

RTD-106

Shasta Division

Central Valley Project

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Shasta Division--Central Valley Project

Authorization of the Central Valley Project (CVP) in 1935, created the project's initial three divisions, including Shasta Division. California first tried to build the CVP, but unable to breach the financial wall, the state turned to the Bureau of Reclamation. Federal and state project planners envisioned Shasta Dam as the key to the Central Valley Project. Shasta would perform several duties for the project, including water storage, to release for irrigation and salinity control in the Delta; flood control, to protect communities along the Sacramento River, long afflicted by flood waters; and power generation.

Project Location

The Shasta Division is located in Shasta County, California. The division contains Shasta Dam, Lake, and Powerplant; and Keswick Dam, Reservoir, and Powerplant. Lands and population served by the division stretch south into Tehama County. The city of Redding, the seat of Shasta County, is the largest community in the division.¹

Historic Setting

Several groups of Native Americans inhabited northern California prior to the influx of European settlers. The Yana and Atsigewi inhabited the Shasta region. Because the Spanish concentrated their missions along the coast of California, much of the region remained uninhabited by Europeans until the 1840s. The discovery of gold in California brought floods of white immigrants to the state.²

Many immigrants' attention soon turned from the lure of easy money through gold discovery, to the seemingly more stable lifestyle of the farmer. Agriculture in the Central Valley proved almost as much a gamble as prospecting for gold. When nature cast the die, the roll could literally result in flood or famine. California began searching for the right plan to ease the roller coaster ride of drought and flood faced by the Central Valley farmers.

1. Water and Power Resources Service, *Project Data* (Denver: Government Printing Office, 1981), 217-8.

2. Stephen Johnson, Robert Dawson, and Gerald Haslam, *The Great Central Valley, California's Heartland: A Photographic Project by Stephen Johnson and Robert Dawson, Text by Gerald Haslam* (Berkeley: University of California Press, 1993), 30-1.

Project Authorization

California designed the Central Valley Project to control the Sacramento River floods, and to transfer water to the dry lands of the San Joaquin Valley. Even with the authorization of revenue bonds, California found itself unable to finance the project, and the state could not get the project approved for loans and grants under the National Recovery Act. Harry W. Bashore reported to Reclamation on the upper San Joaquin Relief Project, saying the State Engineer considered Kennett Reservoir (Shasta Lake) the cornerstone for the entire Central Valley Project. California applied to the Federal Emergency Administration of Public Works (FEA) for grants and loans, and created the Water Project Authority. The Committee on Rivers and Harbors of the House of Representatives recommended involvement by the Federal government for \$12 million in the construction cost of Kennett (Shasta) Dam because of the national benefits in navigation and flood control on the Sacramento River. After reviewing the investigations, the California Joint Federal-State Water Resources Commission, the United States Senate Committee on Irrigation and Reclamation, Bureau of Reclamation, and the Army Corps of Engineers approved and recommended the plan. President Franklin D. Roosevelt Approved the Central Valley Project on December 2, 1935. Congress re-authorized the Project in the Rivers and Harbors Act of 1937.³

Construction History

Shasta Dam

On March 25, 1936, the United States and the California Water Project Authority executed a cooperative agreement to coordinate the CVP and the California State Water Project. Sixteen representatives of labor federation councils and labor organizations presented their objections, about the minimum wage scales established for the Central Valley

3. "Memorandum 'A'," Colorado River Project--Central Valley (California)--Land Acquisition, papers of Harry W. Bashore, box 4, American Heritage Center, University of Wyoming, Laramie, Wyoming, 2; Bureau of Reclamation, *Annual Project History, Central Valley Project, to December 31, 1936*, Record Group 115, 20, 40, 42; Harry W. Bashore, "Central California Water Resources Investigative Report on Upper San Joaquin Relief Project, August, 25, 1933," Colorado River Project--Central Valley (California), papers of Harry W. Bashore, box 4, American Heritage Center, University of Wyoming, Laramie, Wyoming, Vol. II, C. Hereafter Record Group 115 cited as RG 115.

Blacksmith, skilled	\$ 1.10	Miner, chucktender	\$0.60	Powder man	\$0.80
Blacksmith, helper	\$ 0.60	Motorman	\$0.70	Rigger	\$1.10
Carpenter, skilled	\$ 1.10	Mucker	\$0.45	Steel Work, struct.	\$1.10
Carpenter, rough	\$ 0.83 ⁴	Operator, cable	\$1.10	Steel Work, helper	\$0.60
Carpenter, helper	\$ 0.60	Operator, comp.	\$0.70	Steel Place, rein.	\$1.10
Concrete finisher	\$ 1.10	Operator, crane	\$1.10	Steel Place, helper	\$0.60
Driller, jackhammer	\$ 0.70	Operator, engine	\$0.70	Tractor Driver	\$0.80
Electrician	\$ 1.10	Operator, muck mach.	\$1.10	Truck driver, 4 tons or less	\$0.70
Electrician, helper	\$ 0.60	Operator, muck helper	\$0.60	Truck driver, 4 tons or more	\$0.80
Laborer	\$ 0.45	Operator, pump	\$0.70	Welder	\$1.10
Mechanic, repair	\$ 1.10	Operator, ps/drag	\$1.10	Welder, helper	\$0.60
Mechanic, helper	\$ 0.60	Operator, ps/d helper	\$0.60		
Machinist	\$ 1.10	Pipe fitter	\$0.80		
Miner, machine man	\$ 0.80	Pipe fitter, helper	\$0.60		

Table 1. Occupations and initial wage scale on the Central Valley Project, 1936.
Source: Bureau of Reclamation, *Annual Project History, Central Valley Project, to 1936*, 137.

Project, to Walker R. Young (see Table 1). Union representatives contended the pay did not reflect actual prevailing wages. They argued the titles of rough carpenter and carpenter should not exist because California entitled anyone using carpenter's tools to the same pay. The State Attorney General ruled California's prevailing wage rate law did not apply to CVP construction because the state had not funded any of the Project. The meeting proved an omen for future relations between government, contractors, and workers.⁵

Reclamation studied locations for three dams. For the future Shasta Dam, Reclamation only studied the original Kennett site. Reclamation discovered that development of the Kennett site required the relocation of approximately thirty miles of the Southern Pacific Railroad's line. Reclamation investigated two sites for the proposed Baird Dam, and three for Table Mountain Dam, neither of which were constructed.⁶

Reclamation began initial exploration of the Kennett Dam site in December 1935. First it

4. This was shown as \$0.825.

5. Reclamation, *Project History, Central Valley Project, to 1936*, 24, 92-4.

6. *Ibid.*, 59, 74, 76.

cleared out and re-timbered several exploratory tunnels originally begun by California on January 6, 1936. Drilling on the site revealed ancient, re-crystallized, volcanic rock.⁷

Work crews began experimental washing and grouting of seams in the foundation in 1937, and work started on the government construction camp called Toyon. Three companies received contracts to construct buildings and water systems for the camp, and finished the camp in early 1938. During a public meeting in Sacramento, Reclamation determined the wage scale for construction of the government construction camp at and relocation of the Southern Pacific's track. At a ceremony on September 12, 1937, Reclamation Commissioner John C. Page officially named the dam Shasta, after Mount Shasta, citing the geographic and historic significance of the name. The unofficial use of Kennett came from a railroad way station in Sacramento Canyon just above the dam site.⁸

The activities of labor unions impacted construction early and often. Late in 1938, a

Pacific Contractors, Inc.	
American Pipe and Construction Co.	Arundel Corp.
W. E. Callahan Construction Co.	L. E. Dixon Co.
Foley Brothers, Inc., of St. Paul and New York	
Griffith Co.	Gunther and Shirley Co.
A. Guthrie & Co., Inc.	Hunken-Conkey Construction Co.
L. T. Lawler	J. C. Maguire & Co.
Metropolitan Construction Co.	M. J. Bevanda
John & Bressi Construction Co.	Clyde W. Wood, Inc.
Shofner, Gordon & Hinman	David W. Thurston

Table 2. Member companies of Pacific Contractors, Inc.

Source: No author given, *Shasta Dam and Its Builders*, (Pacific Constructors, Inc., April 1945), 49-51, 53-7, 59-63.

strike occurred in Redding, on construction of the Southern Pacific bridge. The two sides quickly reached an agreement and work resumed.⁹

7. *Ibid.*, 76-7, 81.

8. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1937*, RG 115, 24, 34-5, 41-2; "Shasta Dam Officially Named by Commissioner Page," *The Reclamation Era*, October 1937, 235; Smith A. Ketchum, "CCC Activities on the Kennett Division Central Valley Project," *The Reclamation Era*, April 1939, 85.

9. Reclamation, *Project History, Central Valley Project, 1937*, 67.

Pacific Constructors, Inc. (hereafter referred to as Pacific Constructors or PCI), a joint venture (see Table 2), received the contract for building Shasta Dam. Possibly to avoid labor troubles afflicting other contractors, PCI drew up a contract with the Building and Trades Department of the American Federation of Labor (AFL) and its affiliates. In the contract, PCI recognized the unions, and agreed, with exceptions, to employ only the unions' members. PCI further agreed to the unions' established wage scale for construction of Shasta Dam and Powerplant.¹⁰

Colonial Construction Company contracted to excavate the diversion tunnel and temporarily relocate the Southern Pacific Railroad line at Shasta Dam, while United Concrete Pipe Corporation received a contract for relocating the Southern Pacific line north of the dam site. Colonial discovered the material in the tunnel excavation was not self supporting, and tried different methods of digging the tunnel to advance progress, finally proving successful. The company excavated a total of 958 feet from both headings. They advanced 709 feet from the south portal alone. Colonial finished more than half of the contract before the end of 1938.¹¹

PCI commenced operations on Shasta Dam before actually receiving the notice to proceed on September 8, 1938. During 1938 PCI finished most of its construction camp; started excavation of both abutments, the switchyard road, and the left abutment corewall; stockpiled earthfill material for embankments; began placement of rolled fill and excavation of rock on the left abutment's embankment section; and nearly completed the by-pass channel for the Sacramento River along the left bank by the end of the year.¹²

Kennett Division construction continued suffering labor disputes in 1939. A jurisdictional conflict between the AFL and its primary rival, the Congress of Industrial Organizations (CIO), suspended United Concrete Pipe's work on the Southern Pacific line near Delta, north of Shasta Dam, for almost twenty days. United had contracted with the AFL to use only their labor. In a legal defeat for the CIO, the Shasta County Court upheld an injunction

10. *Ibid.*, 67-8.

11. Reclamation, *Project History, Central Valley Project, 1937*, 70-1; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1939*, RG 115, 115.

12. Reclamation, *Project History, Central Valley Project, 1937*, 71.

preventing interference with AFL workers by CIO pickets. Local 260 of the Shasta Tunnel and Construction Workers Union, a CIO affiliate, surrendered its charter on June 7, 1939, and withdrew from Shasta County.¹³

Pacific Constructors finished their construction camp in 1939, and continued raising their construction facilities. The company concentrated on excavation during the year. They completed most of the dam excavation. They removed three million cubic yards of material during the work season, completing about one-third of the contract by the end of 1939. Colonial Construction finished the temporary Southern Pacific relocation and the Shasta diversion tunnel during the year.¹⁴

Disruptions by labor spilled over to the Southern Pacific work in 1940. A Southern Pacific Railroad Company crew, laying relocated track, went on strike on March 12. They claimed the work was part of the Shasta Dam construction and came within the scope of the pay scale for labor on the dam. The track laying resumed September 3, after the issuance of an extra work order met their demands.¹⁵

The action by the Southern Pacific crew spurred the local trades council to argue the work approximated other track laying on the Kennett Division, and the same wage rate should apply to all track laying on the Division. A. Teichert and Son, Inc., the contractor, agreed to a higher wage. Around the same time, Pacific Constructors and the Business Trades Council of the AFL agreed to a five day week with eight hour days instead of the existing six day week with six hour and forty minute days.¹⁶

Flooding in February and March of 1940, suspended Pacific Constructors' work temporarily. The rushing water washed away the combination suspension and girder bridge located upstream from the dam site, and seriously damaged PCI's truck and railroad bridge. Between February 25 and 29, the flooding cost Pacific Constructors and Columbia Construction Company a combined total of \$12 million in damage. Several people in the Sacramento Valley

13. Reclamation, *Project History, CVP, 1939*, 59.

14. *Ibid.*, 114.

15. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1940*, RG 115, 71-2, 182-3.

16. *Ibid.*, 72.

lost their lives in the flooding.¹⁷

Concrete placement on railroad relocation structures, the Pit River Bridge, and Shasta Dam commenced in 1940, and continued throughout the year at various locations. Pacific Constructors poured the first concrete on Shasta Dam July 8, 1940, using an elaborate cableway to place concrete on Shasta Dam. The cable system had a 460 foot tall head tower and five tail towers, and used eight cubic yard buckets to haul the concrete to the placement locations. Pacific Constructors placed the concrete in Shasta in separate fifty foot wide sections or blocks.¹⁸

Pacific Constructors dissipated the heat generated while curing the concrete by circulating river water through pipes installed in the concrete. They cooled the first few lifts, the five feet high sections placed and allowed to set, in the foundation depressions immediately, using closely spaced piping to circulate cool water until the concrete temperature came within five degrees of the water temperature. Summer temperatures at the Pit River Bridge required a refrigeration plant to control concrete temperatures. The contractors cured the concrete by sprinkling with water, covering with wet sand, or with a curing compound. The curing process allowed faster heat dissipation because slow curing resulted in the concrete losing strength.¹⁹

Rising water in December 1940, broke through both cofferdams, flooding the powerhouse and spillway areas, further delaying work. The flooding did not significantly slow progress on dam construction. During the year, PCI completed most of the excavation, removing over four million cubic yards of material. The contractor began concrete placement, and laid 500,000 cubic yards of concrete before the end of 1940.²⁰

The Southern Pacific turned its railroad bypass tunnel, in the right abutment, over to PCI for river diversion in July 1942. Colonial Construction Company built the railroad tunnel for eventual use as a river diversion tunnel.²¹ Until then, river diversion during excavation and

17. *Ibid.*, 130, 182.

18. Reclamation, *Project History, Central Valley Project, 1940*, 95-6, 182; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1942: Part 2*, RG 115, 18.

19. Reclamation, *Project History, Central Valley Project, 1940*, 96; "Shasta Dam Concrete Operations," *The Reclamation Era*, April 1941, 117.

20. Reclamation, *Project History, Central Valley Project, 1940*, 130.

21. Reclamation, *Project History, Central Valley Project, 1942: Pt. 2*, 18; "Railroad Construction at Shasta Dam," *The Reclamation Era*, October 1939, 285.

concrete placement remained a complex task. PCI continually diverted and re-diverted the Sacramento River back and forth across the dam site, in different stages, as they excavated and raised the blocks of the dam, using a series of cofferdams to keep water out of the construction areas. Because of the time it took to divert the river, PCI would often excavate and start placement of concrete in one section of the dam, instead of excavating the entire dam and powerplant foundation before the placement of any concrete. When the Southern Pacific transferred its tunnel to PCI for river diversion, it eliminated the need to divert the water through the construction site.

In 1941, Reclamation provided funds for Keswick Dam and a fifth power unit in Shasta Powerplant. The escalating war in Europe encouraged the government to place guards at project structures, in limited numbers, protecting against possible sabotage. After the Japanese attack at Pearl Harbor, the government increased guard protection to twenty-four hours a day, and restricted access to critical facilities. Reclamation initially assigned twenty-nine guards to Kennett Division facilities. By the end of the year, forty temporary guards, and three permanent and four temporary watchmen guarded Reclamation's structures. The Army put a guard at the Southern Pacific Railroad bridge, near the Sacramento River bridge.²²

Work continued rapidly on Shasta Dam during 1941. The contractors diverted the Sacramento River into a temporary channel for the first stage river diversion in August 1940. Pacific Constructors placed the one millionth cubic yard of concrete in Shasta on May 3, 1941. The war effort required a large amount of steel, postponing delivery of the seventeen bulkhead gates for Shasta Dam's draft tube outlets. Workers poured the two millionth yard of concrete on October 13. In addition, the contractor found a badly fractured seam in the river channel requiring more excavation than originally thought. The seam delayed placement of concrete in the river channel for some time.²³

Seasonal heavy rains and high runoff in the early months of 1941, caused delays in

22. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1941: Part 1*, RG 115, 6-7; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1941: Part 2*, RG 115, 23.

23. Reclamation, *Project History, Central Valley Project, 1940*, 182; Reclamation, *Project History, Central Valley Project, 1941: Pt. 1*, 9.

concrete placement, especially in spillway and powerhouse construction. Flood waters washed excavated material into the spillway. The priority rating on Shasta failed to prevent all postponements. A cement shortage in June 1941, halted work briefly, several times. PCI succeeded in diverting the river into a temporary channel in June and July. The contractor resumed concrete placement on the spillway July 26, 1941. The company completed concrete operations sufficiently to allowed river diversion over the lower concrete blocks on September 30, 1941. The new diversion route permitted workers to start excavation in the diversion channel area. Pacific Constructor started installation of the penstock pipes on October 21. December weather conditions hindered progress as winter floods stopped operations in the river channel.²⁴

Continued escalation of World War II caused delays in procuring steel for dam construction. The lack of steel prevented delivery of the seventeen permanent bulkhead gates required to close the draft tube outlets. Pacific Constructors used timber stop logs to temporarily close the outlets and control flooding. They installed the stop logs November 27, 1941, and the Sacramento overtopped the cofferdam on December 3.²⁵

Shasta Dam drew much attention during 1941. The Mutual Broadcasting System (MBS) made a coast to coast broadcast from the dam on April 5. The Columbia Broadcasting System (CBS) broadcast a report from Shasta August 16. Secretary of the Interior Harold Ickes visited the dam with a group on Halloween 1941.²⁶

The original construction program scheduled completion of Shasta Powerplant and first power generation for 1945. The rapidly growing defense industry in California necessitated power availability in January 1944. To meet the growing need, Shasta received a high priority rating for continuing construction in 1941.²⁷

In addition to material shortages, World War II caused a high labor turnover rate on the Central Valley Project construction as workers left to join the military or take more lucrative

24. Reclamation, *Project History, Central Valley Project, 1941: Pt. 2*, 24, 27, 29.

25. *Ibid.*, 57.

26. *Ibid.*, 64.

27. *Ibid.*, 22.

defense industry jobs. Openings quickly filled with less experienced workers. Reclamation authorized contractors, on an individual basis, to augment employees' weekly wages by increasing total work hours from forty to forty-eight per week. To a small extent, the move counteracted employees' incentive to seek work elsewhere. Reclamation raised the minimum wage scale to a rate more competitive with other fields. Even so, many contractors still found it necessary to adopt a wage scale above the minimum specified in their contracts.²⁸

Pacific Constructors had practically completed excavation of Shasta's spillway and left abutment in 1941. Flooding on the Sacramento River in late January and early February 1942, suspended work on the spillway. The river overtopped the cofferdam on January 23, and the water level rose and fell sporadically until February 14, when it returned to its normal channel. Afterward, PCI removed the water from the excavation. The contractor's work progress became more rapid when the flooding subsided.²⁹

The heavy rains in the early months of 1942, did not seriously affect progress on the right abutment excavation and the relocation of the Southern Pacific line. Southern Pacific began routing trains over the relocated track on March 14, 1942, permitting excavation for the powerhouse and penstock section to proceed. During the second stage river diversion, an impervious rock dike kept the water at bay during right side excavation, until diversion of the river. Pacific Constructors built a cofferdam, along the spillway apron to a concrete training wall, to allow diversion of the Sacramento through the three left bays of the spillway section. A downstream cofferdam along the left bank directed the water from the spillway lip back to the river channel 200 feet downstream.³⁰

As operations continued, Pacific Constructors switched to a smaller cableway and a four cubic yard bucket for placing concrete on Shasta. The new cableway system consisted of a stationary head tower and one moveable tail tower giving the contractor more latitude in laying the concrete. Concreting operations started on the right abutment May 13, 1942, and continued

28. Reclamation, *Project History, CVP, 1941, Pt. 1*, 77-9.

29. Reclamation, *Project History, Central Valley Project, 1942: Pt. 2*, 35.

30. *Ibid.*, 37.

on the left abutment and spillway. Pacific Constructors did no work on one of the blocks because the construction train passed through the opening. Detailed form work and complex placement of reinforcing steel and other embedded materials, made concrete placement, on the spillway, fishtrap, powerhouse, and penstocks, a complicated operation with an unusual amount of work.³¹

PCI placed concrete stop logs in front of the upstream cofferdam to contain the main flow of the river, and force it over the low blocks of the spillway section. PCI laid earth and rockfill over the upstream coffer to close it June 9, 1942. The company removed water from the river channel in the following days, and commenced excavation in the river section on June 14.³²

Pacific Constructors diverted the Sacramento River alternately through the rows in the river channel and the spillway as work continued in 1942, until the Southern Pacific turned its railroad tunnel over to the contractors in July when regular train service over the old railroad line discontinued. Prior to acquisition of the old railroad tunnel, other diversions utilized a five panel bulkhead, thirty-two feet high, to span the fifty foot block openings. PCI placed the first concrete in the right abutment during 1942. The contractor mostly cooled the concrete with water pumped directly from the river.³³

Pacific Constructors began removing both cofferdams near the end of 1942, as concrete operations continued. The company accomplished rapid progress during the year, laying the three millionth cubic yard of concrete on Shasta March 28, 1942, and the four millionth yard August 31. Workers continued on installation of the turbine draft tubes.³⁴

The government ordered Reclamation to transfer two generators and turbines from Shasta to Grand Coulee Dam in Washington. Estimates showed Reclamation could start generating power at Grand Coulee in spring 1943, whereas Shasta could not begin operation until 1944. The heads of the two dams were similar, allowing the transfer to take place, though it proved an expensive operation. Reclamation transferred the two generators from storage at Boulder Dam

31. *Ibid.*, 40.

32. *Ibid.*, 37.

33. *Ibid.*, 18, 25, 27.

34. *Ibid.*, 40-1, 47, 55.

in Nevada, one turbine from Shasta, and the other turbine from Allis-Chalmers Company in Milwaukee, where it neared completion.³⁵

Due to the war effort, the Federal government salvaged old materials from the work on the Kennett Division. Reclamation used force account labor to salvage materials from the old railroad line. The crews collected steel and wooden water tanks, steel oil tanks, oil and water pumps and fittings, steel pipe, scrap iron, cast iron culvert pipe, ties, track, and accessories not salvaged by Army contractors. The Army salvaged wire, cables, and hardware from the communication and signal systems, and their contractors salvaged all rails and fittings between Shasta's diversion tunnel and Delta Division. The Public Roads Administration (PRA) dismantled one of the crossing bridges for use on the Alaskan highway.³⁶

Kennett Division contractors employed 2,416 employees in 1943, despite the manpower shortage created by World War II. The war, however, did not end labor strife on the division. In late October 1943, a strike for higher wages suspended work on Keswick Dam and Powerplant. The Shasta County Building and Construction Trades Council (SCBCTC) applied to the Wage Adjustment Board (WAB) for an increased wage scale. Workers returned to the job on November 2, pending a decision by the board. The United Brotherhood of Carpenters and Joiners of America, Local 1599 at Redding, informed the National Labor Relations Board (NLRB) on November 18, a strike would occur if the WAB did not render a decision in the Atkinson-Kier case by January 20, 1944.³⁷

In 1943, Pacific Constructors continued alternating diversion of the Sacramento River through different blocks of Shasta Dam. The company left two blocks open for river diversion with a third open to relieve flooding. PCI continued excavation of both abutments, for the powerhouse tailrace, and the river channel. The contractor finished excavation for the spillway apron and the right and left training walls. PCI laid the material for the left abutment's upstream

35. "Jap Evacuees to be Settled on Unused Lands of Western Irrigation Projects: Bureau of Reclamation to Supervise Work of 20,000 Moved from Coast Strategic Areas; Other War Problems Add to Bureau's Work," *Engineering News Record*, 7 May 1942, 57.

36. Reclamation, *Project History, Central Valley Project, 1942: Pt. 2*, 46.

37. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1943: Part 1*, RG 115, 64-5.

embankment, and placed riprap around the hill to prevent possible slides from the road above.³⁸

The manpower shortage slowed concrete operations in 1943, though they continued through the year. Concrete placement in Shasta Dam reached 6,125,174 cubic yards. Operations moved more slowly on the powerhouse and its appurtenant structures. Concrete placement on the powerhouse only amounted to 8,060 cubic yards in 1943, bringing the total to 86,160 yards. Concrete operations resumed on the diversion blocks May 17, 1943, and Pacific Constructors routed the river through the diversion tunnel on July 6. After the Sacramento River started flowing through the tunnel, the rate of concrete placement on the spillway sections increased.³⁹

The contractor initiated water removal from the spillway apron area August 17, 1943. The company completed concrete operations on all but two blocks by the end of the year. PCI vacuum processed the surface of the spillway face and apron to remove excess water. The company placed vacuum mats on the surface, and vacuumed at twenty to twenty-five inches of mercury for one half to one full hour. The process removed an average of .06 gallons of water per square foot, from the face and apron, resulting in a hard dense concrete surface, free of air pockets.⁴⁰

During 1943, Pacific Constructors placed concrete in the diversion tunnel works to form the coaster gate structures and the tunnel transition. As workers laid the concrete, they removed timber cribbing and bracing, installed in the shaft during excavation. They removed the timber progressively, up to elevation 727. Above 727, workers simply embedded the timber in concrete. The contractor continued cooling the concrete with water pumped from the river. PCI used a refrigeration plant both for more rapid cooling of some areas, and when river temperatures were too high for final cooling. Penstock installation continued in April 1943, and workers completed most of the work by the end of the year. Pacific Constructors laid the six millionth yard in Shasta Dam on December 23, 1943.⁴¹

38. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1943: Part 3*, RG 115, 17, 21.

39. *Ibid.*, 21, 24.

40. Reclamation, *Project History, Central Valley Project, 1943: Pt. 3*, 24, 27; "Vacuum Processing of Shasta Spillway," *Engineering News Record*, 14 June 1945, 93-6.

41. Reclamation, *Project History, Central Valley Project, 1943: Pt. 3*, 27, 30, 32.

Pacific Constructors closed the diversion tunnel at Shasta, and plugged it with concrete on February 4, 1944. During the year, the company concluded excavation for the final two blocks of the dam, ending all required excavation. A relocated crane recess necessitated more excavation on the right abutment, which the contractor completed later in the year. Pacific Constructors finished placing the left abutment's embankment to within a short distance of the final grade. Only the lack of road surfacing material prevented full completion. Workers completed most of the riprap on the upstream side of the embankment. PCI finished all concrete in Shasta which required cooling by November 17, 1944. The company did not fully complete the gate chambers because the drum gates were not available.⁴²

Pacific Constructors finished cooling the concrete, then filled all the cooling tubes with grout. General Electric Company concluded installation of two generator units on June 1, 1944. Reclamation ran one of the units for testing on June 10, but shut down because of a bearing problem. The unit finally ran successfully on June 19. The other unit had a successful run the next day. CBS broadcast "Shasta Unlimited" from the dam on September 9, 1944.⁴³

Pacific Constructors laid the final concrete on the dam structure December 22, 1944. The firm placed the final concrete in the Vista House at Shasta, completing it in January 1945. During the same month, the company finished laying the concrete in the spillway. The firm finished placement of the embankment material on the left abutment in April. Reclamation accomplished various construction operations and installation of equipment in the powerplant. On June 20, 1945, Reclamation accepted Shasta Dam and Powerplant concrete work from Pacific Constructors.⁴⁴

Reclamation established the Sacramento Valley District on December 14, 1945, and abolished the Kennett Division on September 5, 1946. Installation of the valves, river outlet works, and the spillway drum gate fixtures commenced in 1946, and Reclamation returned

42. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1944: Part 3, Vol. 8*, RG 115, 19, 25.

43. *Ibid.*, 25, 35, 59.

44. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1945: Part 3*, RG 115, 13, 16; "Shasta Dam 'Topped Off'," *Engineering News Record*, 11 January 1945, 88.

generator Units Two and Five from Grand Coulee Dam. Installation of the fourteen ninety-six inch outlet valves and the outlet control system for Shasta Dam started in 1947. Reclamation completed the permanent lighting system, stair handrails, and the visitors' facilities during the year. Reclamation continued installation of the three remaining generator units at Shasta. They nearly completed two units, and had started the third by the end of the year, but work did not continue without problems. W. C. Jones of the Division of Industrial Safety filed a notice of unsafe conditions against Eichleay Company, the contractor placing the penstock pipes, for working above protruding reinforcement steel, defective ladders and scaffolding, and a need for general cleanup.⁴⁵

Work continued on installation of the outlet pipes in 1948, and neared completion at the end of the year. Reclamation continued work on the spillway drum gates during 1948. General Electric finished placing two of the generating units in the powerplant, and continued on the final unit. Harms Brothers of Sacramento received a contract for construction of the Summit City highway and the parking area in Shasta Dam's left abutment in 1947. They concluded work on both by the end of 1948. The company worked forty-five to forty-eight hour weeks to finish after Reclamation granted them an extension to August 7, 1948.⁴⁶

On April 27, 1949, the fifth unit started operation in Shasta Powerplant, five years after the first unit started. On July 2, 1949, Reclamation started guided tours for the public at Shasta. John C. Gist completed placement of the drum gates on Shasta's spillway in 1950, and Haas and Rothschild finished the reservoir clearing. Completion of all facilities at the dam occurred in 1950.⁴⁷

The forested Shasta Lake site needed a large amount of clearing to prepare it for filling. Clearing operations started in conjunction with dam construction. The Civilian Conservation

45. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1946: Part 1*, RG 115, 37-8; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1946: Part 2*, 1; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1947: Part 1*, RG 115, 1, A-46.

46. Reclamation, *Project History, Central Valley Project, 1947: Pt. 1*, I-1; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1948: Part 1*, RG 115, 7, 25.

47. Bureau of Reclamation, *Annual Project History, Central Valley Project, 1949*, RG 115, Regional Headquarters, 2, Sacramento Valley District, 9; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1950*, RG 115, SV-4.

Corps (CCC) set up its local headquarters at the abandoned Baird Fish Hatchery in 1938, and established two camps in the area, BR-84 and BR-85. CCC enrollees cleared brush and timber from thirty-four acres of the Shasta Lake site extending from ten feet below the dead storage level to five feet above the maximum water storage. They landscaped the government construction camp at Shasta, laid base, coarse material for 5,253 feet of walks and driveways, and placed final surface material on another 3,710 feet of sidewalks and roadways, completing the work in 1939. The CCC enrollees cleared another 966 acres of the Shasta reservoir site in 1939.⁴⁸

Wixson and Crowe received one contract for clearing the Shasta Lake site. The firm started in 1940, and cleared 955 acres during the year, completing much of their contract. The CCC also continued work on the reservoir site, and cleared over 1,000 acres during the year. At the same time, the enrollees from BR-84 and BR-85 completed the landscaping of Reclamation's construction camp. World War II caused the Federal government to disband the CCC, and they stopped work on the Shasta site June 30, 1941. Clearing operations on the Shasta reservoir site continued in 1943. The Wixson and Crowe contract comprised the only remaining work, and the firm completed their contract in May 1943. Reclamation continued clearing operations, not covered by contracts, with force account labor in 1946, 1947, and 1948.⁴⁹

Like several reservoir sites on the CVP, Shasta contained cemeteries which required relocation before the filling of the reservoir. In 1940, Reclamation identified all known cemeteries containing six or more remains, and made tentative plans to survey new cemetery sites. Reclamation estimated the Shasta reservoir site contained 350 graves of Native Americans and whites. Officials investigated the merits of purchasing burial plots in existing cemeteries against establishing new cemeteries for the remains.⁵⁰

The saga of the relocated remains resumed with the new work season. Reclamation's

48. Reclamation, *Project History, Central Valley Project, 1938*, 74; Reclamation, *Project History, Central Valley Project, 1939*, 46.

49. Reclamation, *Project History, Central Valley Project, 1940*, 135-6; Reclamation, *Project History, Central Valley Project, 1941: Pt. 1*, 9; Reclamation, *Project History, Central Valley Project, 1943: Pt. 3*, 48; Reclamation, *Project History, Central Valley Project, 1946: Pt. 2*, 1; Reclamation, *Project History, Central Valley Project, 1947: Pt. 1*, 1; Reclamation, *Project History, Central Valley Project, 1948: Pt. 1*, 25.

50. Reclamation, *Project History, Central Valley Project, 1940*, 81-2, 121.

revised estimate showed 308 remains in need of relocation from Shasta Lake; 173 Native Americans and 135 whites. To accommodate the remains, Reclamation established two cemeteries on government lands; the Central Valley Cemetery and the United States Shasta Reservoir Indian Cemetery. In 1942, Reclamation actually had 301 remains to move from twenty-five burial places; 183 Native Americans and 118 whites. Reclamation re-interred two whites at Redding cemeteries and one in Kirkwood, and interred the remaining whites and all the Native Americans in Central Valley and Shasta Reservoir Indian Cemeteries respectively.⁵¹

Keswick Dam

Keswick Dam, in the Shasta Division, was named for Lord Keswick of London, President of the Mountain Copper Company, Limited. Reclamation initiated the contract for Keswick Dam with Guy F. Atkinson Company and Kier Construction Company on August 9, 1941. The companies started work on Keswick Dam August 18, 1941. Atkinson-Kier quickly experienced some of the labor problems facing the CVP.⁵²

Reclamation gave the companies the notice to proceed on October 3, and they received it the next day. They placed the first concrete on November 14. Through the remainder of the year, the contractors completed excavation of the left abutment, except final cleanup, and just over half of the right abutment excavation. By the end of 1941, Atkinson-Kier completed the foundation grouting for the spillway and the left abutment. The contractors placed concrete in the dam with a highline and a four cubic yard bucket. Flood conditions between December 2 and 4, and between December 14 and 22, 1941, suspended work on Keswick for a time, but Atkinson-Kier still completed nearly half of the contract, even with their difficulties.⁵³

During concrete placement on Keswick, Atkinson-Kier sprayed water over the aggregate through July, August, and September to keep its temperature below eighty-five degrees.

Workers heated the mix water in the winter months to keep the mix temperature above fifty

51. Reclamation, *Project History, Central Valley Project, 1941, Pt. 1*, 65-6; Reclamation, *Project History, Central Valley Project, 1942, Pt. 1*, 42-3.

52. Reclamation, *Project History, Central Valley Project, 1941: Pt. 1*, 8, 47, 81; No author given, *Shasta Dam and Its Builders*, 18.

53. Reclamation, *Project History, Central Valley Project, 1941: Pt. 1*, 47.

degrees. Atkinson-Kier produced over 14,000 cubic yards of concrete before the end of 1941, despite labor problems.⁵⁴

E. L. Gates and Wixson and Crowe received contracts for clearing the Keswick Reservoir site. Gates started his contract October 13. Workers cut large trees and hauled them out with a tractor. Where the ground proved too steep to use the tractor, crews cut the trees and brush, then piled it within reach of the vehicle. Wixson and Crowe moved into the abandoned Baird Fish Hatchery, to use as a headquarters for conducting their operations, on Christmas Eve of 1941. The firm started two schedules on December 29, and another the next day.⁵⁵

Concrete vibrator operators went on strike at Keswick for four days in September 1942. The business agent of the Construction and General Laborers' Union (AFL affiliate) declared the strike unauthorized by the union. Nevertheless, the operators' wages increased by twenty cents per hour and work resumed on September 10.⁵⁶

Reclamation moved back the completion date of Keswick Dam by Atkinson-Kier in 1942, under the first War Powers Act of 1941. Reclamation initiated the Order for Changes on March 17, 1942. Harold Ickes approved the Order on July 27. On December 26, 1942, the War Production Board (WPB) limited construction at Keswick Dam and Powerplant. The board only permitted completion of the fish trap and the section of dam necessary for operation of the trap.⁵⁷

The war effort continued confusing the construction situation at Keswick Dam in 1943. Atkinson-Kier completed all work on the dam, authorized by the WPB, on April 24, 1943. The company started dismantling their operation, but they received orders to resume construction on April 26. Atkinson-Kier resumed operations as soon as the company hired laborers to replace those released, and reorganized their construction forces. Orders for Changes Number Two, issued July 12, 1943, and pursuant to the First War Powers Act of 1941; ordered the completion of concrete construction on Keswick Powerplant and adjacent structures; except second stage concrete, and lightweight and concrete floor finishing. The Orders for Changes added embedded

54. Reclamation, *Project History, Central Valley Project, 1941, Pt. 2*, 10, 13.

55. *Ibid.*, 54-5.

56. Reclamation, *Project History, Central Valley Project, 1942, Pt. 1*, 54.

57. Reclamation, *Project History, Central Valley Project, 1942: Pt. 2*, 35, 41.

metal work and construction of roofs in the Powerhouse superstructure, elevator tower, and related structures downstream from the powerhouse. The Orders extended the completion time to April 30, 1944.⁵⁸

Atkinson-Kier concluded removal of the downstream cofferdam on January 19, 1943. By the end of the year, the company laid concrete in the powerhouse to elevation 580, except for a part between the main service bay and the dam, which ranged between elevations 546 and 559. Low water in August and September 1943, allowed Atkinson-Kier to lay concrete in two blocks. The company left a fifteen foot wide channel through each block to simplify river diversion during future construction of the spillway's ogee section. The contractor placed approximately 53,000 cubic yards of concrete in 1943.⁵⁹

The year of 1944, started with promise for the United States in general because it brought the country closer to the end of World War II. However, the year began badly for Atkinson-Kier and Keswick Dam. A strike shut down construction at the dam from February 7, to March 11. Early on, Atkinson-Kier agreed to raise wages for the company's laborers and petitioned the War Labor Board (WLB) for permission to proceed. The labor unions involved filed a similar petition, but the WLB rejected both. The unions voted on a strike February 5, and favored striking by a vote of eighty-eight to seventy-one. The workers returned to the job on March 11, after the WLB expressed its intent to further investigate a wage increase. The board approved a wage increase at Keswick on November 21, 1944, retroactive to December 1942, settling a long dispute between workers and the WLB. The 1944 *Project History* complained, "There appeared a tendency to overrate workers to the higher salaried crafts."⁶⁰

Keswick Dam received little attention in 1945 and 1946, even from Reclamation's annual reports. Concrete placement continued in 1947, as well as completion of the railroad relocation. The contractor devoted the year to installing the penstock frames, turbines, generators, and draft tube gates. Atkinson-Kier finished the powerhouse structure and made minor improvements on

58. Reclamation, *Project History, Central Valley Project, 1943: Pt. 3*, 39.

59. *Ibid.*, 43, 46.

60. Reclamation, *Project History, Central Valley Project, 1944: Pt. 3, Vol. 8*, 8, 40, 60.

it. The firm completed the right abutment road and the fish traps by the end of the year.⁶¹

The contractor resumed removal of the upstream cofferdam in January 1947. The company completed dismantling the cofferdam in the tailbay section the next month. Reclamation continued work on Keswick Powerplant by force account. Exhaustion of funds halted work on Keswick December 1, 1947, although some work continued on one unit of the powerplant afterward.⁶²

Atkinson-Kier completed the Keswick spillway, and repaired eroded portions of the spillway apron in July 1948. Wismer and Becker installed two of the generators at Keswick Powerplant in 1949. Reclamation placed generator Units Two and Three into operation at Keswick on October 9 and December 21, 1949, respectively. Elliot and Gist received the contract for finishing work on Keswick Dam on February 28, 1949. The firm placed the fifty by fifty foot spillway gates at Keswick early in 1950, and they started operation on February 20. Wismer and Becker installed the final generating unit at Keswick Powerplant on March 31, 1950.⁶³

Division Operation

The Shasta Division operates as probably the least complex division in the Central Valley Project. Shasta Dam stores Sacramento River water for releases to the south. The dam provides a flood control barrier on the river to protect inhabited areas downstream. Shasta Powerplant utilizes a portion of water releases for hydroelectric power generation, when in operation. Keswick Dam acts as Shasta Dam's afterbay, stabilizing the erratic water flow released through Shasta Powerplant. Keswick Reservoir captures water diverted from the Trinity River through the Trinity Division. Keswick Powerplant further generates power using Sacramento River water.

Post-Construction History

61. Reclamation, *Project History, Central Valley Project, 1947: Pt. 1, 2.*

62. *Ibid.*, A-2, A-9, A-19, A-118.

63. Reclamation, *Project History, Central Valley Project, 1948: Pt. 1, 22*; Reclamation, *Project History, Central Valley Project, 1949*, Regional Headquarters, 3, Sacramento Valley District, 8, 9, 39; Reclamation, *Project History, Central Valley Project, 1950*, 2, SV-14.

Shasta Lake placed an obstacle in the path of people commuting near the reservoir. To relieve the problem, Reclamation started a ferry operation on the lake in 1945, for businesses and individuals needing to traverse the new body of water. The operation used two twenty-four by fifty-six foot barges towed by two thirty-six foot Higgins boats. Each barge could haul fifty-five tons of loaded ore trucks. Reclamation formally dedicated Shasta Dam as the key structure of the Central Valley Project on June 17, 1950. Shasta spilled on May 18, 1952, the first time since completion. In 1955, when Reclamation stopped the flow of water from Shasta Dam from 16,000 cubic feet per second down to nothing, the state of California claimed the lowered Sacramento River allowed levee banks to slip.⁶⁴

The environmental movement entered the mainstream in the early 1970s, and soon, along with the Endangered Species Act of 1973, created more controversy around the Central Valley Project. The new controversy surrounded migratory fish species, primarily Chinook salmon and Steelhead trout, and how the presence of dams on the Shasta Division affected them. Shasta and Keswick Dams blocked a large number of streams, tributary to the Sacramento River, used for spawning by the migratory fish. Fish traps and hatcheries combined to move the migrating fish upstream or artificially breed them, but they could not keep pace with the decreasing population of migratory aquatic wildlife. Shasta Dam not only blocked migration upstream, but it blocked the flow of cool water downstream, keeping water temperature above the maximum fifty-six degrees Fahrenheit necessary for the spawning salmon. Beginning in 1992, Reclamation bypassed the turbines in Shasta Powerplant, and released water directly into the Sacramento River to improve conditions for endangered, winter-run Chinook salmon.⁶⁵

Settlement of the Project

Greater settlement of the Shasta area came with the start of construction of Shasta Dam. The increased job opportunities brought hundreds of families to the region. They created new

64. Reclamation, *Project History, Central Valley Project, 1945: Pt. 3*, 2; Reclamation, *Project History, Central Valley Project, 1950*, 2; Bureau of Reclamation, *Annual Project History, Central Valley Project, 1952*, RG 115, 3; "California Files Claim for Shasta Dam Damages," *Engineering News Record*, 21 July 1955, 28.

65. Water Education Foundation, *Layperson's Guide to the Central Valley Project*, 1, 8; Bureau of Reclamation, *Red Bluff Diversion Dam Fish Passage Program, An Update of Red Bluff Planning and Public Involvement Activities, Update No. 1*, Bureau of Reclamation, July 1994, 4.

communities like Project City, Summit City, Central Valley (formerly Boomtown), and the oddly named Santa Claus, which remained in various stages of development at the end of 1938. The proximity of Shasta Dam increased the value of submarginal lands. Owners subdivided the land, and sold it to businesses and residents at inflated prices.⁶⁶

Estimates indicated the town of Redding and Shasta County increased in population by 40 percent after the beginning of operations. Redding and Shasta County increased greatly by 1990. The 1990 census recorded a population of 66,462 in Redding. Shasta County had 147,036 residents. Central Valley, the only one of the construction communities remaining, (or which retained its name), had a total population of 4,340 in 1990.⁶⁷

Uses of Project Water

Reclamation designed Shasta Dam as a multiple purpose dam. The dam's primary purposes consisted of flood control, power generation, and salinity control. Shasta captures the flow of the Sacramento River and its tributaries north of the dam. The Sacramento's flow is runoff from the mountains of northern California. The dam stores flood waters behind the structure to prevent them from moving downstream to inhabited areas, and controlled releases can supply irrigation water downstream. Prior to construction of Shasta, floods frequently ravaged the Sacramento Valley, including the state capital. Reclamation used flood control regulations prescribed by the Corps of Engineers, for Shasta's operations, as per an agreement between the two entities.⁶⁸

Shasta Powerplant has the capacity to generate 539,000 kilowatts of electricity, when at full operation. Keswick Powerplant added another 75,000 kilowatts of power. Keswick Dam acted as an afterbay for Shasta Dam, stabilizing the erratic flow of water from the larger dam's powerplant. Early on, Reclamation's project policy involved maintaining a minimum flow of

66. Reclamation, *Project History, Central Valley Project, 1938*, 66.

67. Reclamation, *Project History, Central Valley Project, 1939*, 57; Department of Commerce, Bureau of the Census, *Twenty-First Census of the United States, 1990: Population and Housing*, Bureau of the Census, 1990, on CD-ROM.

68. Bureau of Reclamation, *Central Valley Project Operating Plan*, Bureau of Reclamation, October 1952, 33.

3,000 cubic feet per second below Keswick Dam in the interest of fish conservation.⁶⁹

Crops	Acres	Crop Values in \$
Barley	150	\$ 40,000
Corn	3,641	\$ 1,997,455
Oats	80	\$ 6,510
Rice	189,474	\$ 104,250,779
Soghums	824	\$ 190,485
Wheat	34,900	\$ 8,890,935
Other Cereals	721	\$ 702,225
Alfalfa Hay	7,820	\$ 4,671,264
Irrigated Pasture	17,284	\$ 1,952,172
Silage or Ensilage	920	\$ 485,000
Sugar Beets	6,934	\$ 6,198,336
Beans, (fresh market)	17	\$ 29,750
Carrots	97	\$ 164,880
Corn, Sweet, (fresh market)	49	\$ 47,334
Melons, Cantaloupes, Etc.	3,471	\$ 9,361,500
Honeydew, Honey Ball, Etc.	2,318	\$ 4,093,150
Watermelon	280	\$ 456,960
Peas, Green, (fresh market)	25	\$ 20,160
Squash	10	\$ 6,000
Tomatoes, Canning	35,677	\$ 51,561,689
Tomatoes (fresh market)	10	\$ 48,550
Other Vegetables	17	\$ 68,000
Apples	40	\$ 162,000
Berries	5	\$ 100,000
Cherries	39	\$ 88,360
Oranges and Tangerines	23	\$ 24,580
Olives	8	\$ 14,400

69. Water and Power Resources, *Project Data*, 224; Reclamation, *Central Valley Project Operating Plan*, 10, 24.

Peaches	2,130	\$	7,240,076
Pears	1,084	\$	2,958,110
Prunes and Plums	2,233	\$	5,467,375
Almonds	2,973	\$	16,070,901
Pecans	33	\$	13,750
Walnuts	4,878	\$	8,038,205
Family Gardens and Orchards	948	\$	94,800
Crops not listed on table	29,321	\$	21,319,597
TOTALS	348,434	\$	256,835,288

Table 3. Selected crops and crop values on the Shasta Division in 1990.

Source: Bureau of Reclamation, *Crop Production Report-1990*, 614-6.

Water from the Shasta Division supplemented irrigation for the surrounding area. The agricultural lands grow a large variety of crops (see Table 3). Crop values on the Shasta Division totaled over \$256 million in 1990. Recreation developed as a major activity, especially at Shasta Lake. Shasta Lake catered to all kinds of water sports, even before completion. Shasta Recreational Area provided a different type of action in 1947. A man, going by the name of Harold Million, lived at Shasta for several months. The National Park Service tried to remove him, but had no luck in doing so. Finally, on July 21, 1947, Million left of his own accord.⁷⁰

Conclusion

Reclamation built Shasta Dam as the keystone of the Central Valley Project. One of the largest concrete dams in the United States, Shasta marked the inauguration of Reclamation's ambitious Central Valley Project. Shasta Dam and the CVP also marked the end of such projects. With the advent of the environmental movement, people became wary of large water projects, and water projects in general. Such doubt had its effects on the completion of CVP features in the 1970s and 1980s.

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70. Reclamation, *Project History, Central Valley Project, 1947: Pt. 1*, L-40.

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