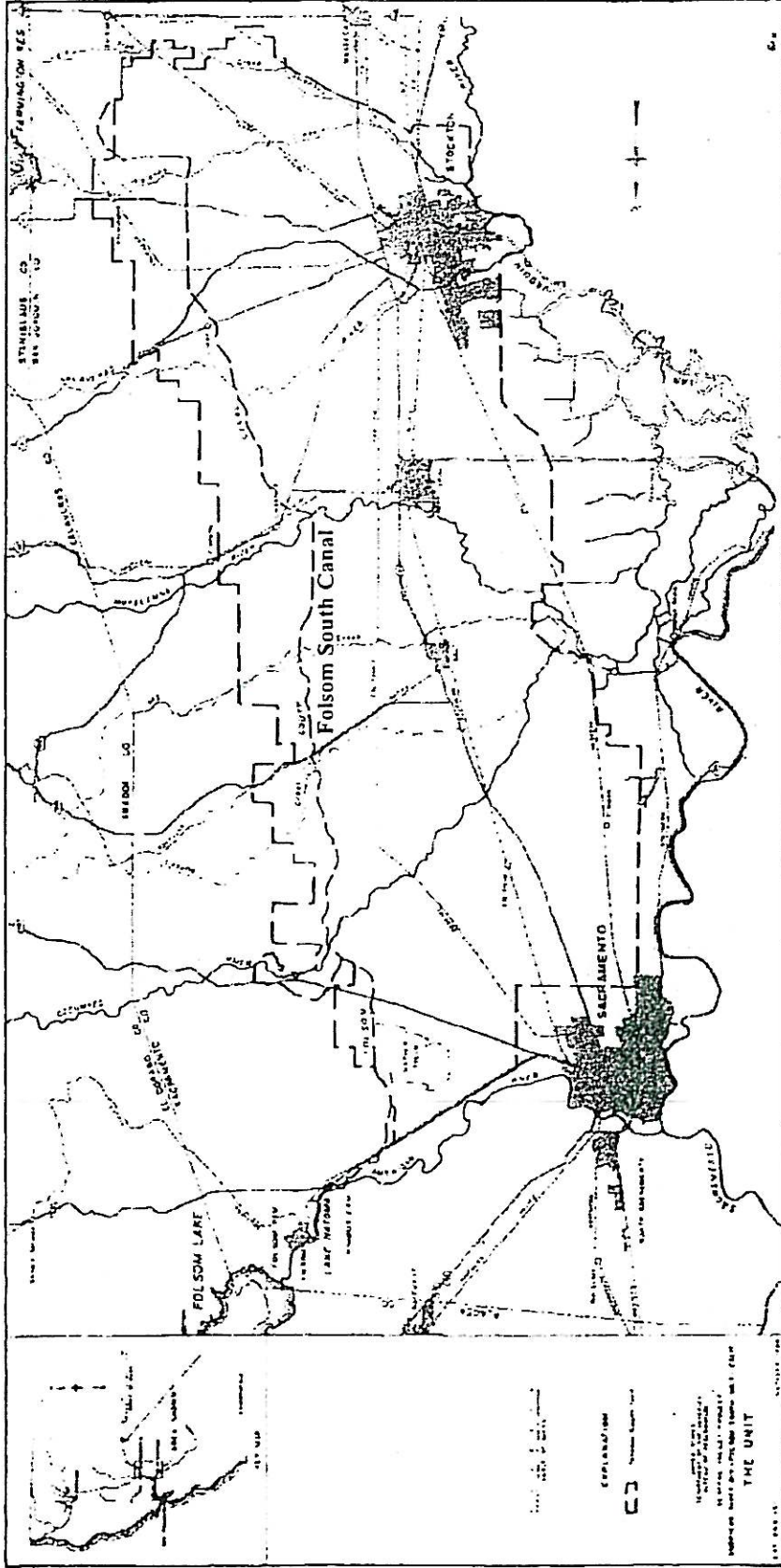


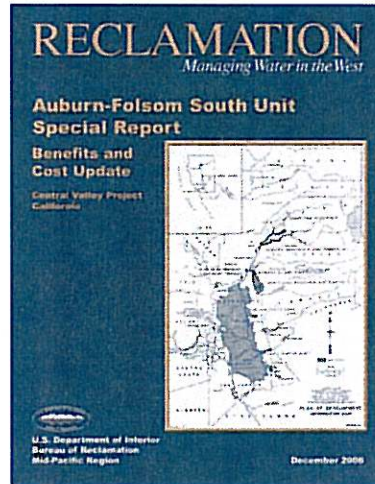
Figure 11 - Folsom South Canal and Associated Facilities

Source: October 22, 1963, Supplemental Report by the Secretary of the Interior on Auburn-Folsom South Unit

3.0 AUBURN-FOLOM SOUTH UNIT SPECIAL REPORT

The United States Bureau of Reclamation released the *Auburn-Folsom South Unit Special Report Benefits and Cost Update* (AFSU Special Report) in December 2006. The report summarizes an analysis authorized by the Energy and Water Appropriations Act FY 2006 (P.L. 109-103) as follows:

The Secretary of the Interior is authorized to complete a special report to update the analysis of costs and associated benefits of the Auburn-Folsom South Unit, Central Valley Project, California, authorized under Federal Reclamation laws and the Act of September 2, 1965, Public Law 89-161, 79 Stat. 615 in order to –



- (1) *Identify those project features that are still relevant;*
- (2) *Identify changes in benefit values from previous analyses and update to current levels;*
- (3) *Identify design standard changes from the 1978 Reclamation design which require updated project engineering;*
- (4) *Assess risks and uncertainties associated with the 1978 Reclamation design;*
- (5) *Update design and reconnaissance-level cost estimate for features identified under paragraph (1); and*
- (6) *Perform other analyses that the Secretary deems appropriate to assist in the determination of whether a full feasibility study is warranted.*

The *AFSU Special Report* analysis focuses on the multi-purpose Auburn Dam, Reservoir and Powerplant; relocation of related roads, utilities, and trails; and the Auburn State Recreation Area because the remaining features of the Auburn-Folsom South Unit have either been constructed or are considered obsolete by the USBR. Features identified as not relevant and therefore excluded from the analysis were County Line Dam, Reservoir, and Conduit; Sugar Pine Dam, Reservoir, and Conduit; and the Folsom South Canal.

The analysis was completed by U.S. Bureau of Reclamation California Central Area Office Mid Pacific Region with headquarters located in Sacramento.

3.1 *AFSU Special Report Auburn Dam Benefits and Costs*

The *AFSU Special Report* asserts the following annual benefits of the Auburn Dam and Reservoir:

- Increased water supply for Agricultural and M&I use (\$29.3 to \$52.9 million)
- Increased flood protection for the Sacramento area (\$9.6 to \$75.0 million)
- Provide new hydropower generation (\$53.0 to \$113.0 million)
- Provide recreation opportunities (-\$21.7 to \$6.0 million)
- Increase water availability for fish and wildlife (not quantified)

The *AFSU Special Report* estimates the total annual benefits of the Auburn Dam and Reservoir ranging from \$75.7 to \$240.4 million. The report estimates project costs to develop Auburn Dam and Reservoir to range from \$6 to \$10 billion. As stated in the report, the analysis did not include an updated benefit/cost ratio as “the range of assumptions adopted in updating cost and benefit values for remaining relevant features precludes any meaningful benefit/cost analysis based upon this Report.” Each of the benefits listed above are described below:

Water Supply Benefits

The *AFSU Special Report* affirms that water supply benefits associated with a multi-purpose Auburn Dam and Reservoir have changed significantly compared to previous studies. Noting that “there was insufficient information or time available to calculate any potential reallocation”, the *AFSU Special Report* relied on a 1963 study projecting average annual irrigation and M&I deliveries attributable to the Auburn Dam of 365 TAF and 25 TAF respectively. Based on this assumption, the analysis indicates annualized irrigation benefits would range from \$25.4 million to \$42.5 million and annualized M&I benefits from \$3.9 million to \$10.4 million.

Flood Control Benefits

The *AFSU Special Report* concludes that flood control benefits associated with a multi-purpose Auburn Dam and Reservoir are likely higher than benefits identified in previous studies. The primary reason for the increase is the increased level of downstream development. The analysis notes that the level of attributed flood control benefits are greatly influenced by (1) the amount of reservoir space allocated for flood control, (2) the coordinated operations of Auburn and Folsom Dams, and (3) the type and extent of downstream flood control improvements implemented. Based upon the *AFSU Special Report* assumption using the flood control operation and space allocation

used in the 1978 design of Auburn Dam and Reservoir, the analysis indicates annualized flood control benefits ranging between \$10 and \$75 million.

Hydropower Benefits

The *AFSU Special Report* states that hydropower benefits associated with a multi-purpose Auburn Dam and Reservoir have changed significantly compared to benefits considered in previous studies. The primary reason for this is the increase in cost of natural gas and other alternative energy sources combined with increased energy demands. Based upon the *AFSU Special Report* assumptions, the analysis indicates annualized hydropower benefits could range between \$53 and \$113 million.

Recreation Benefits

The *AFSU Special Report* asserts that recreation benefits associated with a multi-purpose Auburn Dam and Reservoir have the potential to be reduced when compared to recreation values considered in previous studies. The analysis claims that construction of Auburn Dam and Reservoir will likely shift existing recreation use from land based to water based. Existing recreation visitation at the Auburn State Recreation Area, without Auburn Dam and Reservoir, is much greater than originally estimated in the 1965 authorization. The report postulates that it is possible that the construction of Auburn Dam and Reservoir may lead to a reduction in recreational benefits unless the 1978 Auburn Recreation General Plan is reformulated to accommodate a greater capacity and broader suite of uses. Based upon *ASFU Special Report* assumptions, the analysis indicates recreation benefits anywhere from a negative \$21.7 million to a positive \$6.0 million.

Fish and Wildlife Benefits

The *AFSU Special Report* states that its preliminary analysis confirms earlier reports that the addition of a multi-purpose Auburn Dam and Reservoir could help stabilize Folsom Reservoir surface elevations, increasing its cold water pool, and lowering water temperatures in the American River below Nimbus Dam, and that much more extensive analyses would be required to be able to quantify any benefits. Water quality was not identified as a project purpose in the original authorizing legislation for the AFSU. However, the report states that benefits associated with a multi-purpose Auburn Dam and Reservoir may now be significant due to current regulatory requirements. Auburn Dam and Reservoir could improve the American River Unit system flexibility, opening up greater opportunities for managing water quality in the

Lower American River and the California Delta. Fish and wildlife benefits were not quantified in the *AFSU Special Report*.

3.2 *AFSU Special Report Analysis Shortcomings*

In general, information presented in the *AFSU Special Report* regarding benefits and costs of the Auburn Dam and Reservoir is incomplete. This is due principally because the authorization and scoping of the *AFSU Special Report* constrained the USBR to base their analysis on a 1978 project understanding, design, and operations plan, which were all based on a 1950's project formulation. Statutory requirements, optimum project operation, demographics, science and engineering have all changed significantly since the original project formulation. Therefore, the *AFSU Special Report* conclusions on project benefits and costs cannot be relied upon to postulate the feasibility or infeasibility of the Auburn Dam and Reservoir. Some specific *AFSU Special Report* shortcomings are described below.

No Project Reformulation

The U.S. Bureau of Reclamation's analysis summarized in the *AFSU Special Report* is based on the multi-purpose Auburn Dam and Reservoir project that was last considered in 1978. The 1978 project understanding, goals, objectives, and design are all based on the 1950's project formulation. This is a major shortcoming in the scoping of the *AFSU Special Report*, as the basic formulation of the project has a direct and significant affect when considering benefits and costs as well as defining a general understanding of the project. The project was not reformulated to reflect current conditions including:

- changes in downstream flow and temperature requirements
- changes in California Delta water quality requirements
- CVP and SWP operational changes
- changes in water demands and priorities
- increased population both in the downstream floodplain and service areas
- changed hydrology understanding including climate change
- changes in dam design and construction techniques

All calculations of significant Auburn Dam and Reservoir project benefits are directly dependant on how reservoir storage is allocated under project operation. The *AFSU*

Special Report analysis did not include optimization studies of the allocation of pool space or sizing of Auburn Dam and Reservoir. The analysis does not investigate the optimal trade-off between irrigation and M&I water supplies, flood control, hydropower, recreation, and fish and wildlife resources. The analysis relied on statewide operational modeling using CALSIM II and CVPM models for which neither was optimized for the addition of Auburn Dam and Reservoir. To fully understand the benefits of Auburn Dam and Reservoir, optimization studies are required to account for the changes in water allocation goals and objectives that have occurred throughout the state since 1978.

Incomplete Recognition of Regional Benefits

Auburn Dam and Reservoir would develop a substantial new water supply. This supply would help satisfy M&I and agricultural water needs identified within the project region, and help to alleviate critical groundwater overdraft in Placer, Sacramento, and San Joaquin Counties.

Studies by the U.S. Army Corps of Engineers (USACE) and the Sacramento Area Flood Control Agency (SAFCA) indicate an urgent need for higher levels of flood protection in the Sacramento metropolitan area, and that a dam at Auburn is needed to accomplish that goal. The *AFSU Special Report* estimated the maximum potential damages to the Sacramento area from a single flood event to be approximately \$17 billion. The USACE updated this amount in their *2007 Folsom Post Authorization Change Report* to approximately \$20 billion (\$200 million annually). A dam constructed at Auburn today would upgrade Sacramento area's flood protection to about 1 in 500 year protection level. The analysis documented in the *AFSU Special Report* based flood control benefit analyses on flood operation and storage space allocation considered in the 1978 design. The benefits stated in the report (\$10-\$75 million annually) do not reflect optimized operation with Folsom Reservoir or considerations to re-allocations of available flood space. The report acknowledges this shortcoming of considering outdated design criteria and states that "using the defined flood control pool elevation...without redefining spillway operations and coordinating operations with Folsom Dam, may cause the Auburn Dam to overtop. This created a problem for modeling the flow routings without reformulating Auburn."

Water temperatures in the lower American River below Nimbus Dam during summer months can exceed the upper range of temperatures reported to be suitable for juvenile salmon and steelhead rearing. Steelhead has been a fish species listed as "threatened"

under the federal Endangered Species Act. Auburn Dam and Reservoir could improve the water temperature in the lower American River by making cold water available during the late summer and fall period. This significant benefit should be identified when considering those of the Auburn Dam. Auburn Dam will create a coldwater pool in its reservoir and may also increase coldwater pool operational flexibility in Folsom Reservoir through coordinated operation.

The addition of Auburn Dam and Reservoir in the American River watershed will allow increased flexibility of Folsom Reservoir operations. This could allow Folsom Reservoir to operate at greater storage levels improving recreation opportunities especially summer time recreation.

Incomplete Recognition of Statewide Benefits

The *AFSU Special Report* lacks an analysis of the California Delta and statewide benefits that would be provided by Auburn Dam and Reservoir. Auburn Reservoir would not only provide water supply to meet the needs of the region, but because of its strategic location in the American River basin, it would provide a significant increase in statewide water resource project operational flexibility. The American River Unit of the CVP, which includes Folsom Reservoir, is considered the “first responder” when water releases from storage are quickly needed to meet California Delta water quality objectives, including the repulsion of salt water intrusion from the ocean. The additional water available in Auburn Reservoir would improve operational flexibility of the CVP and SWP, including the operation of Folsom, Shasta and Oroville Reservoirs as the operation of these major facilities are closely coordinated. This significant and statewide operational benefit afforded by the Auburn Dam and Reservoir should be recognized and quantified.

No Project Design Updates

The *AFSU Special Report* utilized the 1978 design for a multi-purpose Auburn Dam and Reservoir, yet acknowledged that the facility would likely never be constructed in that configuration. The report lists the reasons for this as:

1. Design criteria for dams and other water control structures have changed dramatically since the 1970s. The most significant changes have occurred in the hydrologic and seismic disciplines.

2. The evolution of dam design over the last 30 years has led to a greater understanding of physical processes, and new materials and construction methodologies have been developed, which were not available in the late 1970s.
3. Many of the engineering criteria used in the 1978 design are outdated and would be replaced by state-of-the-practice criteria during future studies.
4. Changed criteria in many of these areas would result in changes to quantities of materials and construction methodologies, both of which would have an important impact on costs.

Relying on an accepted outdated design of the Auburn Dam directly affects results of the cost escalation analysis used in the *AFSU Special Report* analysis as follows:

- Auburn Dam would likely be roller compacted concrete instead of mass concrete
- updated spillway design criteria will likely require a larger spillway
- potential for pumped storage hydropower generation
- features for coordinated operation with Folsom Dam (flood control, hydro peaking, cold water management, statewide benefits)
- updated recreation features

No Climate Change Analysis

The *AFSU Special Report* did not address climate change. Continued climate change will increase pressure on California's water resources, which are already over-stretched by the demands of a growing economy and population. With continued climate change, it is anticipated that more precipitation will fall as rain instead of snow, and the snow that does fall will melt earlier, reducing the Sierra Nevada spring runoff. Loss of water supply afforded by snowpack accumulation and melt will need to be replaced by surface and groundwater storage to provide for increasing regional and state wide water demands, minimizing water shortages, and to reduce future flood damages.

At the same time snowmelt runoff flowing through California's dams will decrease due to climate change, higher temperatures will likely increase electricity demand beyond simple population growth because of things such as higher air conditioning use and required groundwater pumping. Hydropower associated with Auburn Dam can be used to help meet rising electricity demands. Hydropower pump-storage operation

utilizing Folsom Reservoir should be considered as peak electricity demands continue to rise. Also, increased output from Folsom powerhouse would be possible due to the ability to maintain higher Folsom Reservoir water surface levels as well generally maintaining greater opportunities to operate the power facilities.

Continued climate change can increase the flooding risk to the Sacramento metropolitan area. This increase in flood risk will occur while downstream floodplain development is increasing. Auburn Dam and Reservoir would be able to capture higher peak flood flows providing much need additional flood protection and help minimize overall flood risk.

The peak flow attenuation function of Auburn Reservoir is also critical to the viability of groundwater banking; diversion of flood waters for groundwater recharge is extremely difficult due to:

- sediment and turbidity clogs recharge facilities
- floating debris
- physical difficulty with diverting water from a raging river
- short duration of flooding means diversion rates must be very high to achieve meaningful recharge results
- high capacity diversions mean high capacity recharge facilities
- high capacity diversions also mean high pumping rates and energy demands
- groundwater recharge basins are often taxed by local rainfall at the same time they are expected to receive floodwater

Auburn Dam and reservoir would provide relief for each of these ground water project difficulties.

4.0 CHRONOLOGY OF MAJOR EVENTS

1944 Folsom Dam Authorized – The Flood Control Act of 1944 authorized the U.S. Army Corps of Engineers (Corps) to build a dam on the lower American River. The dam was originally designed to provide in excess of 500-year level of flood protection.

1951 Major Flood 1 – After the ground breaking of Folsom Dam, the American River Watershed experiences the first of five record storms.

1955 Folsom Dam Completed – The Folsom Dam was completed at a cost of \$94 million. The dam prevented damage in the Sacramento area from the Christmas flood of the same year. The Christmas flood highlighted the need for additional flood protection.

1956 Major Flood 2 – Although engineers had predicted that it would take a year to fill the Folsom Dam, the second record storm in the American River Watershed filled the dam in a week, saving Sacramento from flooding.

1960 Feasibility Report on the Auburn-Folsom South Unit, Central Valley Project (CVP) – Completed by the Bureau of Reclamation.

1962 Flood Control Act – (PL 87-874) authorized the USACE to study the American River Basin for flood control and allied purposes.

1964 Record Flood 3 – The third record flood in less than 15 years causes engineers to re-evaluate the American River flood frequency. It is concluded that the Folsom Dam is designed to handle a 120-year storm-event.

1965 Auburn-Folsom South Unit Authorized – (PL 89-161) The Auburn-Folsom South Unit was authorized by Congress as an operationally and financially integrated part of the Central Valley Project (CVP). Authorized features of the Auburn-Folsom South Unit included the following:

- Auburn Dam, Reservoir, and Powerplant on the North Fork of the American River
- Folsom South Canal
- Sugar Pine Dam, Reservoir and conveyance
- County Line Dam, Reservoir, and conveyance

1967 Construction of the Auburn-Folsom South Unit is Initiated – Local roads (pertaining to the Auburn Dam) are relocated and construction is started on the Auburn-Foresthill Bridge.

1968 Construction Begins on the Folsom South Canal

1972 Water Right Decision 1400 – The California State Water Resources Control Board (SWRCB) adopted *Water Right Decision 1400* which established flow and storage requirements for the Auburn-Folsom South Unit including minimum flows for various periods of the year.

1972 Auburn Dam Diversion Tunnel Completed – The 33-foot diameter, 2,400-foot long Auburn Diversion Tunnel was completed in November.

1973 Auburn-Foresthill Bridge Completed

1973 Folsom South Canal Completed – Construction of the first two reaches of the Folsom South Canal (about 27 miles) is completed but further construction is suspended pending the outcome of studies related to minimum fishery and recreation flows in the American River downstream from Nimbus Dam.

1974 Foundation Excavation Begins – Foundation excavation begins on the Auburn Dam.

1975 Auburn Dam Construction Halted – Major construction on the Auburn Dam is halted in order to re-evaluate the design after an earthquake measuring 5.7 on the Richter scale occurred near Oroville, CA (about 50 miles northwest of the Auburn Dam site). The event raised safety concerns over the thin-arched concrete design proposed for the dam.

1976 Seismic Report – (April) The Association of Engineering Geologists, Seismic Hazards Committee, issued a report stating that a moderate earthquake, similar to the 1975 event near Oroville, could cause the proposed dam at Auburn to fail.

1977 Auburn Dam Design Data Report – (August) The Bureau of Reclamation completes the *Design and Analysis of Auburn Dam, Volume One Design Data*.

1978 Auburn Dam Re-Design – Reclamation documented the design and engineering associated with the double curvature concrete gravity dam in a five volume set titled *Design and Analysis of Auburn Dam*.

1979 Foundation Substantially Complete – The Reclamation accepted the foundation excavation and treatment contract work as substantially complete.

1980 USBR Feasibility Design Summary, Auburn Dam Concrete Curved-Gravity Dam Alternative (CG-3) – The double curvature concrete gravity dam is selected as the updated dam design.

1982 Sugar Pine Dam Completed

1983 Sugar Pine Pipeline Competed – The 8-mile long pipeline carries water from Sugar Pine Reservoir to the Foresthill Divide area. The pipeline has a capacity of 13 cfs.

1984 Operation and Maintenance of the Sugar Pine Project Transferred to FPUD – The Sugar Pine Dam and Pipeline project was transferred to the Foresthill Public Utility District (FPUD) for operation and maintenance.

1985 Final Report on the Evaluation of the Auburn Dam Project – Completed by Bechtel National, Inc.

1986 Major Flood 4 – In February 1986, the community perception of the flood risk posed to the American River basin changed when major storms in Northern California dumped 10 inches of rain in 11 days, causing record flood flows in the American River basin. The Folsom Dam experienced record high outflows which combined with high flows in the Sacramento River and resulted in water levels rising above the design stage of levees protecting the Sacramento area. It became clear after the storm that Sacramento was a city at significant risk of flooding. These concerns led to a series of investigative reports and authorizations of projects intended to help reduce the level of flood risk posed to the Sacramento area, specifically the area downstream along the American River to its confluence with the Sacramento River. The Folsom Dam was downgraded to about a 60-year storm event.

1988 Continuing Appropriations Act – Provided funding for the USACE to conduct investigations of the American River Watershed.

1989 SAFCA Formed – The Sacramento Area Flood Control Agency (SAFCA) is formed.

1991 Feasibility Report – The USACE completed the *American River Watershed Investigation Feasibility Report and EIS/EIR*. The report recommended levee

improvements and a detention dam at Auburn. The 1991 plan called for a 483 foot-high concrete gravity dam with a capacity of 545,000 acre-feet to provide 200 year flood protection for Sacramento.

1993 Defense Appropriations Act – (PL 102-396) authorized Natomas levee improvements identified in the *1991 Feasibility Report* but rejects a detention dam at Auburn. Congress directs the Corps to study alternative means of flood damage reduction and directs the Corps and the USBR to prepare a Flood Management Plan for Folsom Dam.

1993 SAFCA Initiates NALP – SAFCA initiates construction of the North Area Local Project, which include levee improvements to protect North Sacramento and Natomas.

1994 Folsom Dam Operation Improved – SAFCA and the Bureau of Reclamation execute an agreement to operate Folsom Dam and Reservoir to take advantage of incidental flood control provided by upstream water and power reservoirs.

1996 Supplemental Information Report (SIR) – The *American River Watershed, California, Supplemental Information Report (SIR) and Environmental Impact Statement/Environmental Impact Report (EIS/EIR)* was prepared by the USBR, SAFCA, and the USACE. The report outlines three plans to achieve flood risk reduction:

1. **Folsom Modification Plan**
2. **Stepped Release Plan**
3. **Auburn Detention Dam Plan** – An 894,000 acre-foot detention dam was recommended as the National Economic Development (NED) plan.

1996 Water Resources Development Act – (PL 104-303) Congress again rejects a flood detention dam at Auburn due to the magnitude of opposition to the proposed use of upstream flood detention storage, but authorizes the *American River Common Features Project* which includes additional levee improvement features common to all three plans in the 1996 SIR.

The Common Features Project includes approximately 24 miles of slurry wall in the levees along the lower American River, approximately 12 miles of levee modifications along the east bank of the Sacramento River downstream from the Natomas Cross

Canal, 3-telemetry stream flow gauges upstream from the Folsom Reservoir, and modifications to the flood warning system along the lower American River.

1997 Major Flood 5 – The fifth record storm in 46 years again highlights the risk of flooding in the Sacramento area. The fury of the storm hits 40 miles north of the Sacramento area in the Feather River and levee failures flood Olivehurst, Arboga, Wilton, Manteca and Modesto.

1998 FEMA Accredits Natomas Flood Protection – FEMA accredits increased flood protection in Natomas and Portions of North Sacramento.

1998 SAFCA's Folsom Dam Modifications Report, New Outlets Plan – Presents alternatives to lower the spillways under the Folsom Modification Plan.

1999 Water Resources Development Act – (PL 106-53) authorized the Folsom Modification Project, as identified in the 1996 SIR and modified by SAFCA, and directs the USACE to conduct further studies. The act also authorized added improvements to the *Common Features Project* which included approximately 3.8 miles of additional levee modification along the lower American River and 10 miles on Natomas Cross Canal. The improvements included Mayhew, Howe Avenue Bridge, Morrison Creek, and additional work in Natomas and the Lower American River.

2002 Long-Term Study – The *American River Watershed, California, Long-Term Study and EIS/EIR* completed by the Corps recommends raising Folsom Dam by 7 feet with a flood pool elevation of 482 feet msl.

2002 Second Addendum to the SIR– (March) The Corps completed the Second Addendum to the *1996 SIR (Common Features)* to support the Project Cooperation Agreement (PCA) Amendment for implementation of the lower American River as authorized under *WRDA 1999*. The cost estimate for the American River Common Features Project exceeded the amount authorized by the *WRDA 1999*. Revised project features, designs, and costs were prepared and included in the *Second Addendum to the SIR and EA/IS*.

2003 Folsom Dam Reevaluation Report – The *Folsom Dam Modification Project Limited Reevaluation Report and EA/IS* reconciled conflicts between the authorized Folsom Modification Project components and recommendations in the *2002 Long Term Study*.

2003 Title to Sugar Pine Dam Transferred – Title to the Sugar Pine Dam and Reservoir is transferred to the Foresthill Public Utility District (FPUD).

2004 Energy and Water Development Appropriations Act – (PL 108-137) authorized a 7-foot raise of Folsom Dam. The project also includes a bridge over the American River near Folsom Dam, improvements to L.L. Anderson Dam (a non-Federal dam) and ecosystem restoration.

2005 Energy and Water Development Appropriations Act – (PL 109-103) authorized the Secretary of the Interior to complete a Special Report to update the analysis of costs and associated benefits of the authorized Auburn-Folsom South Unit.

2006 Auburn-Folsom South Unit Workshop – Held in Sacramento on January 20th, the purpose of the workshop was to gather persons with knowledge about the initial development of the Auburn-Folsom South Unit.

2006 Energy and Water Development Appropriations Act – (PL 109-103) directed the Corps and Reclamation to collaborate on flood damage reduction and dam safety efforts at Folsom Dam.

2006 Auburn-Folsom South Unit Special Report – The United States Bureau of Reclamation releases a benefits and cost update for the Auburn Dam in December.

2007 PAC Report – The *Post Authorization Change Report* is completed by the USACE. The report documents changes to both the *Folsom Modifications Project* and the *Folsom Dam Raise Project* and combines them into a single *Refined Authorized Project (RAP)* to be carried out in cooperation with both the Corps and Reclamation. A summary of the features of each of these projects is as follows:

- **Folsom Modification Project** – The Water Resources Development Act (WRDA) of 1999 (PL 106-53) provided authorization for the Folsom Modification Project. It directed the Corps to implement a project to modify Folsom Dam and Reservoir generally as described the *1996 American River Watershed, California, Supplemental Information Report* by the Corps, and as modified the *1998 Folsom Dam Modification Report, New Outlets Plan*, by the Sacramento Area Flood Control Agency (SAFCA). The total authorized cost was \$150 million.

- **Folsom Dam Raise Project** – The Energy and Water Development Appropriations Act of 2004 (PL 108-137) directed the Secretary of the Army to carry out a project for flood damage reduction and ecosystem restoration, as described in the Corps *Chief of Engineers Report*, dated November 2002, at a total cost of \$257.3 million. Included in the Folsom Dam Raise Project authority are provisions for the expedited design and construction of a new bridge at Folsom and ecosystem restoration. The original project consisted of raising the main dam, associated wing dams, dikes and other appurtenances by 7 feet. The project was later revised to a 3.5 feet raise.
- **Project Collaboration and Auxiliary Spillway** – The Energy and Water Development Appropriations Act of 2006 (PL 109-103) directed the Secretary of the Army and the Secretary of the Interior to collaborate on authorized activities to maximize flood damage reduction improvements and address dam safety needs at Folsom Dam. Pursuant to this legislation, the Secretaries are to consider reasonable modifications to existing authorized activities, including an auxiliary spillway.

5.0 RECOMMENDATIONS

As population rises, California faces greater demands for water, power, recreation, flood protection, and increasingly critical threats to its ecosystems. Developing supplemental water by construction of new storage reservoirs on principle streams would help enhance sustainability of California's water resources. Because of its strategic location, the Auburn Dam and Reservoir would provide significant regional and statewide benefit. Auburn Dam and Reservoir specific recommendations include the following.

Maintain the Auburn Dam Option

As the water resources of the region and the state continue to be stressed, it is prudent to maintain substantial options that can be utilized to help meet water resources needs. This includes the option to develop the Auburn Dam and Reservoir. The Auburn Dam site should be preserved to maintain the option of developing the project at some time in the future.

Water Right Protection

In January, 2008 the State Water Resources Control Board issued a notice to the Bureau of Reclamation alleging that the Reclamation had failed to diligently pursue beneficial use of water authorized by the water rights permits that allowed diversion on the North Fork American River to supply the Auburn Dam Project. The Reclamation requested a water right hearing on the Boards request of permit revocation. A pre-hearing conference was held on June 4. A public hearing is set to be held on July 21 for the State Water Resources Control Board to receive evidence relevant to determining whether the water rights permits assigned to the Bureau of Reclamation should be revoked. The water right permits associated with the Auburn Dam should be preserved as their loss would place an unnecessary obstacle on the potential future development of the project.

Need for Additional Study

Additional reservoir storage on the American River would provide for a significant increase in watershed performance and regional benefits. In light of climate change and the increasing societal and ecosystem demands on the American River watershed, a

new comprehensive Feasibility Study of the Auburn Dam is warranted. The Feasibility Study should examine alternatives to optimize project benefits and accommodate the following needs:

1. Urban water supplies; in basin and export
2. Flood damage reduction in the Sacramento Metropolitan Area
3. Carbon-free power supply, including hydropower peaking and pumped storage operations in conjunction with Folsom Reservoir
4. Recreation enhancement for both Auburn and Folsom Reservoir areas
5. Ecosystem enhancement, including water temperature management, Lower American River flows, and reservoir fisheries in both Auburn and Folsom Reservoirs
6. Optimize other Statewide benefits

6.0 REFERENCES

1. Bechtel National, Inc. (Bechtel) 1985. Final Report on the Evaluation of the Auburn Dam Project. Prepared for California Department of Water Resources. November.
2. United States Army Corps of Engineers, Sacramento District; the Reclamation Board, State of California; and the Sacramento Area Flood Control Agency. 1996. Supplemental Information Report. American River Watershed Project, California. March.
3. United States Army Corps of Engineers, Sacramento District. 2002. American River Watershed, California Long Term Study. February.
4. United States Department of the Interior, Bureau of Reclamation, Mid Pacific Region. 2006. Auburn-Folsom South Unit Central Valley Project Technical Memorandum, Project Description Review. March.
5. United States Army Corps of Engineers, Sacramento District. 2006. Auburn Folsom South Unit Special Report, California, Office Report. June.
6. United States Army Corps of Engineers, Sacramento District; the Reclamation Board, State of California. 1991. American Rive Watershed Investigation, California, Feasibility Report. December.
7. United States Department of Interior, Bureau of Reclamation, Mid-Pacific Region. 2006. Auburn-Folsom South Unit Special Report, Benefits and Cost Update. December.
8. United States Army Corps of Engineers; United States Department of the Interior, Bureau of Reclamation. 2007. Record of Decision, Folsom Dam Safety and Flood Damage Reduction Joint Federal Project. May.
9. United States Army Corps of Engineers. 2007. American River Watershed Project, California, Folsom Modification and Folsom Dam Raise Projects, Post Authorization Change Report. March.
10. United States Department of the Interior, Bureau of Reclamation, Mid-Pacific Region. 2006. Auburn-Folsom South Unit Central Valley Project, Technical Memorandum, Economic Benefits Update. June.
11. United States Department of the Interior, Bureau of Reclamation, Mid-Pacific Region. 2007. Record of Decision, Folsom Dam Safety of Dams and Security Upgrades Projects. May.
12. United States Department of the Interior, Bureau of Reclamation, Central California Area Office. 2006. Auburn-Folsom South Unit Update of Cost. June.

13. United States Department of the Interior, Bureau of Reclamation, Mid-Pacific Region. 2006. Auburn-Folsom South Unit Special Report, Technical Memorandum, Water supply, Power Generation, and Water Temperature Analysis. July.
14. United States Department of the Interior Bureau of Reclamation Report on Undeveloped Land, Water and Power Resources of California and their Utilization in a Post-War Construction Program, Region II. Sacramento, California, April 1944.
15. State of California Department of Public Works, Report on State Water Plan Prepared Pursuant to Chapter 832, Statutes o 1929, Bulletin No. 26, Sacramento River Basin, 1931.
16. United States Census Bureau (<http://www.census.gov/>)
17. State of California Resources Agency Delta Blue Ribbon Task Force Delta Vision, November 30, 2007.

