

II - Painted Rock Dam

2-1. Project Background.

Painted Rock Dam was built by the Corps of Engineers for its congressionally authorized purpose of flood control. Completed in January 1960, Painted Rock Dam is located on the Gila River, approximately 126 miles from its confluence with the Colorado River (see Fig 2-1). The drainage area above Painted Rock Dam is 50,800 sq mi and is shown on Fig 2-1. The reservoir has a total storage of 2,476,339 ac-ft at spillway crest (based on 1985 survey). Fig. 2-2 shows the project's pertinent data, and Figure 2-3 is a diagram showing the reservoir's storage allocation. The approved flood control plan for Painted Rock Dam calls for a maximum reservoir release of 22,500 cfs, as stated in the Painted Rock Dam water control manual dated June 1962. The operation schedules (original versions found on the water control manual, and the 1993 revised versions shown on Figs. 2-4.a and 2-4.b) show that releases of up to 23,000 cfs can be made from the dam; however, the downstream channel has a limited capacity, lower than the maximum flood control releases, as explained in sections 2-2 and 2-4.a.

There are numerous reservoirs in the Gila Basin above Painted Rock Dam. However, only eight influence the regulation of major floods at the dam (see Figure 2-1, and Table 2-1). These reservoirs have a combined usable storage space below spillway crests of approximately 3.25 million ac-ft, and intercept runoff from an area of 26,742 sq. mi, or approximately 53 percent of the total drainage area above Painted Rock Dam. These projects and their operations in 1993 are briefly discussed in section 2-6.

**TABLE 2-1 Pertinent Data for Existing Dams ¹
Upstream of Painted Rock**

| Dam | Reservoir | River | D. A. (sq mi) | Storage ² (ac-ft) | Purpose | Agency |
|-----------------------|-----------------------|------------------|--------------------------|---|-----------------------------|---------------|
| 1. Coolidge | San Carlos | Gila | 12,886 | 884,594 | Irrigation and Power | BIA |
| 2. New Waddell | Lake Pleasant | Agua Fria | 1,460 | 902,502 | Irrigation | CAWCD |
| 3. Roosevelt | Roosevelt Lake | Salt | 5,830 | 1,075,507 | Irrigation and Power | SRP |
| 4. Horse Mesa | Apache Lake | Salt | 5,940 | 188,106 | Irrigation and Power | SRP |
| 5. Mormon Flat | Canyon Lake | Salt | 6,100 | 19,886 | Irrigation and Power | SRP |
| 6. Stewart Mt. | Saguaro lake | Salt | 6,211 | 44,084 | Irrigation and Power | SRP |
| 7. Horseshoe | Horseshoe | Verde | 5,991 | 68,777 | Irrigation | SRP |
| 8. Bartlett | Bartlett | Verde | 6,185 | 72,073 | Irrigation | SRP |

Note: 1. There are other dams loc. upstream; However, only the projects shown above influence the operation of Painted Rock Dam.
2. Up to spillway crest elevation.

2-2. Downstream Development.

Below Painted Rock Dam, the Gila River flows approximately 126 miles to the Colorado River at Yuma. South of the River, Interstate Highway 8 runs the entire distance from Gila Bend to Yuma. There are nine bridges across the Gila River that connect the communities downstream of the dam (see table 2-2), and only six of these nine crossings were designed to handle as much as 10,000 cfs. With only an estimated 5,000 to 7,000 residences scattered throughout the area, there is no major urban development that exists along the Lower Gila River between the dam and the City of Yuma. For 65 miles downstream of the dam, the terrain is sparsely inhabited, with widely scattered pockets of agriculture. The next 45 miles consists of the Wellton Mohawk Irrigation District which is an intensive agricultural area consisting of about 65,000 acres of land. Existing improvements include irrigation canals, pump stations, transmission lines, and flood control structures. In addition to the nine bridge crossings shown on Table 2-2, there are other bridges that are affected in the overflow area created when releases are in excess of current channel capacities.

TABLE 2-2
Major Gila River Crossings
Downstream of Painted Rock Dam

| Name | Location from Dam (miles) | Design Capacity (cfs) |
|-----------------------|----------------------------------|------------------------------|
| 1. Sentinel | 35 | 5,000 |
| 2. Dateland (Ave 264) | 49 | 10,000 |
| 3. Ave 51E | 66 | 7,000 |
| 4. Ave 45E | 83 | 10,000 |
| 5. Ave 38E | 98 | 10,000 |
| 6. Ave 30E | 120 | 10,000 |
| 7. Ave 20E | 104 | 10,000 |
| 8. US Highway 95 | 115 | 25,000 |
| 9. Ave 7E | 125 | 7,000 |

Where the Gila River joins the Colorado River east of Yuma, there is a large irrigated agriculture area owned in part by the North Gila Valley Irrigation District, and in part by the Yuma Irrigation District. To the east and south of Yuma, The Yuma Mesa Irrigation District extends to the US - Mexico International Border. The combined flows from the Colorado River and the Gila River continue to Mexico where water is used primarily for irrigated agriculture on the upper delta and Mexicali Valley.

2-3. Agencies Involved in the Operation of the Dam.

2-3.a. The Corps of Engineers (COE). The COE is responsible for the operation and maintenance of Painted Rock Dam.

2-3.b. US Bureau of Reclamation (USBR). The USBR is responsible for the channel improvements along the lower Gila River and the lower Colorado River system. During the period of the significant storms of 1993 as discussed in this report, the USBR was managing a safety modification for Coolidge Dam for the Bureau of Indian Affairs, the reconstruction of Roosevelt Dam for Salt River Project, and the construction of New Waddell Dam for the Central Arizona Water Conservation District.

2-3.c. Bureau of Indian Affairs (BIA). The BIA owns and operates Coolidge Dam located on the Gila River upstream of Painted Rock Dam.

2-3.d. Wellton-Mohawk Irrigation and Drainage District (WMIDD). Created by Act of the Arizona State Legislature on July 23, 1951, the WMIDD is a political subdivision of the State of Arizona, and is responsible for the irrigation and power within its jurisdiction. The District consisting of 65,000 acres of irrigable farmlands extends 45 miles along the Gila River, from the Gila Gravity Canal Siphon under the Gila River, 15 miles east of Yuma, to Texas Hill. The irrigation system was constructed by USBR and turned over to the WMIDD for operation and maintenance.

2-3.e. Salt River Project (SRP). SRP operates the Salt River system consisting of Roosevelt, Horse Mesa, Mormon Flat, and Stewart Mountain Dams; and the Verde River system consisting of Horseshoe and Bartlett Dams.

2-3.f. US International Boundary and Water Commission (IBWC). The IBWC is interested in the operation of Painted Rock Dam because of the Commission's responsibilities relating to the United States' 1944 Water Treaty with Mexico.

2-3.g. Central Arizona Water Conservation District (CAWCD). Operates New Waddell Dam located on the Agua Fria River upstream of Painted Rock Dam .

2-4. Constraints at Painted Rock Dam

2-4.a. Limited Downstream Channel Capacity. The currently approved water control plan for Painted Rock Dam calls for a maximum flood control release of 22,500 cfs, as discussed in section 2-1. However, releases in excess of 10,000 cfs could produce devastating social and economic impacts to the downstream areas, especially to the Wellton Mohawk's intensive improvements. Table 2-2 lists the major bridge crossings that connect communities downstream of the dam. Releases in excess of 15,000 cfs would result in closure of all these river crossings and isolation of the north and south sides of the river. According to the local sheriff department's estimate, approximately 3,500 area residents would be isolated on the north bank when all bridges are closed. Travel to schools, work and hospitals would be impossible, except for a 120 mi long alternate route.

2-5. Painted Rock Dam Operation During the Floods of 1993.

Virtually empty before January 4, 1993, Painted Rock Reservoir received high inflows resulting from a series of storms that lasted through late February. As the water surface elevation was on an increasing trend, releases were gradually increased in the first weeks on January, reaching 12,500 cfs near the end of month. The COE deviated from the fixed flood control schedules (Figs. 2-4a and 2-4b) in order to minimize damages downstream, as explained in Section 2-2 and 2-4.a. On 1 February the release rates were reduced to 10,000 cfs because roads and bridges were starting to get washed away or inundated. A week later, on 8 February, release rates had to be increased back up to 12,500 cfs due to significant rainfall in the watershed. This rate (12,500 cfs) was maintained until 21 February when the WSE exceeded the spillway crest elevation of 661 ft. As the spillway discharges increased, the outlet gates were lowered accordingly so as to maintain a total discharge (spillway and outlet gates) of 12,500 cfs, thus minimizing downstream impacts. However, the WSE continued to increase, resulting higher spillway flows, that eventually exceeded 12,500 cfs on 23 February. At this time, all of the outlet gates were completely closed. In the succeeding days, as the water surface elevation continued to rise, the spillway discharges continued to increase. These increases continued and finally exceeded the operational maximum flood control release of 22,500 cfs. The peak outflow occurred on 27 February at about 25,600 cfs on 27 February. The peak WSE was 667 ft. On 1 March, as the spillway discharges dropped below 25,000 cfs, the outlet gates were opened accordingly so as to maintain 24,000 cfs, until the WSE dropped below the spillway crest elevation of 661 ft, on 16 March.

On 17 March, at the requests of downstream interests, the outlet discharge was gradually reduced to 20,000 cfs. This reduction allowed the re-opening of US Highway 95, a major roadway corridor, and Sentinel Road. It also allowed the repairs of other bridges and roadways, such as the one near Dateland. On 9 April, at the requests of local officials, release rates were further decreased to 15,000 cfs, in order to allow the re-opening of other transportation corridors, draining of additional fields for farming, and help the USBR maintain their levees along the lower Gila River. On 29 April, the release rates were decreased to 10,000 cfs to help the WMIDD and the USBR in their flood fighting efforts, and to speed the reconstruction of US Highway 95 bridge, which eventually collapsed due to sustained high flows. On 21 May, the COE inspected and found the outlet works to be in good condition with no emergency repairs required. In order to facilitate this inspection, the releases were gradually decreased to zero. After the inspection, the gates were set back to maintain a release of 10,000 cfs.

On 27 May, at the requests of local officials, including the Governor of Arizona, Painted Rock releases were reduced to 5,000 cfs, as the inflow was projected to drop to near zero. This reduction negated further flood fighting efforts, and enabled the political jurisdictions, and the farmers to begin their recovery measures. It also enabled the USBR to assess damages, begin repairs of their facilities, and coordinate water resources from the Gila and Colorado Rivers. On 7 July, releases were gradually reduced to 2,200 cfs over 7 day period. This reduction was made in order to facilitate the repair and reconstruction of the USBR's Main Outlet Drain Extension (MODE). The MODE is a reach of the channel which carries saline groundwater flows from the WMIDD directly to the Gulf of California without flowing to the Colorado River and adversely affecting the salinity levels of water going to Mexico.

Aside from a first time ever spillway flow from a LAD project, the floods of 1993 also resulted in historic maximums recorded at Painted Rock Dam, including: 1) maximum water surface elevation of 667 ft (6 ft above spillway crest), maximum storage of 2,808,960 (113 percent of flood control capacity), 3) maximum outflow of 25,600 cfs (spillway), and maximum inflow of approximately 186,000 cfs (see table 2-3). Fig 2-3 shows the inflow and outflow hydrographs for Painted Rock Dam during the 1993 floods, and fig. 2-4 shows the water surface elevation and storage for the same time period. Table 2-4 shows the 30- and 60- inflow volumes and their corresponding return periods. Table 2-5 summarizes the COE's operation of Painted Rock Dam during January and February 1993 floods.

Table 2-3
Maximum Inflow, Outflow,
WSE and Storage
at Painted Rock Dam
During Jan - Feb 1993 Floods

| | Maximum Value | Date |
|------------------------------|---------------------|-------------|
| Inflow (cfs) | 186,000 | 10 Jan 1993 |
| Outflow (cfs) | 25,600 ¹ | 26 Feb 1993 |
| Water Surface Elevation (ft) | 667.00 ² | 26 Feb 1993 |
| Storage (ac-ft) | 2,808,960 | 26 Feb 1993 |

Notes:

1. Spillway Flow.
2. 6 ft above spillway crest.

Table 2-4
Frequency Perspective On
Painted Rock Dam Inflow
During Jan - Feb 1993 Floods

| Time Frame (Days) | Inflow Volume (Ac-ft) | Return Period (Yrs.) |
|--------------------|-----------------------|----------------------|
| 30 (7 Jan - 7 Feb) | 2,670,000 | > 200 |
| 60 (7 Jan - 7 Mar) | 3,960,000 | >500 |

2-6. Operation of Other Projects above Painted Rock Dam.

While the significant inflow continued to inundate the Painted Rock Reservoir during the months of January and February, very little could be done on the upstream structures in order to prevent Painted Rock Dam from spilling.

During the first week of March, SRP reported that December through March precipitation in the 13,000 sq. mi. Salt River Project watershed resulted in outflows from the six dams located on the Verde/Salt complex. On the Verde system, storage was 9 percent above the planned storage. Roosevelt Dam which had been undergoing rehabilitation, had only one of its 2 spillways in operation. The other spillway was blocked by a construction coffer dam. On 1 March, SRP reported that March 1 storage for Roosevelt Dam was 25 percent above the planned storage.

On the Gila River, Coolidge Dam received significant inflows and started spilling on 11 January. Built and operated by the Bureau of Indian Affairs for agriculture, Coolidge Dam was undergoing safety modifications during this period of significant storms. The spillway discharge peaked on 20 January at 32,800 cfs. Peak WSE was 2,521.68 ft, more than 10 ft above the spillway crest elevation. Previous maximum spill from Coolidge Dam occurred in 1983 at 5,000 cfs. USBR who was managing the safety modification of the dam stated that a reservoir restriction of WSE 2,496.4 ft exists during the period of construction. Coolidge Dam spills which eventually entered Painted Rock Reservoir continued until the 2nd week of March.

On the Agua Fria River, heavy runoff from the January storms added 224,000 ac-ft to the Lake Pleasant Reservoir. On 9 February, the USBR started releasing from the New Waddell Dam which forms the Lake Pleasant reservoir. These releases were gradually increased up to 9,000 cfs. New Waddell Dam recently underwent reconstruction and was on its first year of filling, and the rapid rise in WSE substantially exceeded the USBR's criteria for filling the newly reconstructed dam; therefore, water had to be released rather than stored, hence the storage space behind New Waddell Dam was not used for flood control.

Table 2-5
Summary of COE's
Painted Rock Dam Operation
During Jan - Feb 1993 Floods

| Date | Discharge (cfs) | Remarks |
|-----------------|-----------------|--|
| 28 Jan - 31 Jan | 12,500 | To utilize max. d/s channel capacity. |
| 1 Feb - 7 Feb | 10,000 | Prevent/minimize d/s damages. |
| 8 Feb - 20 Feb | 12,500 | Additional rainfall caused more inflow into the dam. |
| 21 Feb - 26 Feb | 12,500 | Spillway discharge begun. Maintained total outflow (from spillway and outlet gates) to 12,500 cfs. |
| 27 Feb - 28 Feb | up to 26,000 | Spillway flow. Max. reached 26,000 cfs. |
| 1 Mar - 16 Mar | 24,000 | Total discharge (outlet and spillway) maintained at 24,000 cfs. |
| 17 Mar - 8 Apr | 20,000 | Spillway flow ended. Gate discharge maintained at 20,000 cfs for repairs and re-opening of roads. |
| 29 Apr - 26 May | 10,000 | Help USBR and WMIDD in flood fights. |
| 21 May | 0 | Inspection of outlet works and tunnel. Outflow was back to 10,000 cfs at the end of the day. |
| 27 May - 6 Jul | 5,000 | Inflow into the reservoir ended. |
| 7 July - | 2,200 | Reconstruction of USBR's Main Outlet Drain Extension (MODE). |