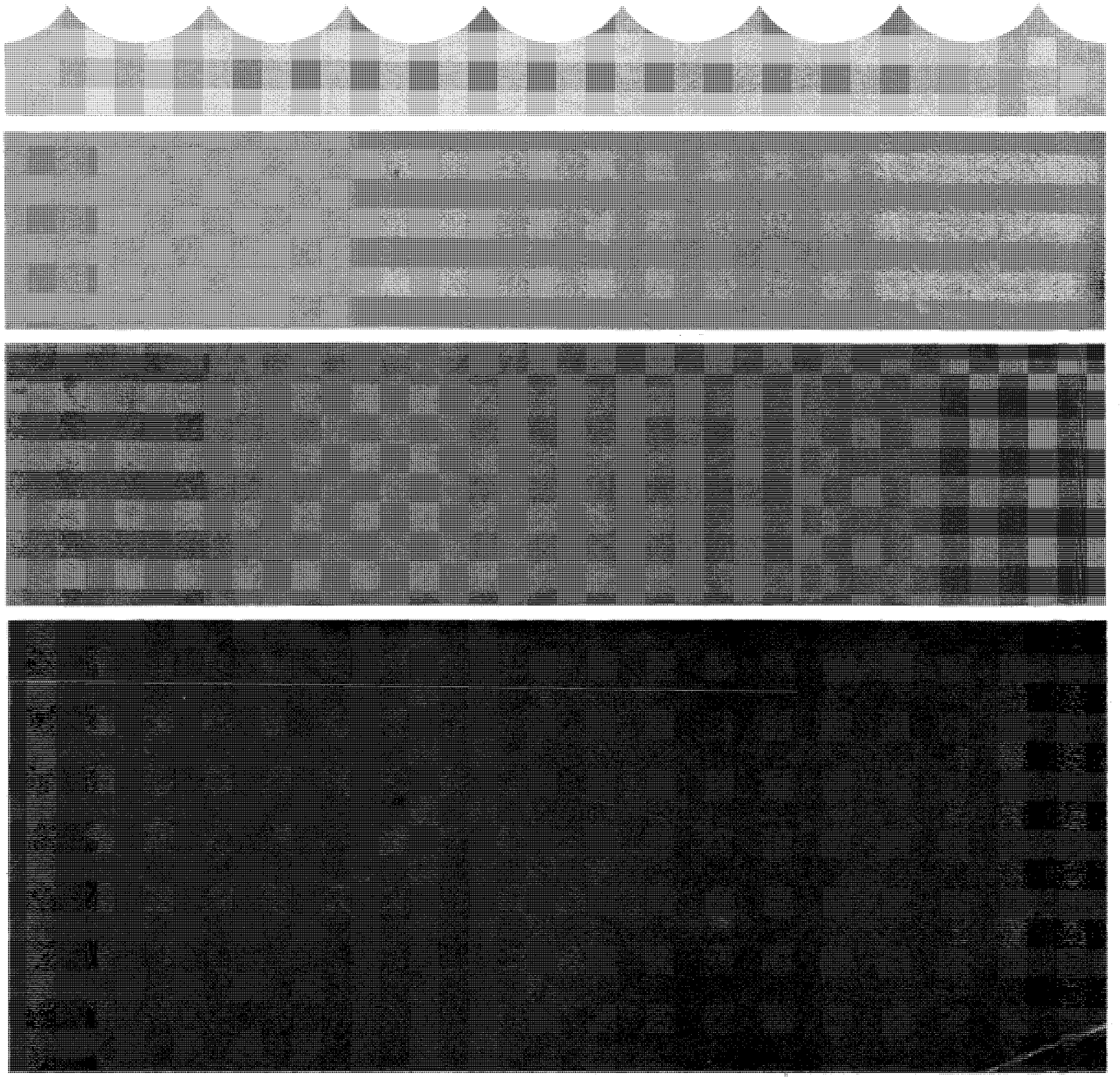
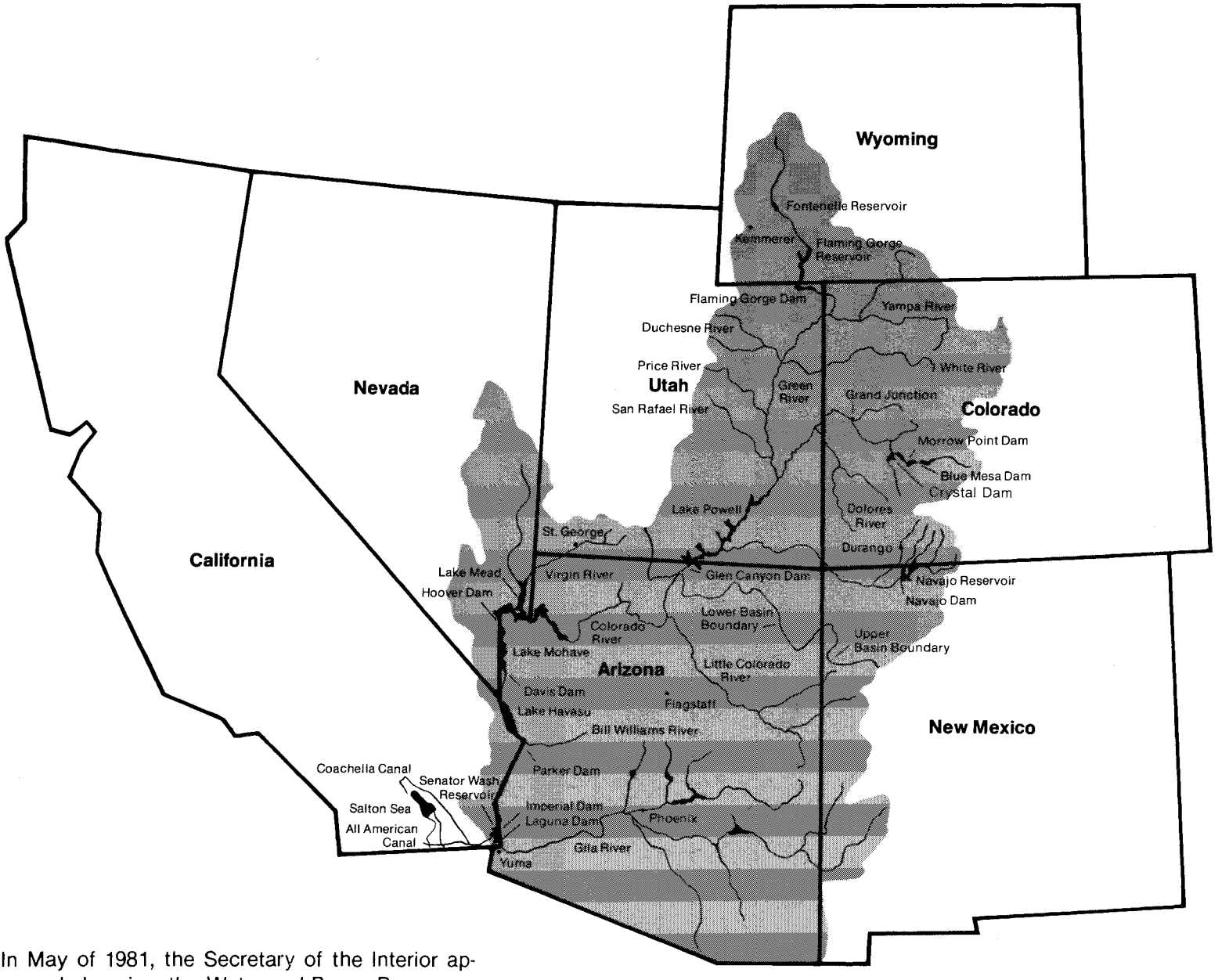
Annual Report

# Operation of the Colorado River Basin 1980 Projected Operations 1981



## Colorado River Basin




In May of 1981, the Secretary of the Interior approved changing the Water and Power Resources Service back to its former name, the Bureau of Reclamation. All references in this publication to the Water and Power Resources Service should be considered synonymous with the Bureau of Reclamation.

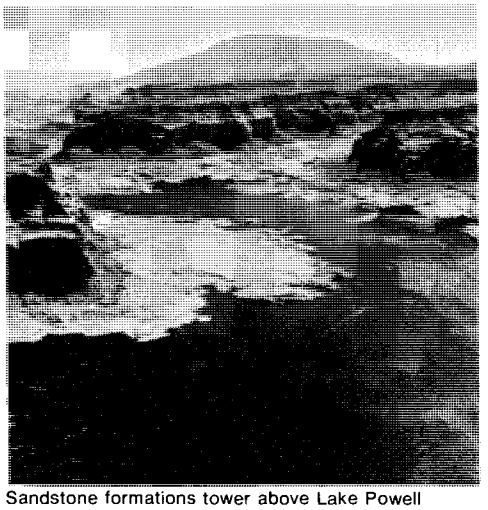
## Contents

U.S. Department of the Interior

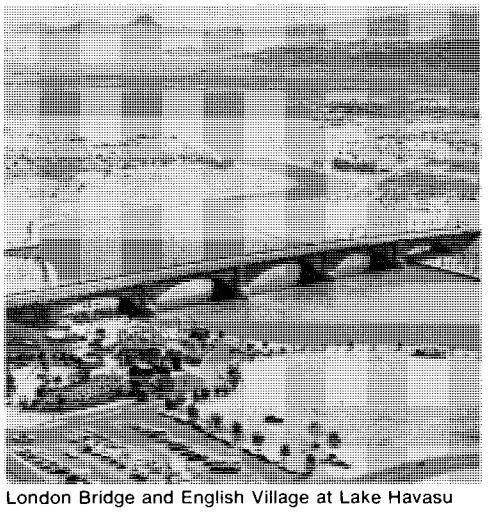
Bureau of Reclamation

January 1981

(Prepared pursuant to the Colorado River Basin Project Act of 1968, Public Law 90-537)



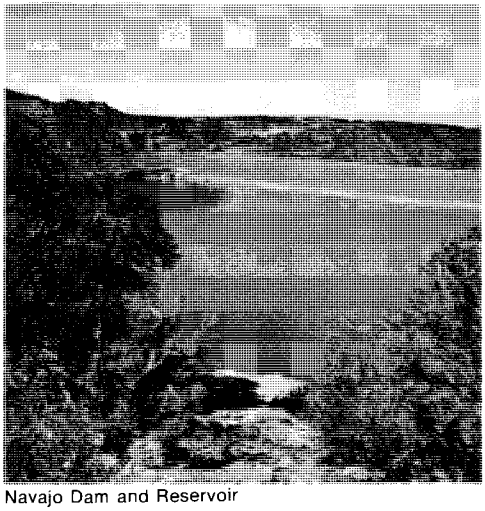
Sandstone formations tower above Lake Powell



London Bridge and English Village at Lake Havasu

Citrus Harvesting

## Introduction



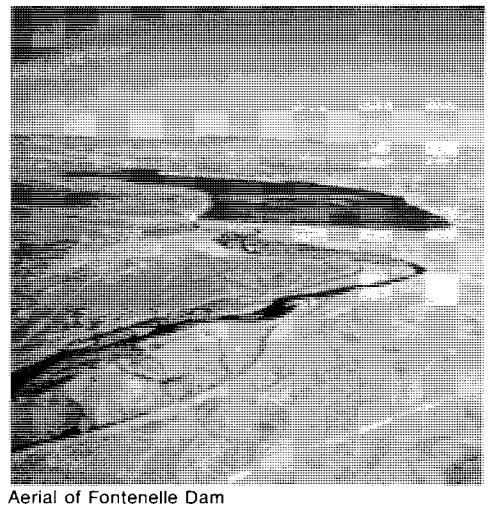
Navajo Dam and Reservoir

The operation of the Colorado River Basin during the past year and the projected operations for the current year reflect domestic use, irrigation, hydroelectric power generation, flood control, water quality control, fish and wildlife propagation, recreation, and Colorado River Compact requirements.

Storage and release of water from the Upper Basin reservoirs are governed by all applicable laws and agreements concerning the Colorado River, including the impoundment and release of water in the Upper Basin required by Sec. 602(a) of Public Law 90-537. The operation of the Lower Basin reservoirs reflects Mexican Treaty obligations and Lower Basin contractual commitments.

Nothing in this report is intended to interpret the provisions of the Colorado River Compact (45 Stat. 1057), the Upper Colorado River Basin Compact (63 Stat. 31), the Water Treaty of 1944 with the United Mexican States (Treaty Series 994, 59 Stat. 1219), the decree entered by the Supreme Court of the United States in Arizona v. California, et al. (376 U.S. 340), the Boulder Canyon Project Act (45 Stat. 1057), the Boulder Canyon Project Adjustment Act 54 Stat. 774; 43 U.S.C. 618a), the Colorado River Storage Project Act (70 Stat. 105; 43 U.S.C. 620), or the Colorado River Basin Project Act (82 Stat. 885; 43 U.S.C. 1501).

## Authority for Report

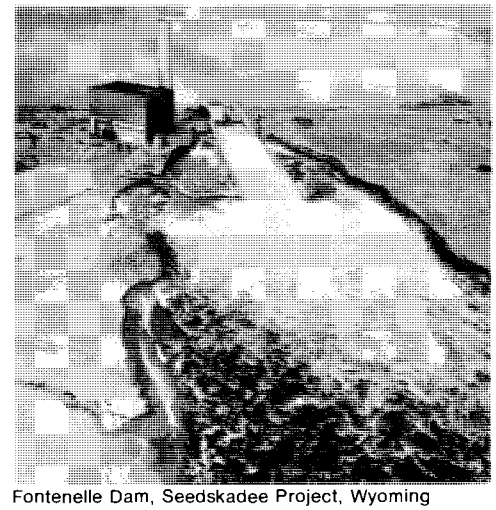


Aerial of Fontenelle Dam

Pursuant to the Colorado River Basin Project Act (Public Law 90-537) of 1968, I am pleased to present to the Congress, and to the Governors of the Colorado River Basin States, the tenth annual report on the Operation of the Colorado River Basin. This report describes the actual operation of the reservoirs in the Colorado River drainage area constructed under the authority of the Colorado River Storage Project Act, the Boulder Canyon Project Act, and the Boulder Canyon Project Adjustment Act during water year 1980 and the projected operation of these reservoirs during water year 1981 under the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs," published in the Federal Register June 10, 1970.

James G. Watt, Secretary
U.S. Department of the Interior

## Actual Operations Under Criteria—Water Year 1980



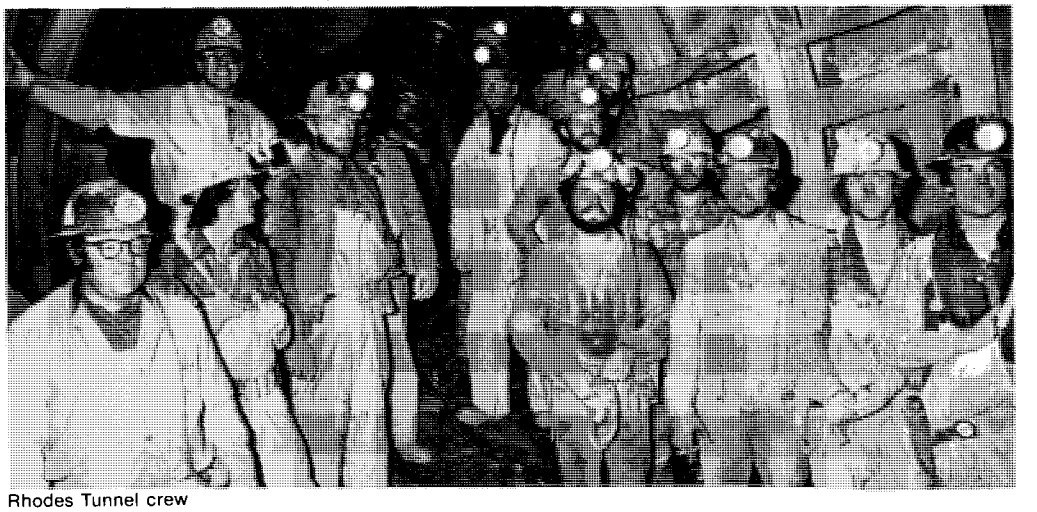
Fontenelle Dam, Seedskadee Project, Wyoming

The operational plan for water year 1980 reflected the concept of Hoover storage credits established during 1979. Prior to filling of Lake Powell in June 1980, anticipatory releases from Lake Mead for flood control and river regulation purposes were accounted for as if actually stored in Lake Mead. Scheduling a minimum annual release of 8.23 million acre-feet from Lake Powell during fall of 1979 and winter of 1980 was planned on the basis that, under any reasonable inflow conditions, the active storage of Lake Powell would have been less than theoretical storage of Lake Mead by September 30, 1980.

As it became apparent from updated forecasts that the inflow would be sufficient, the scheduled releases were revised with the objectives of filling Lake Powell while releasing water on a schedule to optimize power production. Releases from the other reservoirs were made to meet the multiple purpose demands of the system including flood control, water supply, power production, recreation, and fish and wildlife enhancement.

## Projected Plan of Operation Under Criteria—Water Year 1981

Workers at Parker Dam



Rhodes Tunnel crew

During water year 1980, the water supply in the Colorado River Basin was approximately 124 percent of the long-term average, ranging from 106 percent for the Green River at Fontenelle Dam to 132 percent for the San Juan River at Navajo Dam. Aggregate Colorado River System storage at the end of the water year was 54,512,000 acre-feet, representing an increase of 3,573,000 acre-feet from the previous year.

On June 22, 1980, Lake Powell filled to capacity, terminating the filling criteria. On September 30, 1980, the active content of Lake Powell was 23,084,000 acre-feet and the theoretical storage of Lake Mead was 24,223,000 acre-feet (actual storage was 23,637,000 acre-feet). Releases from Lake Powell amounted to 10,920,000 acre-feet. By the end of the water year, the goals of the 1980 operation plan for the major storage reservoirs in the system had been achieved.

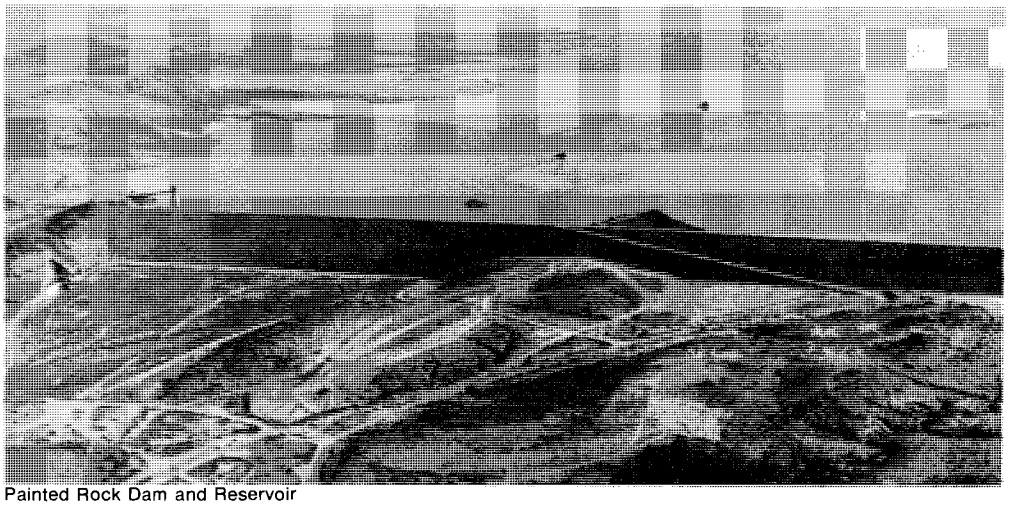
A description of the operations of each reservoir in the Colorado River Basin follows. Charts 1-8 show monthly outflow, water surface elevation, and active storage in each reservoir during water year 1980.

**Determination of "602(a) Storage"**
Sec. 602(a)(3) of the Colorado River Basin Project Act of September 30, 1968, (Public Law 90-537), provides for the storage of Colorado River water not required to be released under article III(c) and III(d) of the Colorado River Compact in Upper Basin reservoirs to the extent the Secretary finds it necessary to assure Compact deliveries without impairment of annual consumptive uses in the Upper Basin. Article II of the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs" provides that the annual plan of operation shall include a determination by the Secretary of the quantity of water considered necessary to be in Upper Basin storage as of September 30 of the current year. This determination shall consider all applicable laws and relevant factors including, but not limited to the following: (a) historic streamflows; (b) the most critical period of record; (c) probabilities of water supply; (d) estimated future depletions in the Upper Basin, including the effects of recurrence of critical periods of water supply; (e) the "Report of the Committee on Probabilities and Test Studies to the Task Force on Operating Criteria for the Colorado River," dated October 30, 1969, and such additional studies as the Secretary deems necessary; (f) the necessity to assure that Upper Basin consumptive uses are not impaired because of failure to store sufficient water to assure deliveries under Sec. 602(a)(1) and (2) of Public Law 90-537.

Taking into consideration these relevant factors, the Secretary has determined that the active storage in Upper Basin reservoirs forecast for September 30, 1981, exceeds the "602(a) Storage" requirement under any reasonable range of assumptions which might be realistically applied to those items which he is directed to consider in establishing this storage requirement. Therefore, the accumulation of "602(a) Storage" is not the criterion governing the release of water during the current year.

**Mexican Treaty Obligations**
Annual calendar year schedules of monthly deliveries of water in the limitrophe section of the Colorado River, allotted in accordance with the Mexican Water Treaty signed in 1944, are formulated by the Mexican Section and presented to the United States Section, International Boundary and Water Commission, before the beginning of each calendar year.

Las Vegas Bay Area of Lake Mead



Painted Rock Dam and Reservoir

Upon 30 days' advance notice to the United States Section, Mexico has the right to modify, within the total schedule, any monthly quantity prescribed by the schedule by not more than 20 percent. During water year 1980, Mexico received a total delivery of about 5,850,000 acre-feet at the Northerly International Boundary. Of that amount, it is estimated that about 1,800,000 acre-feet was attributable to Gila River inflow and the remainder, or about 4,050,000 acre-feet, was released from the Colorado River mainstream reservoirs.

The Gila River inflow to the Colorado is largely a result of flood control releases from Painted Rock Dam.

Of the 4,050,000 acre-feet of mainstream Colorado River water reaching the boundary, about 3,059,000 was delivered through Pilot Knob wasteway from the All-American Canal. An estimated 750,000 acre-feet delivery resulted from water released through Laguna Dam and the remainder was made up of return flows to the Colorado River below Laguna Dam, and returns to the Gila River below the gaging station near Dome, Ariz.

The United States will make scheduled deliveries of 1,700,000 acre-feet of Colorado River water to the Republic of Mexico in calendar year 1981. This includes an additional 200,000 acre-feet of water surplus to United States uses, pursuant to the Mexican Water Treay of 1944.

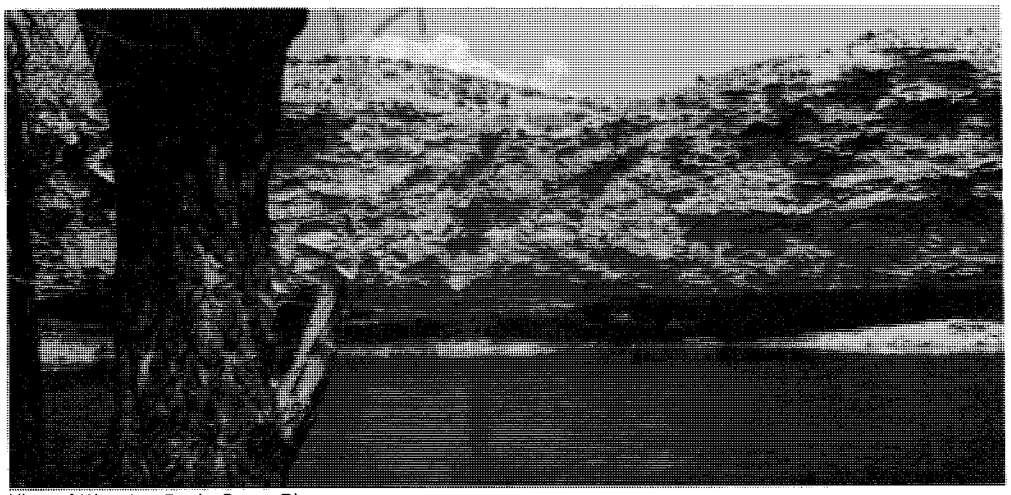
The additional water release is based in part on average runoff conditions assumed for the Colorado River Basin during water year 1981. Should runoff during that time be above average, substantially larger releases for flood control purposes could be required from Hoover Dam and Representatives of the Republic of Mexico will be kept informed of operating schedules through the United States Section of the Commission.

**Regulatory Wastes**

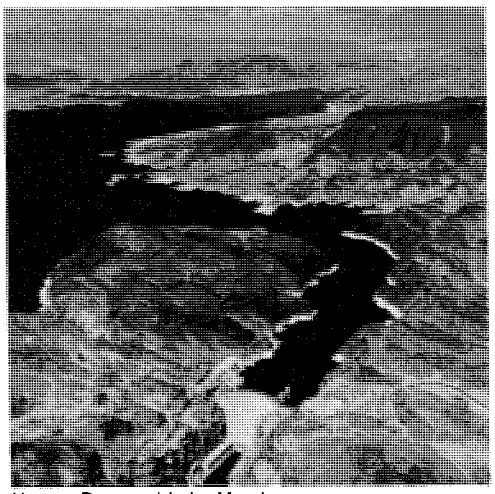
Deliveries to Mexico consist of river water delivered to Imperial Dam and waste and drainage return flows from water users below Imperial Dam. In addition to assuring normal water deliveries the small amount of regulatory storage space in Imperial, Laguna, the Senator Wash Reservoirs was used at times to limit potential downstream flood damages during water year 1980.

Regulatory waste for water year 1981 will depend on the actual hydrologic conditions occurring during that time.

## Additional Releases



View of Weeping Rock, Green River



Hoover Dam and Lake Mead

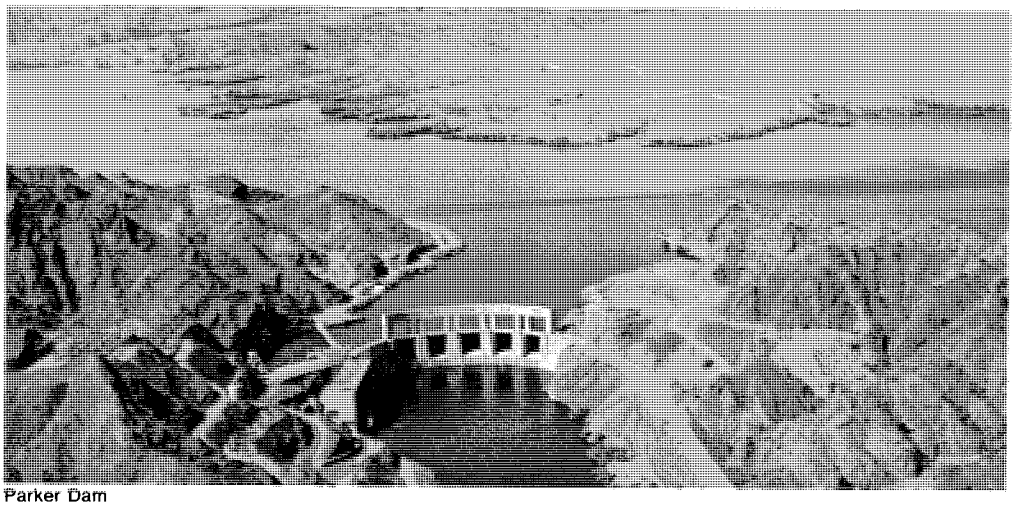
**Water Year 1980**

On August 21, 1979, the Colorado River Basin States and other interested parties met in Salt Lake City, Utah, to discuss the operational plan for the Colorado River and schedule of releases from Lake Mead during water year 1980. Recognizing the high probability of flood control releases being required during 1980 and 1981, the plan adopted for 1980 included the release from Lake Mead of about 700,000 acre-feet of water in excess of downstream requirements for the purposes of river regulation and anticipated flood control operation. This operating plan was also consistent with the declaration made by the Representatives of the Secretary of the Interior at the integration meeting held June 13, 1979, in Boulder City, Nev., to release water at Hoover Dam sufficient to generate contract-defined firm energy during operating year 1980.

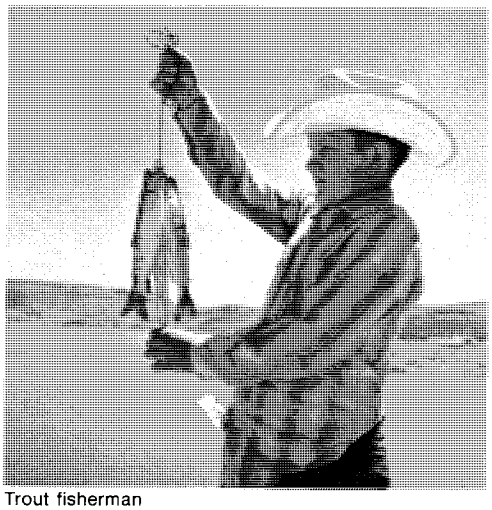
The Commissioner, United States Section, International Boundary and Water Commission, was notified of the availability of additional water for Mexico during calendar year 1980 and a monthly schedule for delivery of up to 1,700,000 acre-feet pursuant to the Mexican Water Treaty of 1944 was requested.

During the winter and spring months precipitation and snow accumulation in the Upper Basin resulted in higher than average runoff to Lake Powell. Furthermore, high runoff conditions in the Bill Williams River and Gila River drainages mandated winter and spring flood control releases by the Corps of Engineers from Alamo and Painted Rock Dams.

On April 10, 1980 a meeting of Federal, State, and Basin interests to discuss "Colorado River Basin Water Conditions" and proposed plans for reservoir operations was held in Las Vegas, Nev. The principal subject of discussion at that meeting was the proposed release of an average of 19,000 cubic feet per second from Parker Dam beginning May 1, 1980, and continuing through December 31, 1980, in order to avoid making future releases of a flooding magnitude and, coincidentally, to optimize power generation. This plan of operation, including the further additional releases, was also implemented consistent with the operational strategy approved by the Assistant Secretary of the Interior in 1979. The Colorado River Basin States were subsequently notified that such releases from Lake Mead during the period, which would create storage space greater than that required by the then current flood control regulations, would be accounted for as being retained in storage for the purposes of storage equalization under Sec. 602(a), Public Law 90-537.



Parker Dam



Trout fisherman

Lake Powell filled to elevation 3,700 feet on June 22, 1980, terminating the "Filling Criteria".

On September 30, 1980, the actual elevation of Lake Mead was 1,204.92 feet (23,637,000 acre-feet). Actual releases at Hoover Dam for water year 1980 totaled 9,958,000 acre-feet. This figure includes 6,899,000 acre-feet for minimum downstream consumptive use, and 3,059,000 acre-feet scheduled to create additional flood control space in the reservoir.

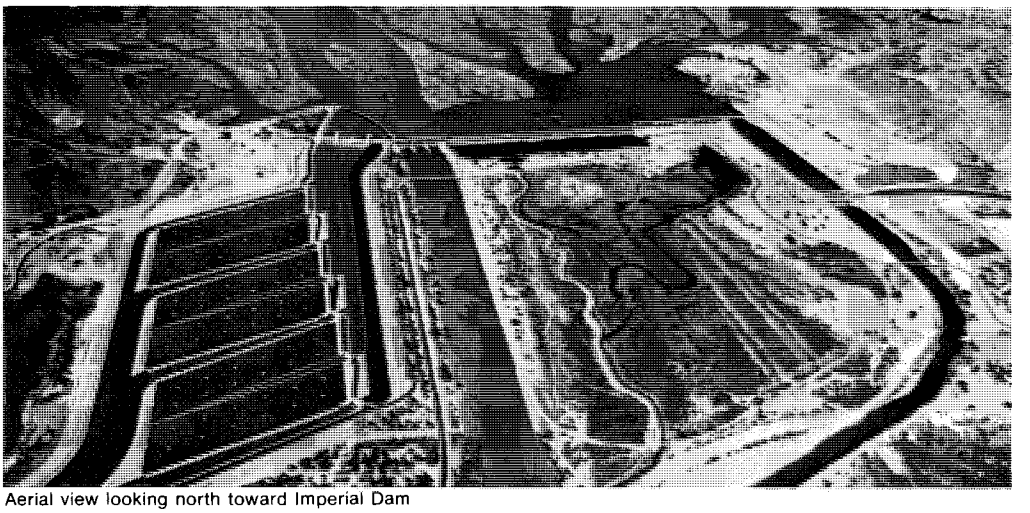
If none of this additional water had been released from Lake Mead during water year 1980, the reservoir's flood control regulations would have forced mandatory release levels beginning in April 1980.

During the months of April, May, and June 1980, studies indicate that total releases of 5,471,000 acre-feet would have been required consistent with flood control regulations. This would have been an excess of 3,105,000 acre-feet above consumptive use requirements for those three months. Releases for the entire water year 1980 would have totaled 10,004,000 acre-feet, an excess of 46,000 above what was actually released during water year 1980.

Anticipatory release of water from Lake Mead was initiated in May 1979. If no anticipatory releases had been made during 1979 or 1980, Lake Mead's elevation would have been approximately 1,208.85 feet (24,223,000 acre-feet) on September 30, 1980.

## Projected Plan of Operation—Water Year 1981

Citrus Processing Plant, Yuma, Ariz.



Aerial view looking north toward Imperial Dam

**Water Year 1981**

At the meeting in Las Vegas, Nevada, on December 11, 1980, representatives of the seven basin states were advised that the active storage in Upper Basin Reservoirs on September 30, 1980, exceeded by more than 10 million acre-feet the requirement for "602(a) Storage" as provided in the Colorado River Basin Project Act of 1968, and that the Lake Mead storage credits that had accumulated to date would be extinguished and no further credits would be accumulated during water year 1981.

Attendees at the Las Vegas meeting were invited to provide comments on the proposed operation plan for water year 1981 by January 31, 1981.

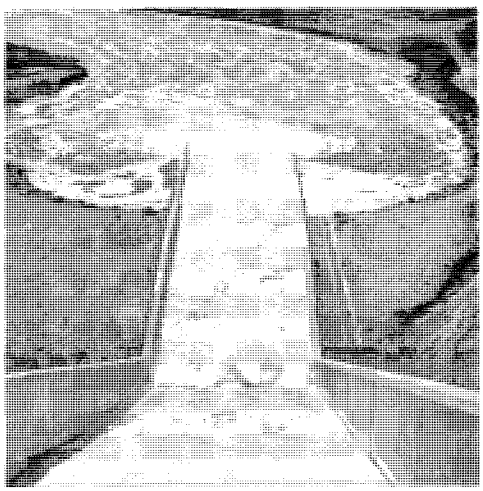
After due consideration of all comments received and upon advice from the Solicitor for Interior, the Secretary determined that the use of Lake Mead storage credits was not warranted after the filling of Lake Powell on June 22, 1980. Further deliberations regarding the proposal to continue the use of storage credits led to the conclusion that the Secretary of the Interior could not allow the use of Lake Mead storage credits after Lake Powell had filled because Section 602(a)(3)(ii) of Public Law 90-537 requires that active storage in Lake Mead be maintained, as nearly as practicable, equal to Lake Powell active storage.

The plan of operation for the Colorado River system that was implemented on October 1, 1980, and was presented at the meeting in Las Vegas on December 11, 1980, was based on the amount of storage in the system at the beginning of water year 1981. The plan includes releases from Lake Powell and Lake Mead being made in order to avoid anticipated flooding and spills to the extent consistent with maximum water conservation.

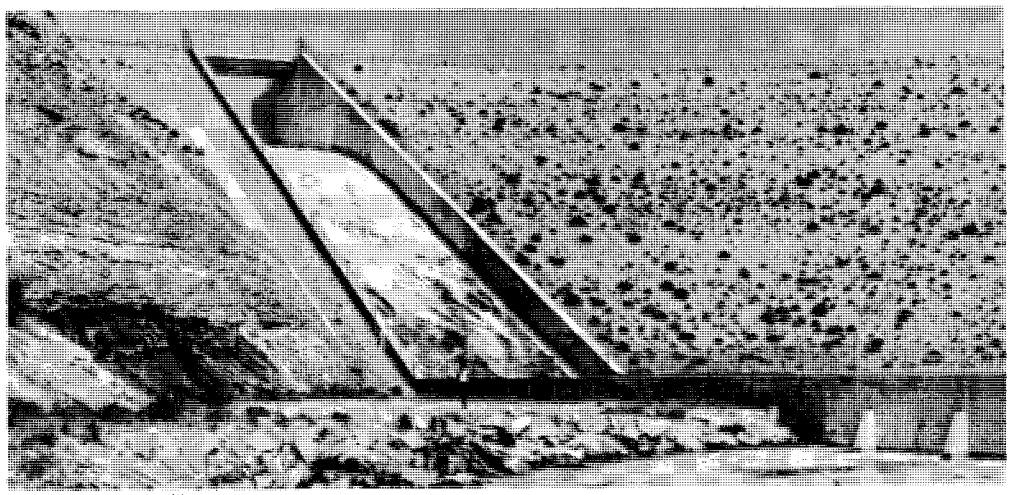
Lake Powell is being operated to avoid anticipated spills and to equalize the levels of Lake Powell and Lake Mead before December 31, 1981. Based on the newly instituted interim flood control agreement with the Corps of Engineers, releases from Lake Mead are being scheduled during the fall and winter months in anticipation of release requirements for flood control in an average year. Based on current reservoir conditions and updated hydrologic forecasts, anticipatory releases from Lake Mead each month will be adjusted either upwards or downwards as necessary to meet the objective of having full reservoir conditions by the time the Central Arizona Project (CAP) comes on line. These objectives are incorporated in the year's operating plan and are not intended as a modification of the current "long-range operating criteria" or to set a precedent as to how the system might be operated in future years.

For average runoff conditions during water year 1981, the projected operation of each of the reservoirs in the Colorado River Basin are described in the following pages. Charts 1-8 show the projected monthly outflows from the reservoirs and the projected end-of-month elevation and active storage in the reservoirs for average assumed runoff conditions and three other assumptions of modified runoffs from the Basin for 1981. The four assumptions are (1) Average based on the 1906-79 record runoff; (2) Upper quartile based on the annual level of annual streamflow which has been exceeded 25 percent of the time during 1906-79; (3) Lower quartile based on flows exceeded 75 percent of the time during 1906-79; (4) Most adverse based on the lowest year of record, which was 1977. The projected operations of Lake Mead reflect levels of anticipatory releases for flood control during October through February and adjustments in actual releases for flood control during January through July that would result with the occurrence of the four assumed runoff conditions. The projected operations of Lake Mohave and Lake Havasu also reflect the releases from Lake Mead resulting from system operations under these assumed runoff conditions.

## Upper Basin Reservoirs
## Fontenelle Reservoir
## (Green River)



Fontenelle spillway



Fontenelle Dam spillway

**Water Year 1980**
Fontenelle Reservoir is operated for power generation, water supply, flood control, fish and wildlife enhancement, and recreation. The water surface was gradually reduced from an elevation of 6,499 feet at the beginning of the water year to a low of 6,477 feet in April prior to the spring runoff. The minimum release during the fall and winter was 700 cubic feet per second ($ft^3/s$). The maximum release for the water year was 6,975 $ft^3/s$. The maximum inflow of 9,715 $ft^3/s$ occurred on May 25. On May 26, the reservoir was filled to capacity with an elevation of 6,506 feet. The minimum release for power generation is 500 $ft^3/s$; the maximum release through the powerplant is 1,750 $ft^3/s$ at rated head.

**Water Year 1981**
At the beginning of year 1981, the elevation at Fontenelle Reservoir was 6,499 feet with a content of 294,000 acre-feet. Releases from the reservoir will be scheduled to draw the water down to 6,480 feet prior to the spring runoff

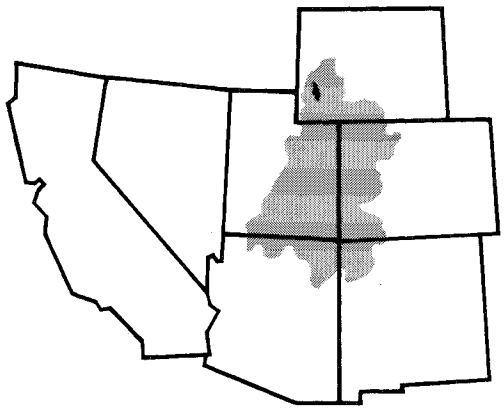
The reservoir will fill in July 1981 unless the inflow is less than average. After the spring runoff, the reservoir level will be controlled by adjusting the releases through the powerplant to reduce slowly the elevation to 6,504 feet by the end of the summer of 1981.

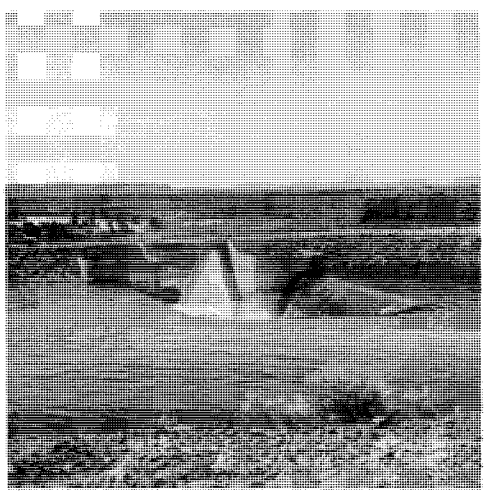
The maximum release, dependent primarily on the magnitude of the inflow, is also contingent on forecast error. Unless the inflow is larger than what has been historically experienced, the projected maximum release is less than 15,000 $ft^3/s$. If the inflow is in the upper quartile, peak outflow is expected to be less than 10,000 $ft^3/s$. With an average inflow, the anticipated peak outflow is less than 7,000 $ft^3/s$. Assuming a lower quartile inflow, the outflow will probably be no greater than 3,000 $ft^3/s$.

**Fontenelle** Active Storage* **Chart 1**

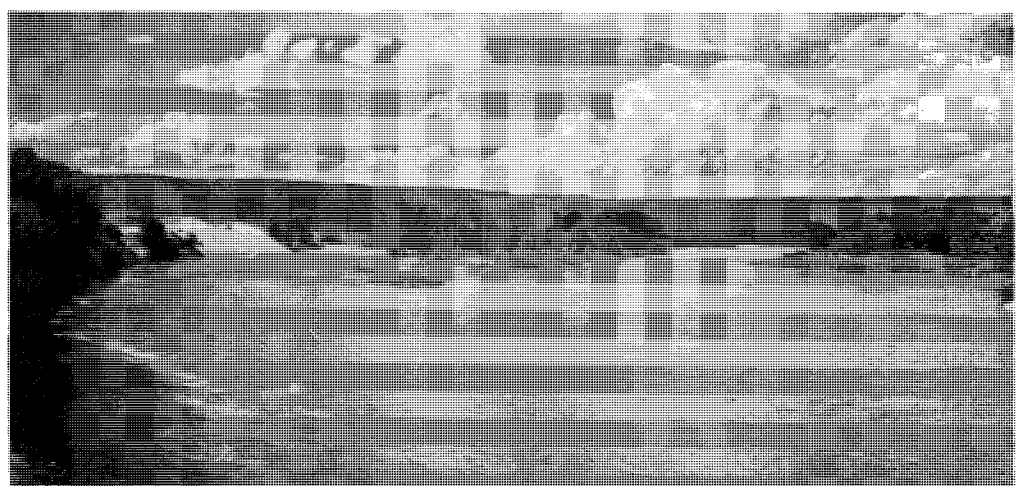
| Reservoir | (Acre-Feet) | El.(Ft.) |
|---|---|---|
| Maximum Storage | 344,834 | 6506 |
| Rated Head | 233,789 | 6491 |
| Minimum Power | 194,962 | 6485 |
| Surface Area (Full) | 8058 Acres | |
| Reservoir Length (Full) | 18 Miles | |
| Power Plant | | |
| Number of Units | 1 | |
| Total Capacity | 10,000 Kilowatts | |

*does not include 563 acre-feet of dead storage below 6408 feet





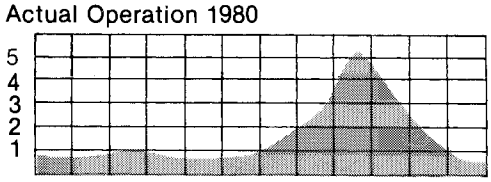
Another view of spillway



Dam and Green River, looking upstream

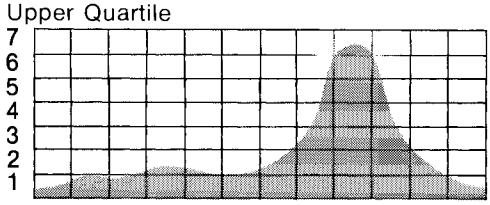
**Outflow** Release in 1000 Cubic Feet/Second

Actual Operation 1980

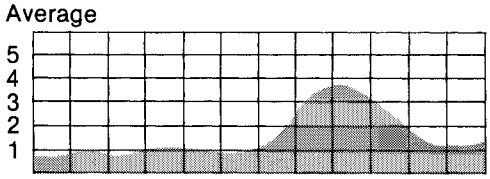



Projected Operation 1981

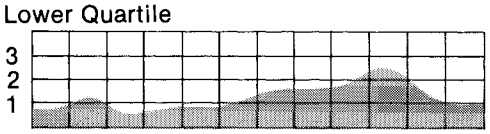
Upper Quartile



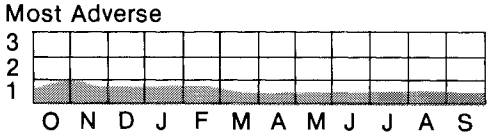

Average




Lower Quartile

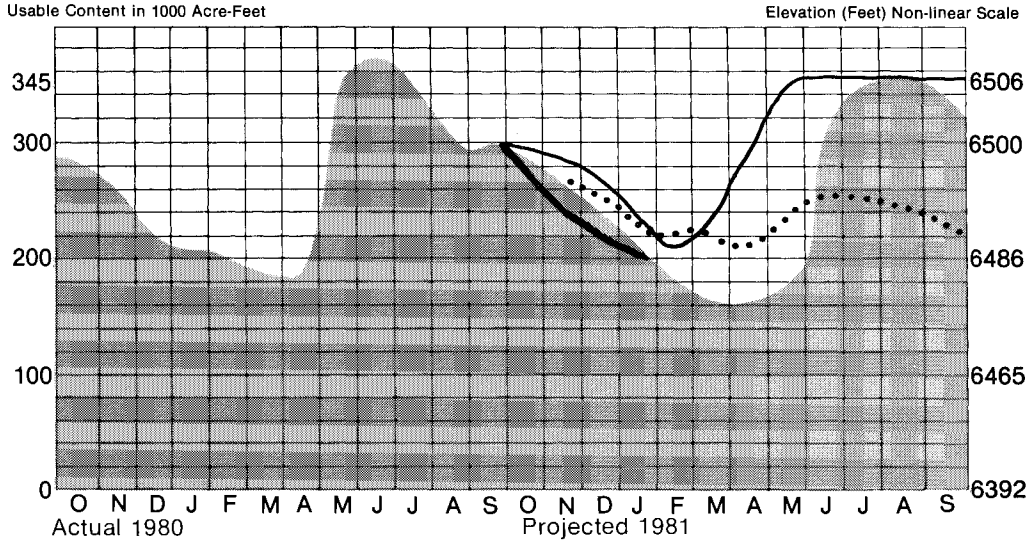



Most Adverse




**Storage**

Usable Content in 1000 Acre-Feet — Elevation (Feet) Non-linear Scale




**Legend**

Most Probable
Upper Quartile
Lower Quartile
Most Adverse

## Flaming Gorge Reservoir (Green River)

Canadian Geese

Flaming Gorge Dam and Reservoir

**Water Year 1980**
At the beginning of water year 1980, the reservoir water surface elevation was 6,008 feet with a content of 2,569,000 acre-feet. The April through July 1980 runoff above Flaming Gorge was 1,496,000 acre-feet, 131 percent of the long-term average. With this runoff, the reservoir reached its seasonal maximum elevation of 6,024 feet with a content of 3,124,000 acre-feet at the end of July. By the end of September, the elevation was 6,023 feet with a content of 3,078,000 acre-feet.

The normal minimum release is 800 $ft^3/s$. The maximum release through the powerplant is 4,600 $ft^3/s$ at rated head.

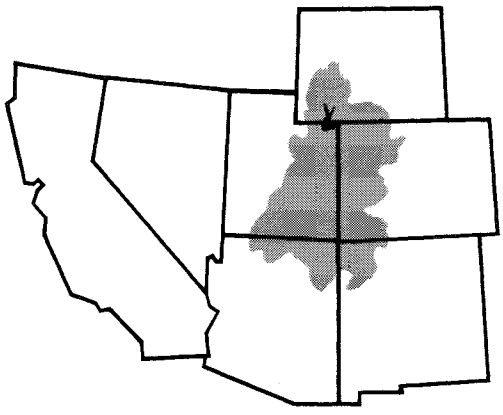
**Water Year 1981**
During water year 1981, the reservoir level at Flaming Gorge will be drawn from 6,023 feet to about 6,018 feet before the spring of 1981. The water level should remain high enough to launch boats from the reservoir's nine ramps. Average inflow would result in a maximum elevation of 6,031 feet with a storage of 3,387,000 acre-feet during July. Flow in the river below the dam is not expected to exceed 4,600 $ft^3/s$ or fall below 800 $ft^3/s$.

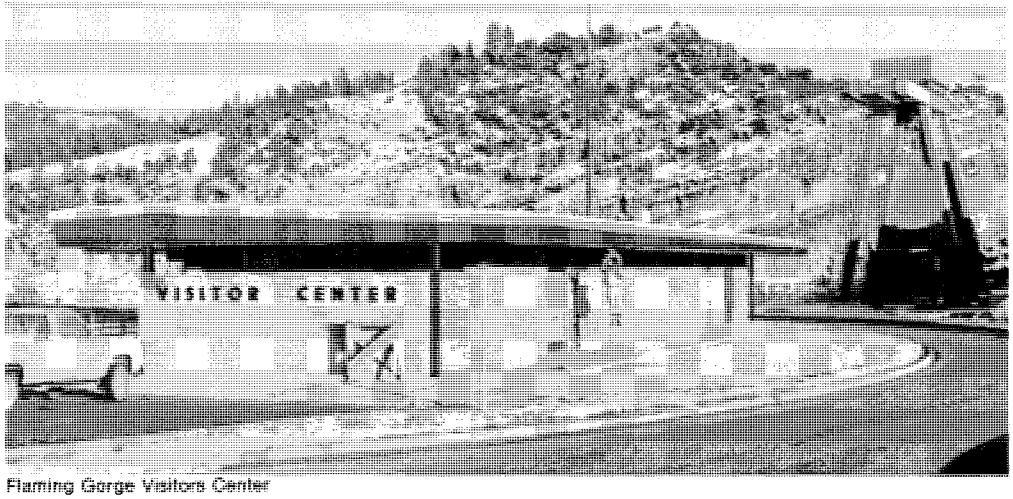
Since there is enough storage space for a high inflow and enough stored water in case of a low inflow, the release from Flaming Gorge is not dependent on inflow for water year 1981, but rather on the demand for electric power and the availability of energy for purchase and exchange.

**Flaming Gorge** Active Storage* **Chart 2**

| Reservoir | (Acre-Feet) | El. (Ft.) |
|---|---|---|
| Maximum Storage | 3,749,000 | 6040 |
| Rated Head | 1,062,000 | 5946 |
| Minimum Power | 233,000 | 5871 |
| Surface Area (Full) | 42,020 Acres | |
| Reservoir Length (Full) | 91 Miles | |
| Power Plant | | |
| Number of Units | 3 | |
| Total Capacity | 108,000 Kilowatts | |

*does not include 40,000 acre-feet of dead storage below 5740 feet



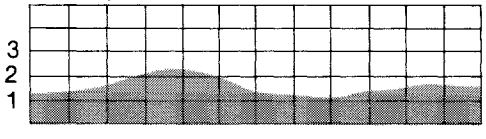


Flaming Gorge Visitors Center


Flaming Gorge selective withdrawal structure

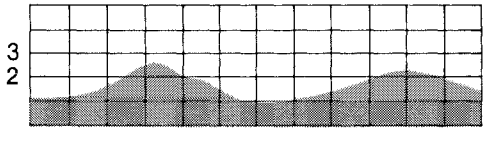
**Outflow** Release in 1000 Cubic Feet/Second

Actual Operation 1980

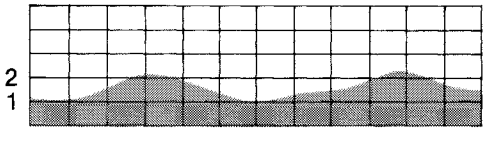



Projected Operation 1981

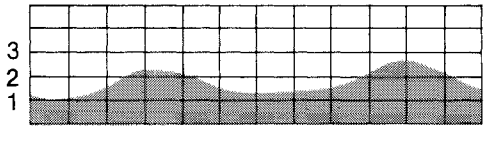
Upper Quartile



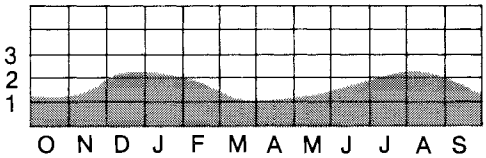

Average




Lower Quartile



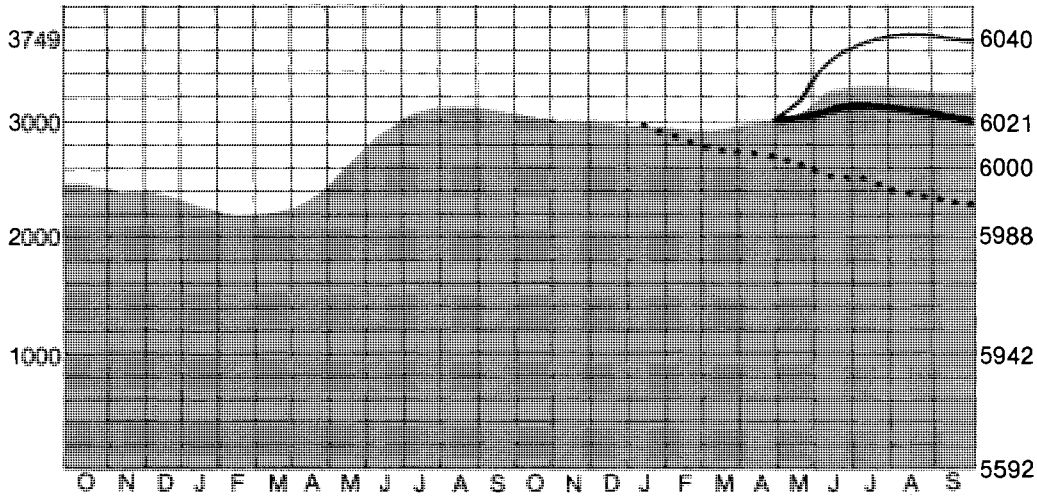

Most Adverse




**Storage**

Usable Content in 1000 Acre-Feet

Elevation in Feet (Non-Linear Scale)




Actual 1980 Projected 1981

**Legend**

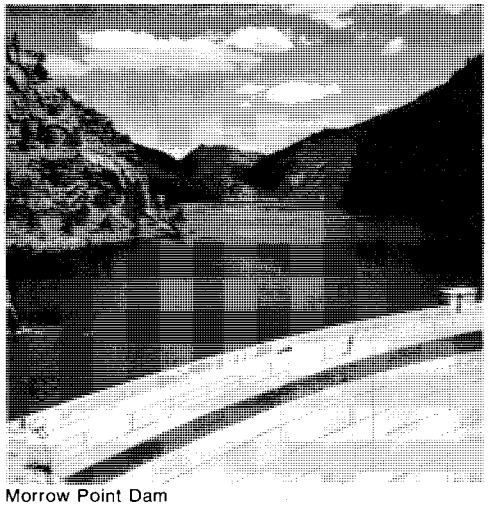
Most Probable

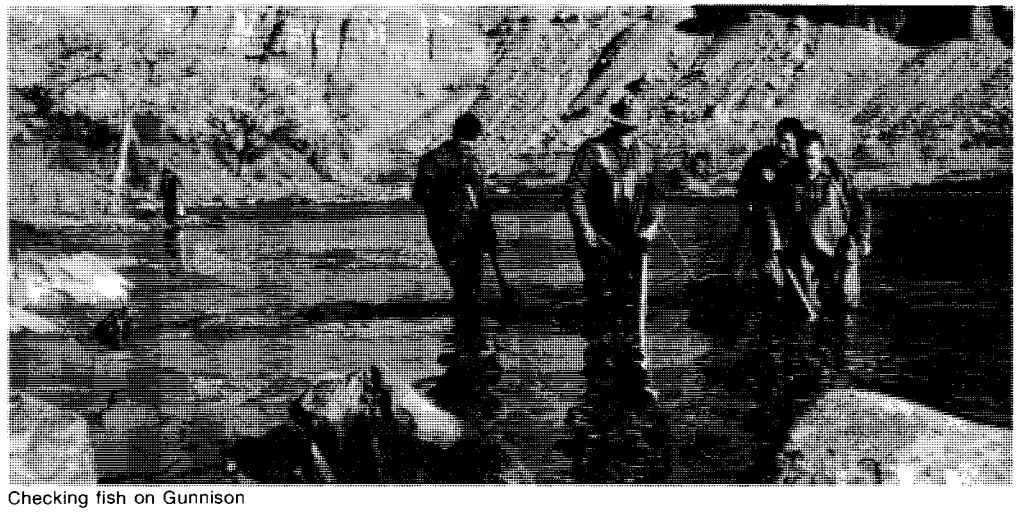
Upper Quartile

Lower Quartile

Most Adverse

## Wayne N. Aspinall Unit
## (Gunnison River)
**Blue Mesa Reservoir**
**Morrow Point Reservoir**
**Crystal Reservoir**


Morrow Point Dam


Checking fish on Gunnison

**Water Year 1980**
The Wayne N. Aspinall Unit, formerly the Curecanti Unit, includes Blue Mesa, Morrow Point, and Crystal Reservoirs. Blue Mesa provides nearly all of the long-term regulation for all three powerplants. Morrow Point provides peaking power and thus, has highly variable releases. The primary function of Crystal Reservoir is to re-regulate the variable Morrow Point releases.

At the end of September 1979, Blue Mesa Reservoir contained 629,240 acre-feet of active storage with a water surface elevation of 7,506 feet. The April through July 1980 inflow to Blue Mesa was 961,000 acre-feet, 25 percent greater than the long-term average; and the total water year inflow was 1,208,000 acre-feet. The water surface elevation of Blue Mesa was only two-tenths of a foot short of maximum elevation in July 1980. No water bypassed the powerplant during water year 1980.

The drawdown for power operations and river regulation was great enough that no further space evacuation for flood control was required.

During water year 1980, all flows in the Gunnison River below the Gunnison Tunnel were greater than 200 $ft^3/s$, the minimum discharge required to protect the fishery in the river.

**Water Year 1981**
Assuming average inflow for water year 1981, Blue Mesa Reservoir is expected to reach a low of 7,467 feet with an active storage of approximately 413,000 acre-feet in March. The projected maximum level is 7,517 feet with an active storage of 809,000 acre-feet.

Morrow Point Reservoir will operate at or near its capacity during the current year. Crystal Reservoir will also operate nearly full except for daily fluctuations needed in regulating the releases from Morrow Point to meet diversion requirements downstream from the Gunnison Tunnel.

If the inflow to Blue Mesa Reservoir is at the upper quartile, the release is expected to average 2,800 $ft^3/s$ for several weeks in June and July 1981. For average, lower quartile and most adverse inflows, a maximum monthly release of about 1,400 $ft^3/s$ is projected in July 1981.

**Blue Mesa** Active Storage* **Chart 3**

| Reservoir | (Acre-Feet) | El.(Ft.) |
|---|---|---|
| Maximum Storage | 829,523 | 7519 |
| Rated Head | 249,395 | 7438 |
| Minimum Power | 81,070 | 7393 |
| Surface Area (Full) | 9,180 Acres | |
| Reservoir Length (Full) | 24 Miles | |
| Power Plant | | |
| Number of Units | 2 | |
| Total Capacity | 60,000 Kilowatts | |

*does not include 111,232 acre-feet of dead storage below 7358 feet

**Morrow Point** Active Storage*

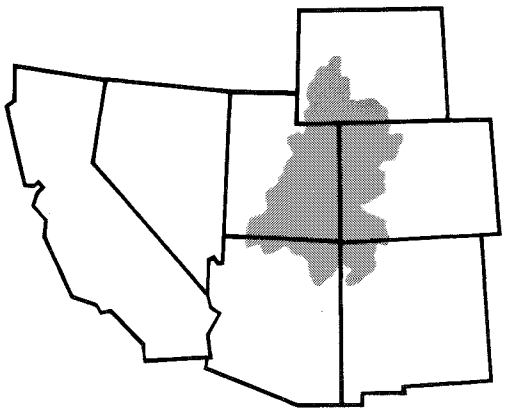
| | | |
|---|---|---|
| Maximum Storage | 117,025 | 7160 |
| Rated Head | 79,805 | 7108 |
| Minimum Power | 74,905 | 7100 |
| Surface Area (Full) | 817 Acres | |
| Reservoir Length (Full) | 11 Miles | |
| Power Plant | | |
| Number of Units | 2 | |
| Total Capacity | 120,000 Kilowatts | |

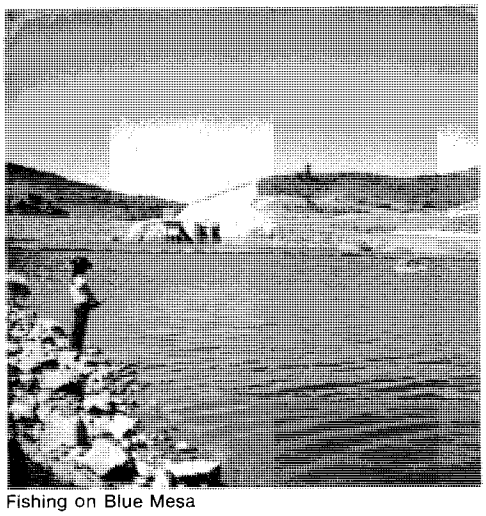
*does not include 165 acre-feet of dead storage below 6808 feet

**Crystal** Active Storage*

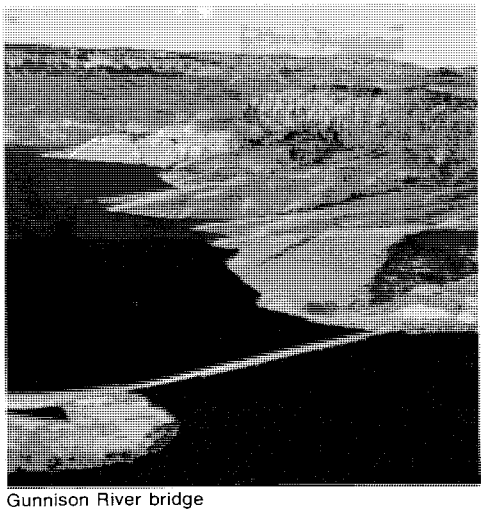
| | | |
|---|---|---|
| Maximum Storage | 17,573 | 6755 |
| Rated Head | 13,886 | 6742 |
| Minimum Power | 10,619 | 6729 |
| Surface Area (Full) | 301 Acres | |
| Reservoir Length (Full) | 7 Miles | |
| Power Plant | | |
| Number of Units | 1 | |
| Total Capacity | 28,000 Kilowatts | |

*does not include 8,200 acre-feet of dead storage below 6670 feet

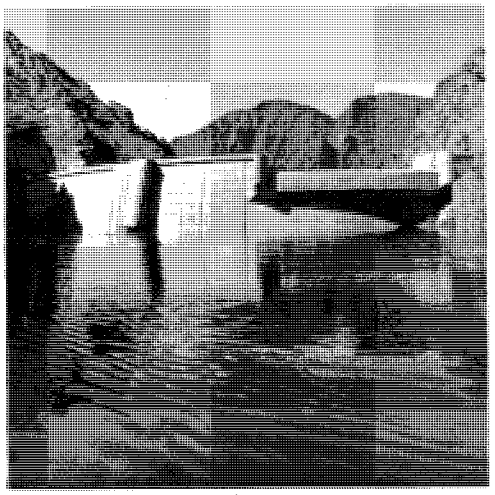




Fishing on Blue Mesa



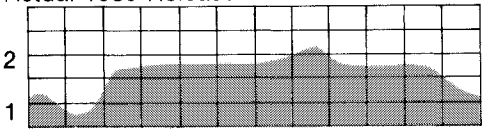
Gunnison River bridge



Crystal Dam and Reservoir

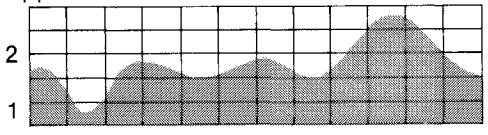
**Outflow Blue Mesa Reservoir**

Actual 1980 Release in 1000 Cubic Ft/Sec

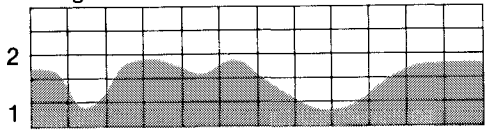



Projected Operation 1981

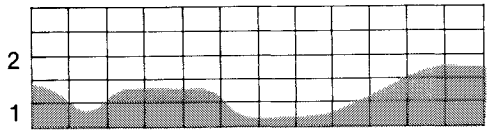
Upper Quartile



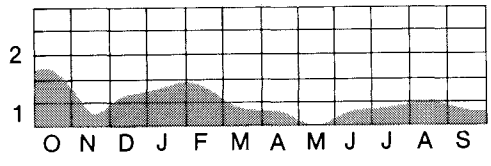

Average




Lower Quartile



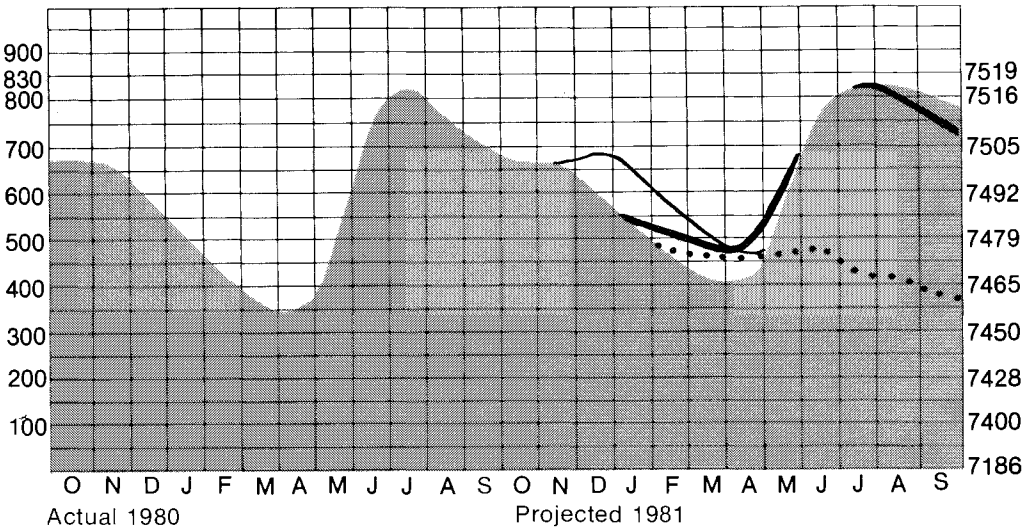

Most Adverse




**Storage Blue Mesa Reservoir**

Usable Content in 1000 Acre-Feet

Elevation in Feet (Non-Linear Scale)




Actual 1980 Projected 1981

**Legend**

Most Probable

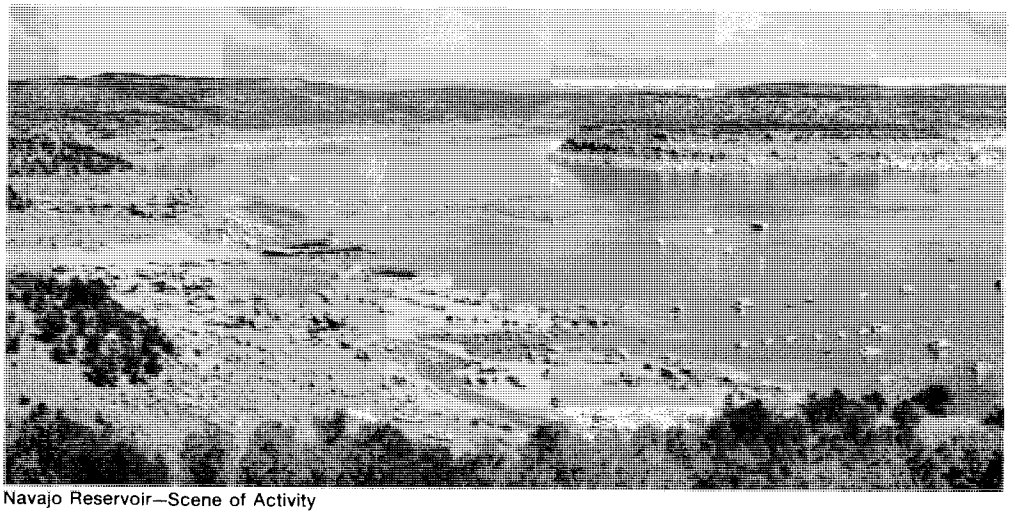
Upper Quartile

Lower Quartile

Most Adverse

## Navajo Reservoir (San Juan River)

Sailing on Navajo Lake



Navajo Reservoir—Scene of Activity

**Water Year 1980**
During the first part of water year 1980 a minimum 300 $ft^3/s$ was released for consumptive use and maintenance of fish and wildlife.

The April-July 1980 inflow was 1,094,000 acre-feet, which is 154 percent of the long-time average. This was the second consecutive year of high runoff. Consequently, Navajo Reservoir was operated for flood control. During the water year, the maximum inflow of 11,065 $ft^3/s$ was reduced to a release of 3,000 $ft^3/s$ and no flood damage occurred.

In anticipation of the high runoff, the reservoir was gradually drawn down to 6,031 feet. Yet, by the end of the spring and summer runoff the reservoir filled to near capacity with a water level of 6,083 feet in July 1980.

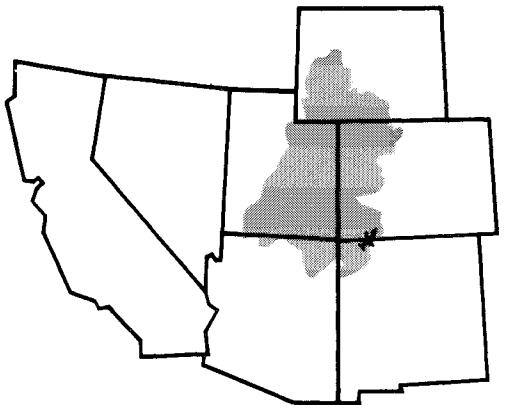
**Water Year 1981**
On September 30, 1980, Navajo Reservoir stored 1,555,000 acre-feet of water at an elevation of 6,076 feet. Assuming average inflow for water year 1981, the projected elevation before snowmelt runoff begins is 6,055 feet with a content of 1,282,000 acre-feet. By July 1981, the reservoir is expected to reach an elevation of 6,078 feet with a content of 1,591,000 acre-feet. This approximate elevation will be maintained throughout the summer to enhance recreational use.

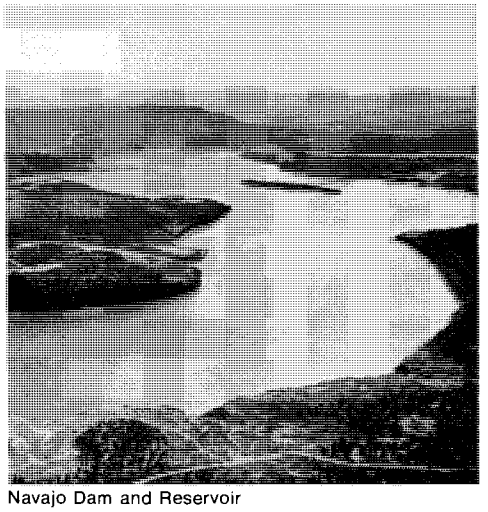
The release from Navajo Reservoir for an upper quartile inflow is projected to be about 1,700 $ft^3/s$ for winter through summer 1981. For an average inflow, the release is expected to be 1,700 $ft^3/s$ for winter and spring, then decrease to 800 $ft^3/s$ for the summer. The projected lower quartile releases are 1,500 $ft^3/s$ for winter, 1,200 $ft^3/s$ for spring, and 700 $ft^3/s$ for summer. Assuming most adverse conditions, the anticipated releases are 1,200 $ft^3/s$ for winter, and 520 $ft^3/s$ for spring and summer.

**Navajo** Active Storage* **Chart 4**

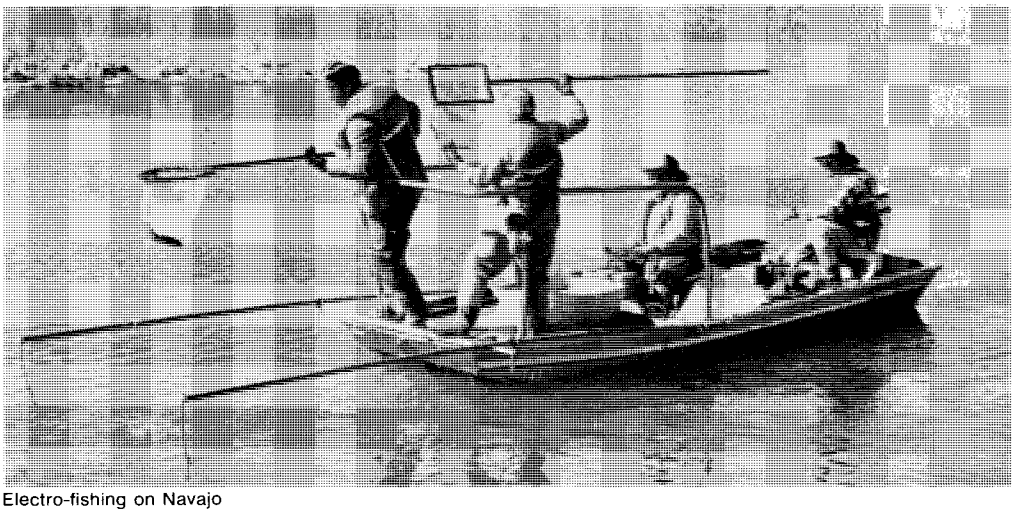
| Reservoir | (Acre-Feet) | El. (Ft.) |
|---|---|---|
| Maximum Storage | 1,696,400 | 6085 |
| Inactive Storage | 660,500 | 5990 |
| Surface Area (Full) | 15,610 Acres | |
| Reservoir Length (Full) | 33 Miles | |

*does not include 12,600 acre-feet of dead storage below 5775 feet





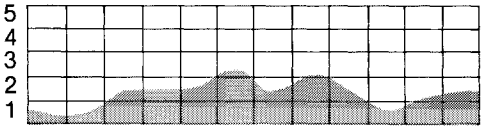
Navajo Dam and Reservoir



Electro-fishing on Navajo

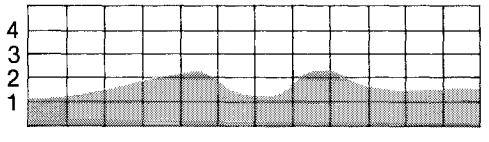
**Outflow** Release in 1000 Cubic Feet/Second

Actual Operation 1980

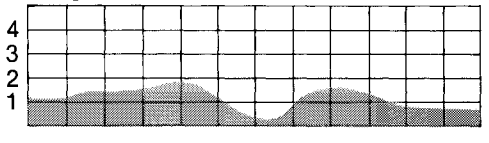



Projected Operation 1981

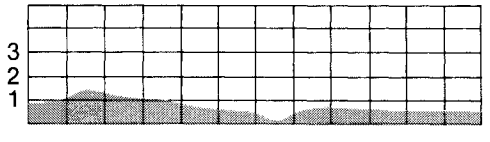
Upper Quartile



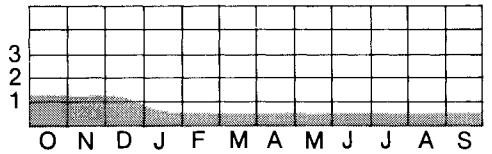

Average




Lower Quartile



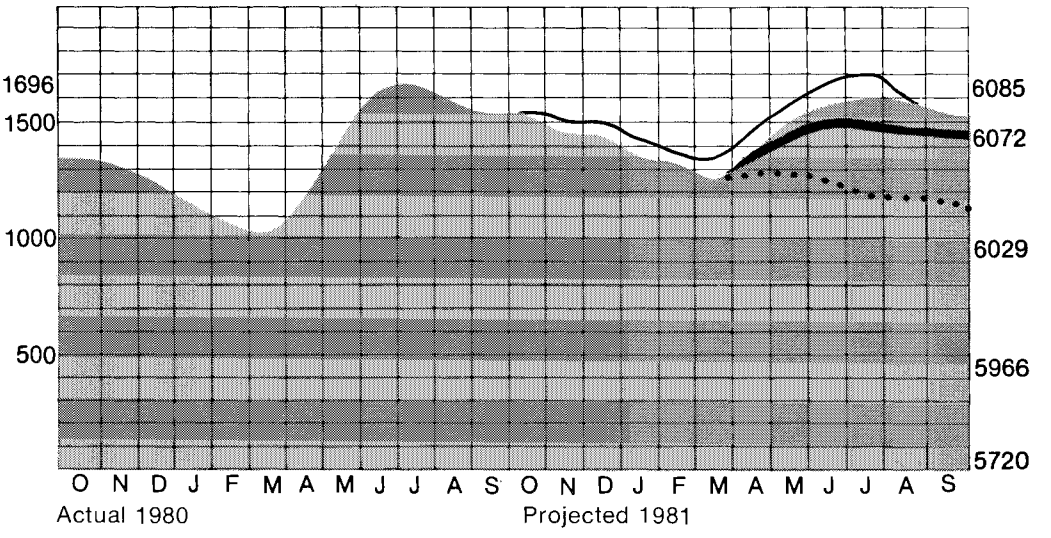

Most Adverse




**Storage**

Usable Content in 1000 Acre-Feet

Elevation in Feet (Non-Linear Scale)




Actual 1980 Projected 1981

**Legend**

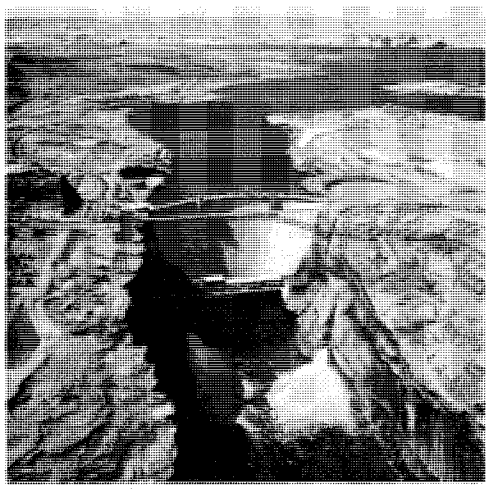
Most Probable

Upper Quartile

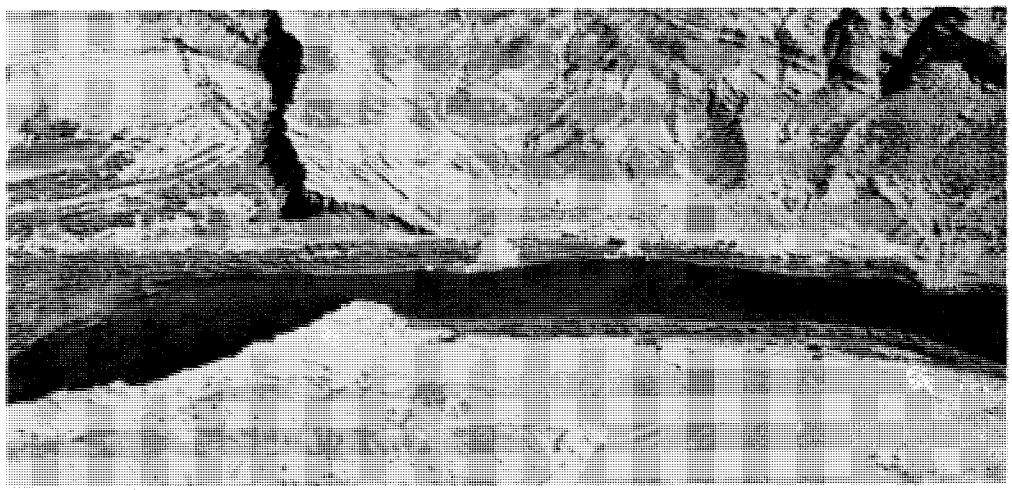
Lower Quartile

Most Adverse

## Lake Powell (Colorado River)



Glen Canyon Spillway operating.



Lees Ferry

**Water Year 1980**
During water year 1980, Lake Powell, which is impounded by Glen Canyon Dam, was operated as part of the Colorado River Storage Project in accordance with governing contracts and laws to provide river regulation, optimum power production, recreation, and fish and wildlife enhancement.

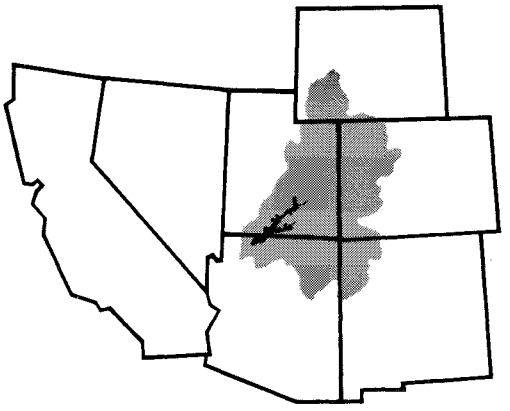
On September 30, 1979, Lake Powell water surface elevation was 3,678 feet with a live storage of 21,636,000 acre-feet. The April-July 1980 runoff at Lees Ferry, Ariz., was 10,958,000 acre-feet, 144 percent of the long-time average. With this inflow, the reservoir filled to capacity for the first time. On June 22, 1980, Lake Powell exceeded elevation 3,700 feet and Lake Mead was at elevation 1,201, thus terminating Lake Powell filling criteria. Several days prior to the filling of Lake Powell, both left and right spillways were successfully tested with flows up to 30,000 $ft^3/s$.

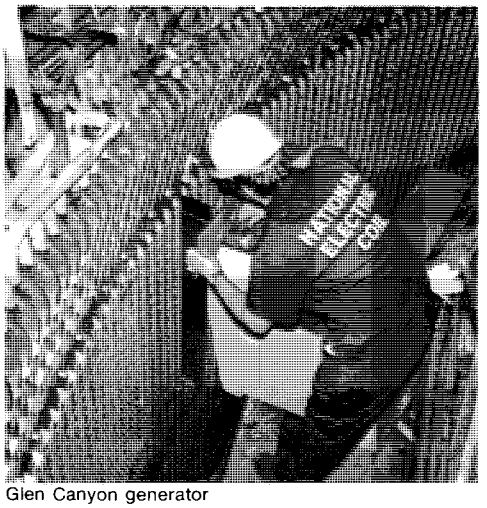
**Water Year 1981**
By the end of September 1980, the elevation of Lake Powell was 3,688 feet. It is expected to be drawn down to about 3,676 feet by spring of 1981. With an average April-July inflow of approximately 8,000,000 acre-feet, a maximum elevation of 3,696 feet is expected. At this elevation, the content is 24.3 million acre-feet, 97 percent of active capacity, and the surface area is approximately 158,000 acres. Scheduled releases from Lake Powell under average conditions amount to 9,950,000 acre-feet, 1,720,000 acre-feet more than the minimum required by the operating criteria. Equalization of storage is anticipated during September 1981. If the inflow to Lake Powell is at the lower quartile or less, the release will be 8,230,000 acre-feet. With an upper quartile inflow, the release is projected to be 11,031,000 acre-feet.

**Lake Powell** Active Storage* **Chart 5**

| Reservoir | (Acre-Feet) | El. (Ft.) |
|---|---|---|
| Maximum Storage | 25,002,000 | 3700 |
| Rated Head | 9,428,000 | 3570 |
| Minimum Power | 4,126,000 | 3490 |
| Surface Area (Full) | 161,390 Acres | |
| Reservoir Length (Full) | 186 Miles | |
| Power Plant | | |
| Number of Units | 8 | |
| Total Capacity | 900,000 Kilowatts | |

*does not include 1,998,000 acre-feet of dead storage below 3370 feet



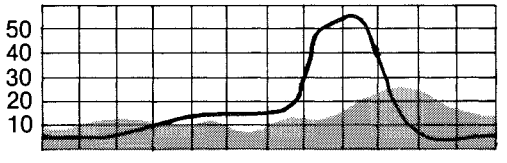


Glen Canyon generator

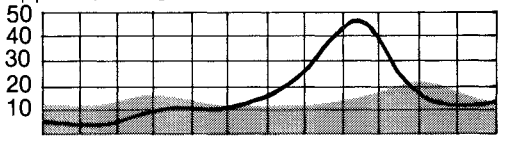
Interesting cliff formations below dam

**Inflow** ——— **Outflow** ▒▒▒

Actual 1980 in 1000 Cubic Feet Second

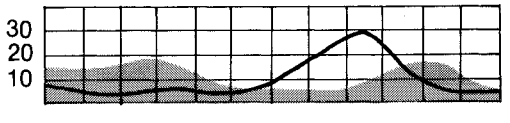



Projected 1981
Upper Quartile

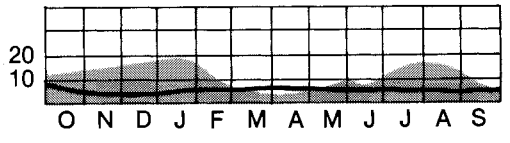



Average


Lower Quartile



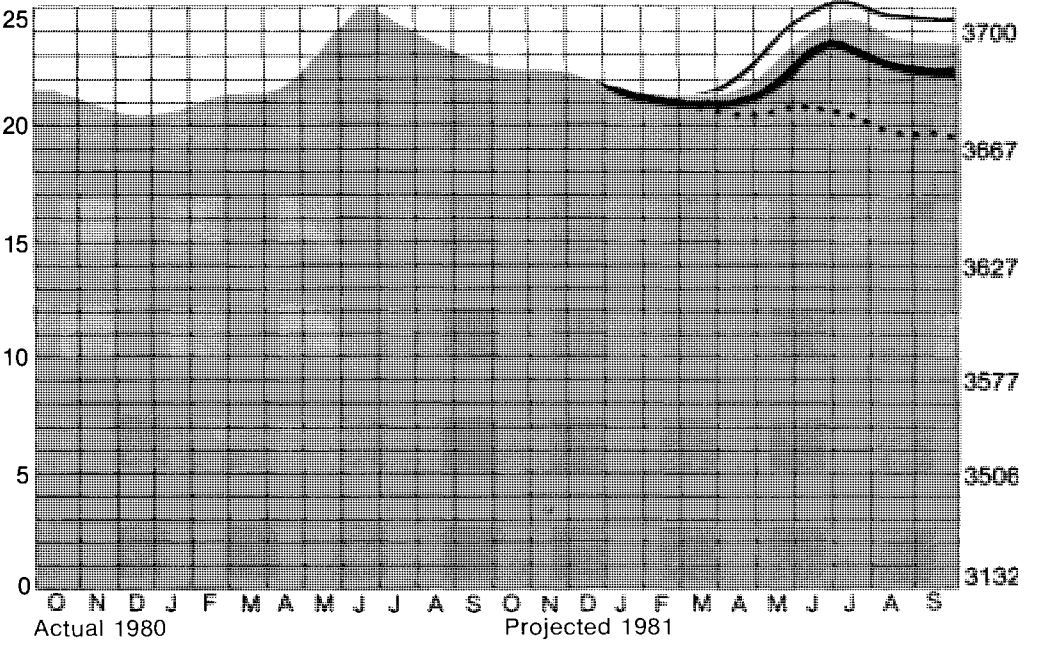

Most Adverse




**Storage**

Usable content in Million Acre-Feet

Elevation in Feet (Non-Linear Scale)




**Legend**

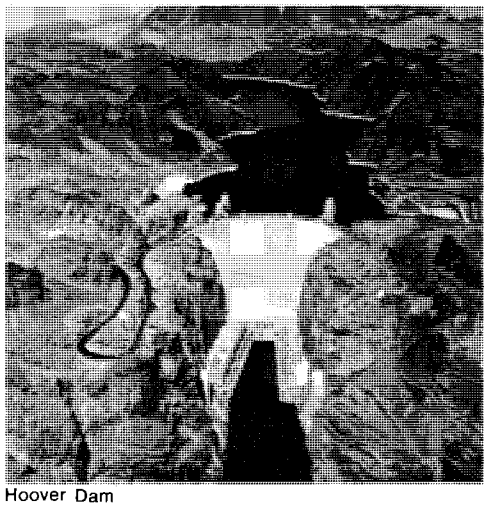
Most Probable ▒▒▒

Upper Quartile ———

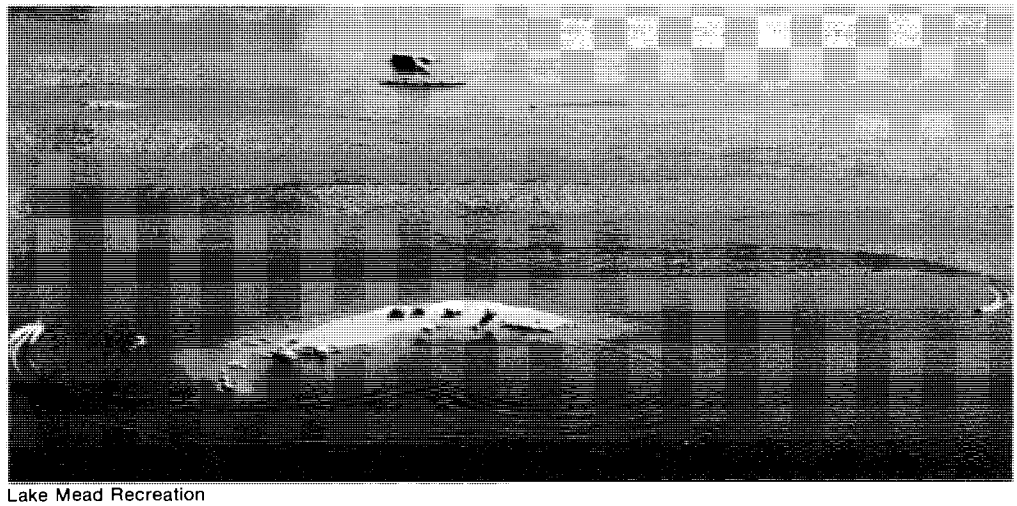
Lower Quartile ▬▬▬

Most Adverse ·····

## Lower Basin Reservoirs
## Lake Mead (Colorado River)



Hoover Dam



Lake Mead Recreation

**Water Year 1980**
At the beginning of water year 1980, Lake Mead, impounded by Hoover Dam, had a water surface elevation of 1,195 feet and an active storage of 22,242,000 acre-feet. During the water year, releases were made to meet downstream water use requirements in the United States and Mexico, programmed levels of Lakes Mohave and Havasu, and transit losses which include river and reservoir evaporation, uses by phreatophytes, changes in bank storage, unmeasured inflows, and diversions. (As mentioned earlier in this report, additional anticipatory releases totaling 3,059,000 acre-feet were made from Hoover Dam and downstream reservoirs during water year 1980 in order to decrease the magnitude of flood control releases during 1981 and 1982). The total release from Lake Mead through Hoover Dam during water year 1980 was an estimated 9,958,000 acre-feet. At the end of the water year, Lake Mead had a water surface elevation of 1,205 feet and an active storage of 23,637,000 acre-feet, which reflect an increase in storage during the water year of 1,395,000 acre-feet.

On September 30, 1980, the active storage of Lake Mead was 553,000 acre-feet more than the active storage of Lake Powell.

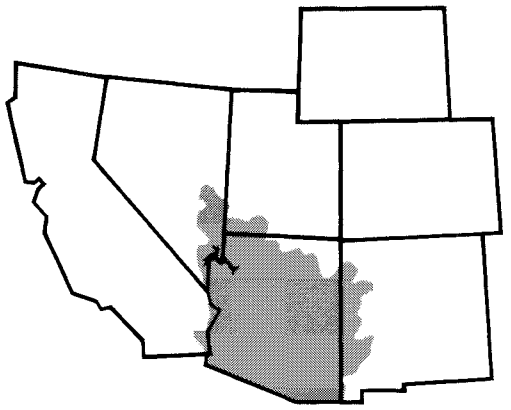
**Water Year 1981**
During the 1981 water year, the Lake Mead water level is scheduled to rise to elevation 1,207 feet at the end of February 1981, then be drawn down to a low elevation of 1,197 feet at the end of June 1981. At that level the lake will have an average active storage of about 22.4 million acre-feet. During water year 1981 a total of 10 million acre-feet is scheduled to be released from Lake Mead. This release will exceed downstream requirements while at the same time meet compact requirements and existing operating criteria. All releases are scheduled to pass through the turbines for electric power production.

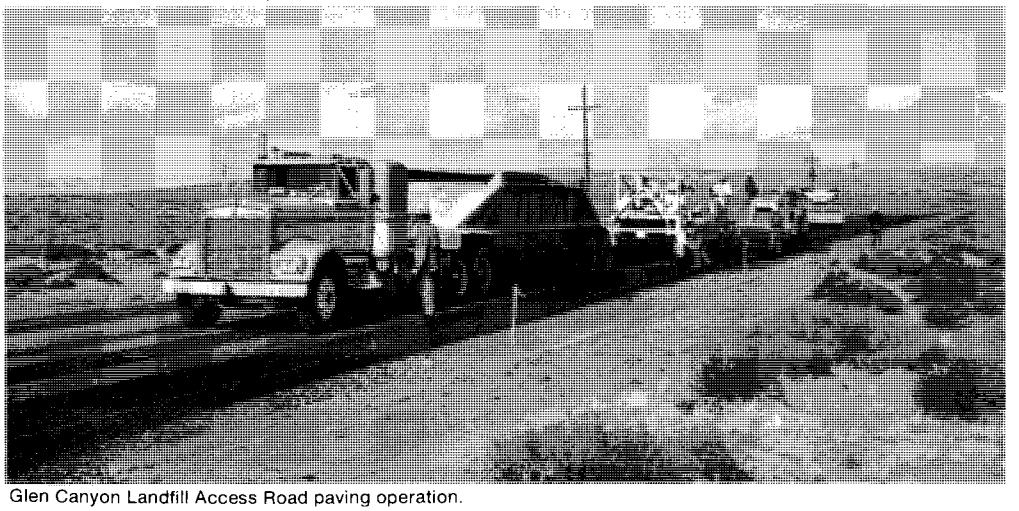
With an upper quartile inflow to the system's reservoirs, it is anticipated that instantaneous peak discharges from Hoover, Davis, and Parker Dams would not be greater than normal year peaks; however, sustained discharges may pose minor problems in the United States portion of the Lower Basin and more significant problems within the Republic of Mexico.

**Lake Mead** Active Storage* **Chart 6**

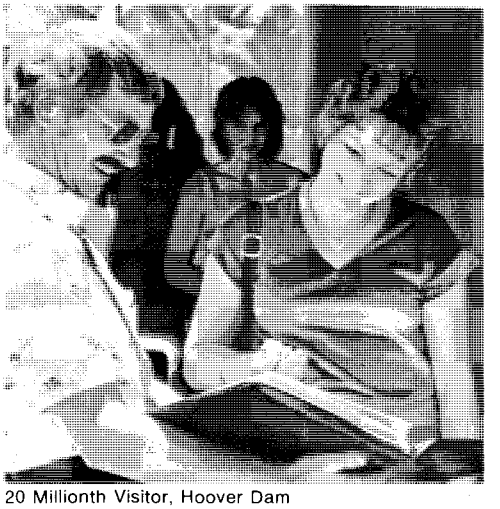
| Reservoir | (Acre-Feet) | El. (Ft.) |
|---|---|---|
| Maximum Storage | 27,377,000 | 1229 |
| Rated Head | 13,653,000 | 1123 |
| Minimum Power | 10,024,000 | 1083 |
| Surface Area (Full) | 162,700 Acres | |
| Reservoir Length (Full) | 115 Miles | |
| Power Plant | | |
| Number of Units | 17 | |
| Total Capacity | 1,344,800 Kilowatts | |

*does not include 2,378,000 acre-feet of dead storage below 895 feet





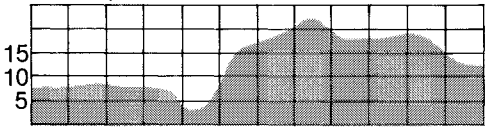
Glen Canyon Landfill Access Road paving operation.



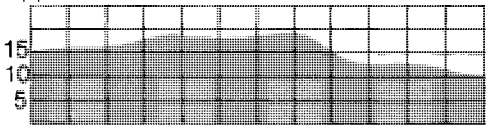
20 Millionth Visitor, Hoover Dam

**Outflow** Release in 1000 Cubic Feet/Second

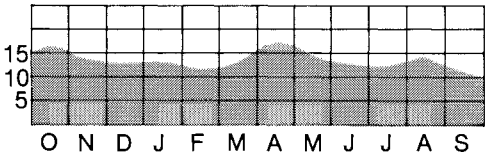
Actual Operation 1980




Projected Operation 1981
Upper Quartile



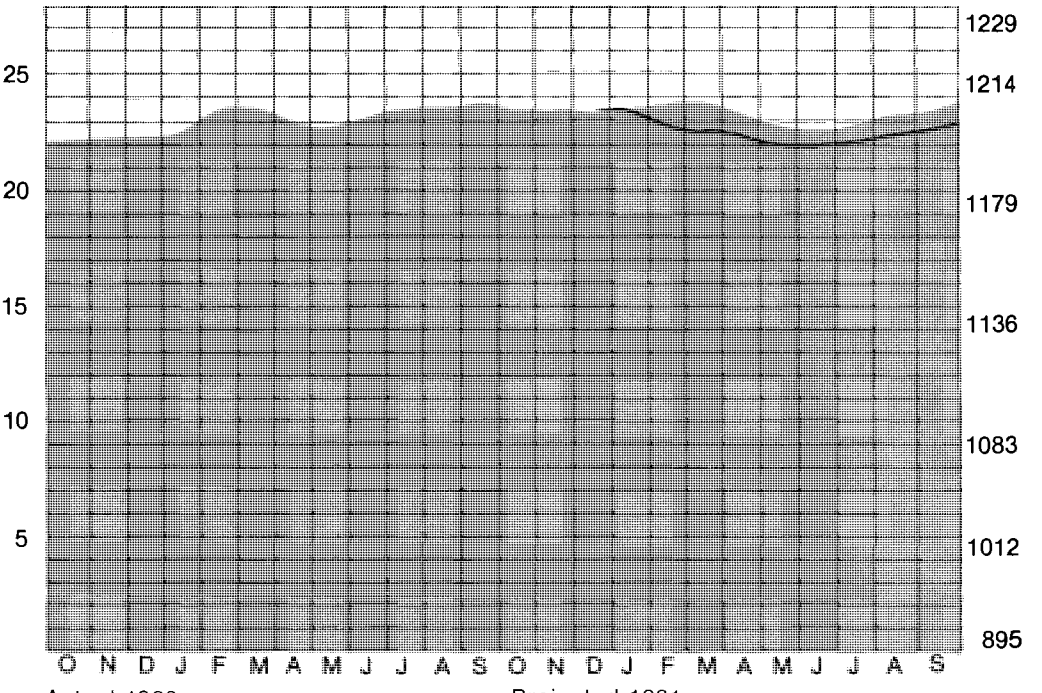

Average, Lower Quartile,
Most Adverse




**Storage**

Active Content in Million Acre-Feet

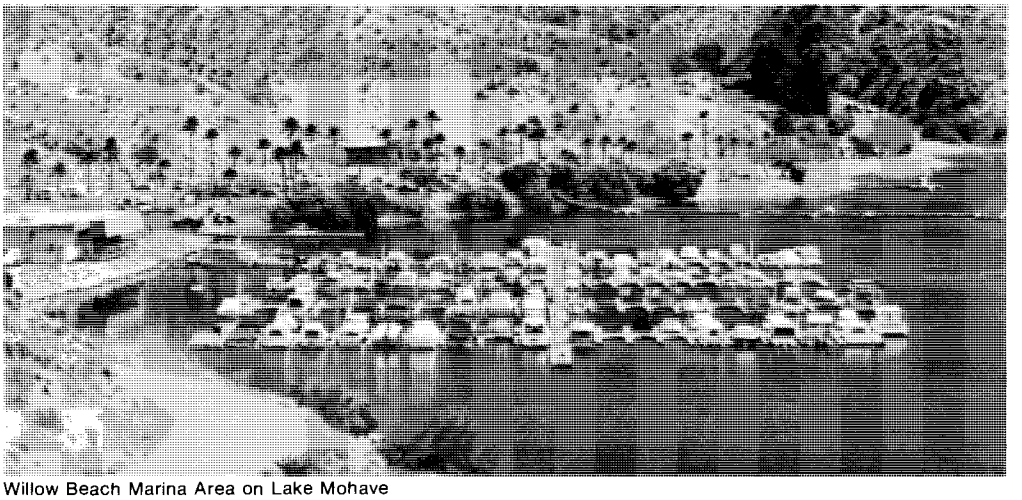
Elevation in Feet (Non-Linear Scale)



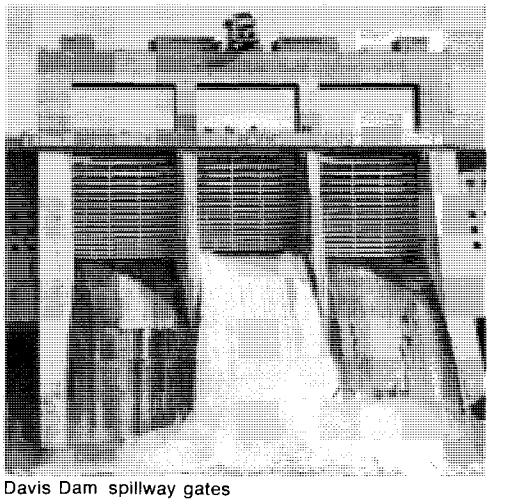

Actual 1980 Projected 1981

**Legend**
Most Probable
Upper Quartile

## Lake Mohave (Colorado River)



Willow Beach Marina Area on Lake Mohave



Davis Dam spillway gates

**Water Year 1980**
At the beginning of water year 1980, the water surface elevation of Lake Mohave, which is impounded by Davis Dam, was 633 feet, with an active storage of 1,428,000 acre-feet.

During the winter months, the water level was raised to 645 feet, with an active storage of 1,762,000 acre-feet at the end of May 1980. The water level was drawn down during the summer and fall months to its lowest elevation of the year, 633 feet. The reservoir ended the water year at elevation 633 feet with 1,445,000 acre-feet in active storage.

Lake Mohave releases were made to satisfy downstream requirements, with a small amount of re-regulation at Lake Havasu. The additional releases from Hoover Dam were also routed through Lake Mohave. During the water year approximately 10,246,000 acre-feet were released at Davis Dam, all of which passed through the turbines for power production.

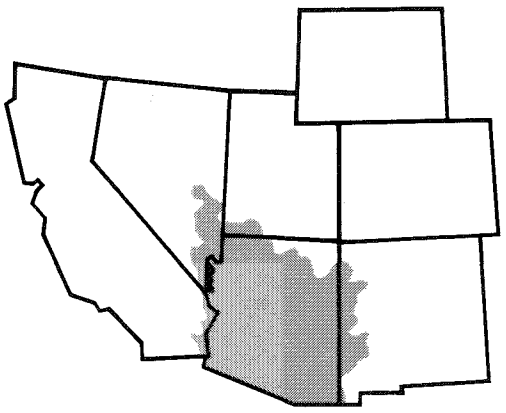
**Water Year 1981**
The water level of Lake Mohave is scheduled to rise through the fall and winter months and reach elevation 645 feet by the end of May 1981. Because of heavy irrigation use during the summer months, the water level in Lake Mohave is expected to be drawn down to elevation 630 feet by the end of water year 1981. During that time a total of 10.2 million acre-feet is scheduled to be released from Lake Mohave to meet all downstream requirements and this amount includes the additional releases from Hoover Dam. All releases are scheduled for electric power production.

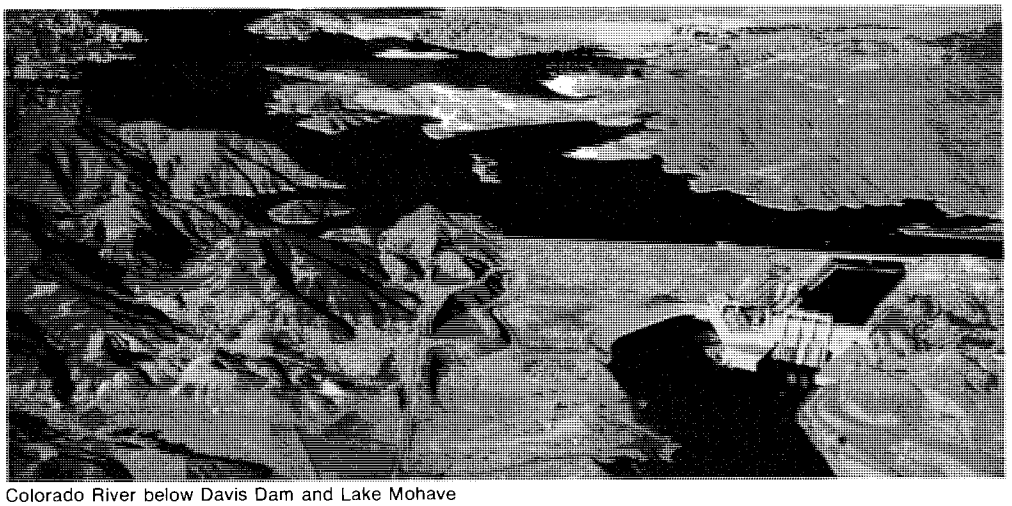
With an upper quartile inflow to the system's reservoirs, it is anticipated that instantaneous peak discharges from Hoover, Davis, and Parker Dams would not be greater than normal year peaks; however, sustained discharges may pose minor problems in the United States portion of the Lower Basin and more significant problems within the Republic of Mexico.

**Lake Mohave** Active Storage* **Chart 7**

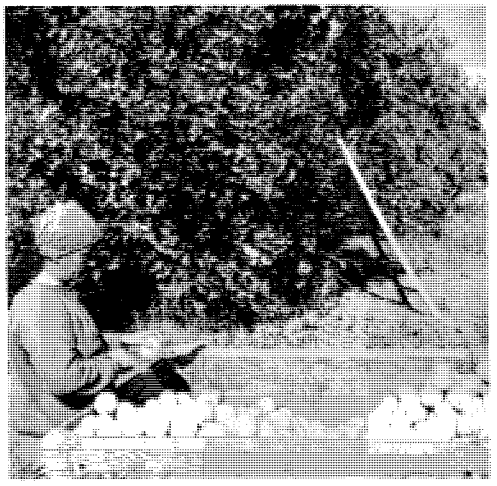
| Reservoir | (Acre-Feet) | El. (Ft.) |
|---|---|---|
| Maximum Storage | 1,810,000 | 647.0 |
| Rated Head | 1,188,000 | 623.0 |
| Minimum Power | 217,500 | 570.0 |
| Surface Area (Full) | 28,200 Acres | |
| Reservoir Length (Full) | 67 Miles | |
| Power Plant | | |
| Number of Units | 5 | |
| Total Capacity | 240,000 Kilowatts | |

*does not include 8,530 acre-feet of dead storage below 533.39 feet





Colorado River below Davis Dam and Lake Mohave

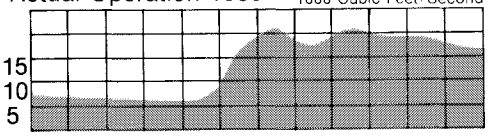


Harvesting lemons

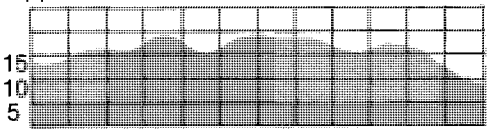
**Lake Mohave Outflow**

Actual Operation 1980

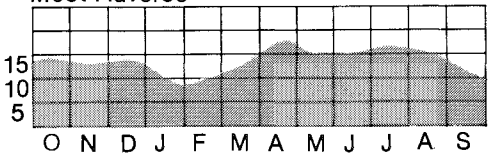
Release in 1000 Cubic Feet/Second




Projected Operation 1981
Upper Quartile



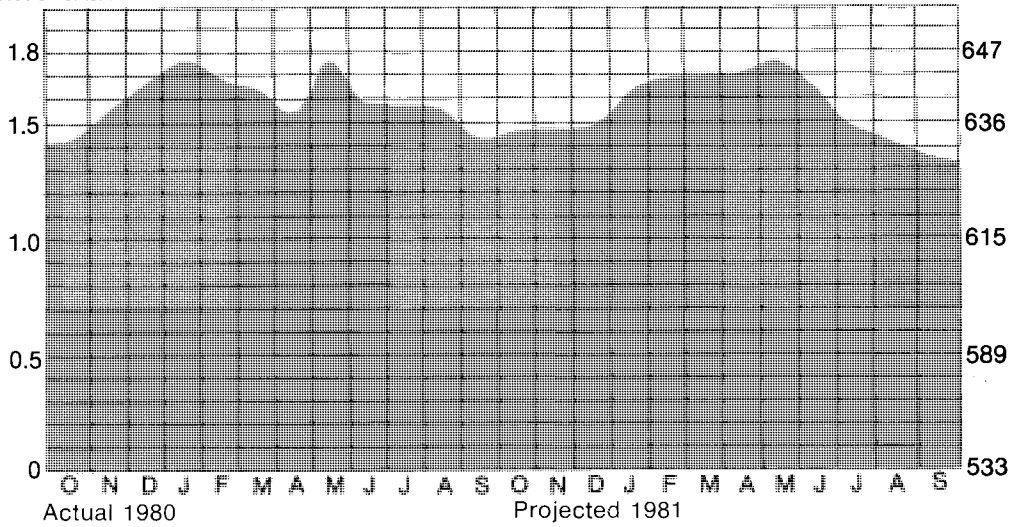

Average, Lower Quartile,
Most Adverse



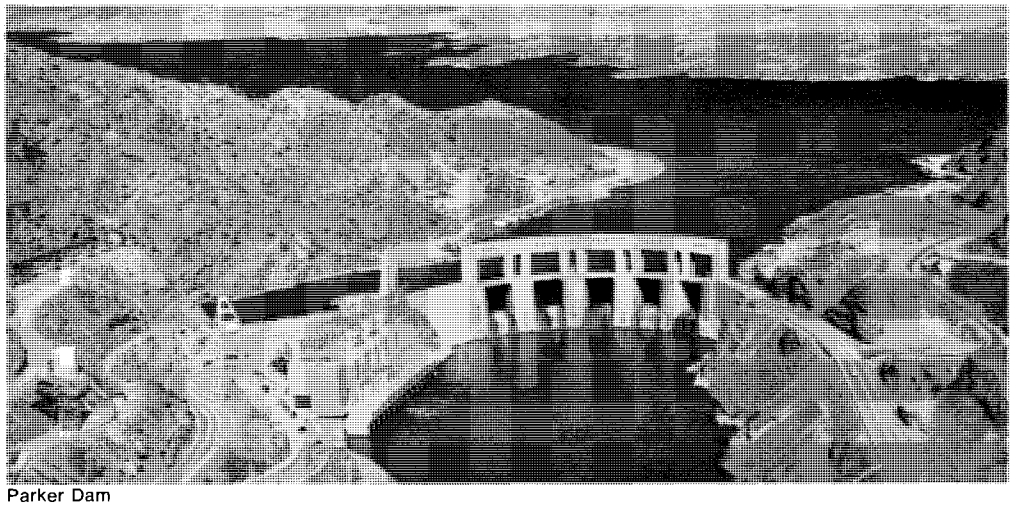

**Lake Mohave Storage**

Usable Content in Million Acre-Feet

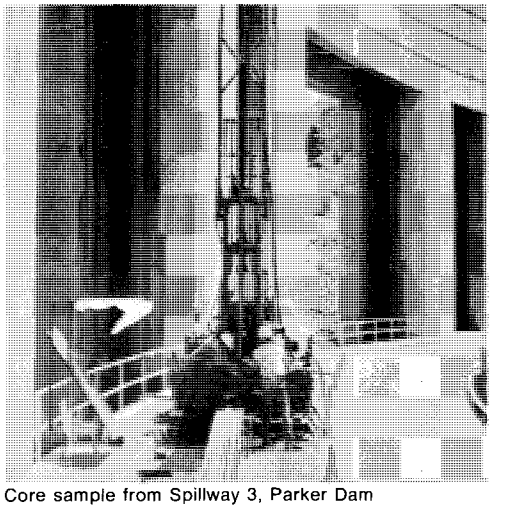
Elevation in Feet (Non-Linear Scale)



## Lake Havasu (Colorado River)



Parker Dam



Core sample from Spillway 3, Parker Dam

**Water Year 1980**
At the beginning of water year 1980, the water level of Lake Havasu, impounded by Parker Dam, was at elevation 447 feet with an active storage of about 565,000 acre-feet. The reservoir was drawn down to approximately elevation 443 feet with an active storage of about 498,000 acre-feet in February, to provide flood control space for runoff from the drainage area between Davis and Parker Dams. The water level was then raised to approximately elevation 448 feet by mid-May. From mid-May through July, the reservoir water level was maintained between 449 and 447, with an active storage of about 566,000 acre-feet at the end of July. By the end of the water year Lake Havasu was drawn down to about 447 feet with an active storage of 554,000 acre-feet.

During the water year, approximately 9,413,000 acre-feet were released at Parker Dam, all of which passed through the turbines for power production. That amount included the additional releases from Lake Mead during the year and the flood control releases from Alamo Dam on the Bill Williams River.

Space in the top 10 feet of Lake Havasu (about 180,000 acre-feet) is reserved by the United States for control of floods and other uses, including river regulation. Normally, only about the top 4 feet, or 77,000 acre-feet of space, have been used for this purpose since Alamo Reservoir on the Bill Williams River has been in operation.

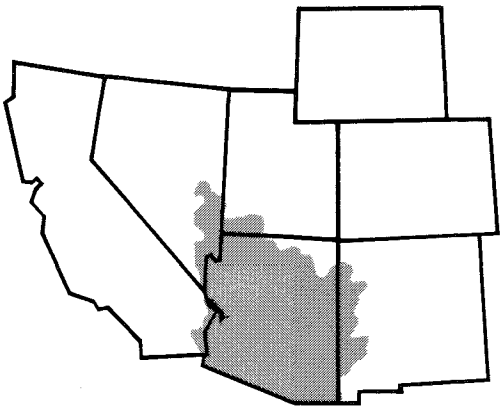
**Water Year 1981**
Lake Havasu is scheduled at the highest levels consistent with the requirements for maintaining flood control space. The yearly low elevation of approximately 446 feet is scheduled for the October through March high flood hazard period. However, a repeat of hydrologic conditions similar to those that occurred in water year 1980 could require a lower elevation to provide for river regulations and flood control space for runoff from the drainage area between Parker and Davis Dams. The yearly high of 450 feet is scheduled for the low flood hazard month of June. During water year 1981, a total of 9 million acre-feet is scheduled to be released from Lake Havasu to meet all downstream requirements, including the additional releases. All releases are scheduled for electric power production.

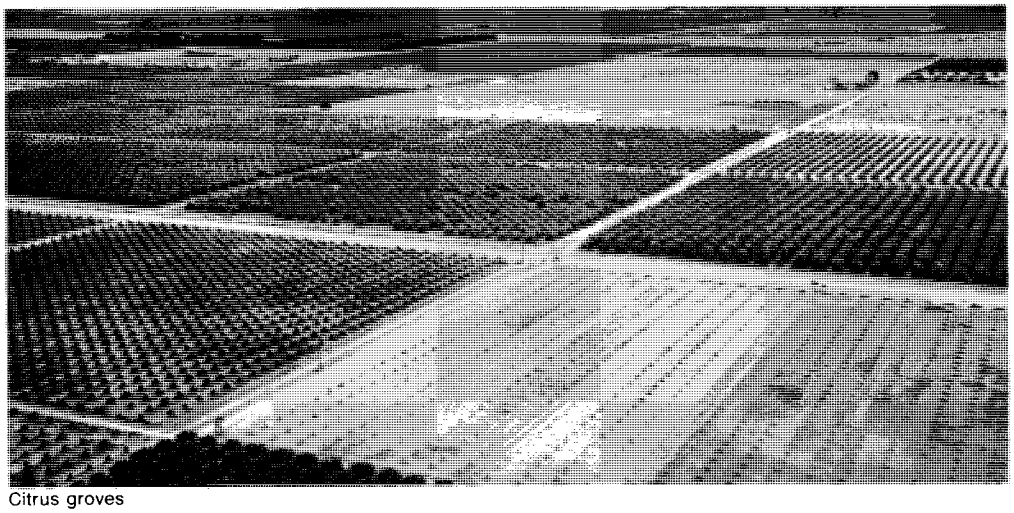
With an upper quartile inflow to the system's reservoirs, it is anticipated that instantaneous peak discharges from Hoover, Davis, and Parker Dams would not be greater than normal year peaks; however, sustained discharges may pose minor problems in the United States portion of the Lower Basin and more significant problems within the Republic of Mexico.

**Lake Havasu** Active Storage* **Chart 8**

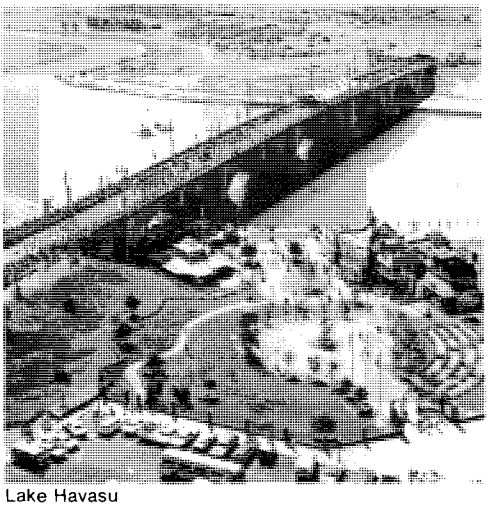
| Reservoir | (Acre-Feet) | El.(Ft.) |
|---|---|---|
| Maximum Storage | 619,400 | 450.0 |
| Rated Head | 619,400 | 450.0 |
| Minimum Power | 439,400 | 440.0 |
| Surface Area (Full) | 20,400 Acres | |
| Reservoir Length (Full) | 35 Miles | |
| Power Plant | | |
| Number of Units | 4 | |
| Total Capacity | 120,000 Kilowatts | |

*does not include 28,600 acre-feet of dead storage below 400.0 feet





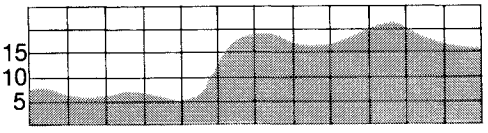
Citrus groves



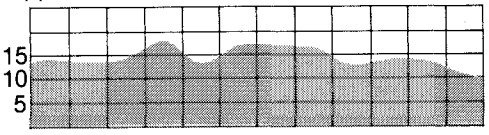
Lake Havasu

**Outflow** Release in 1000 Cubic Feet/Second

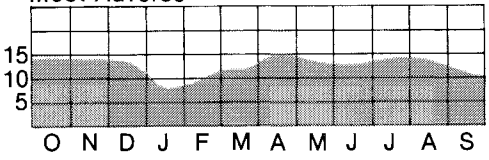
Actual Operation 1980




Projected Operation 1981
Upper Quartile



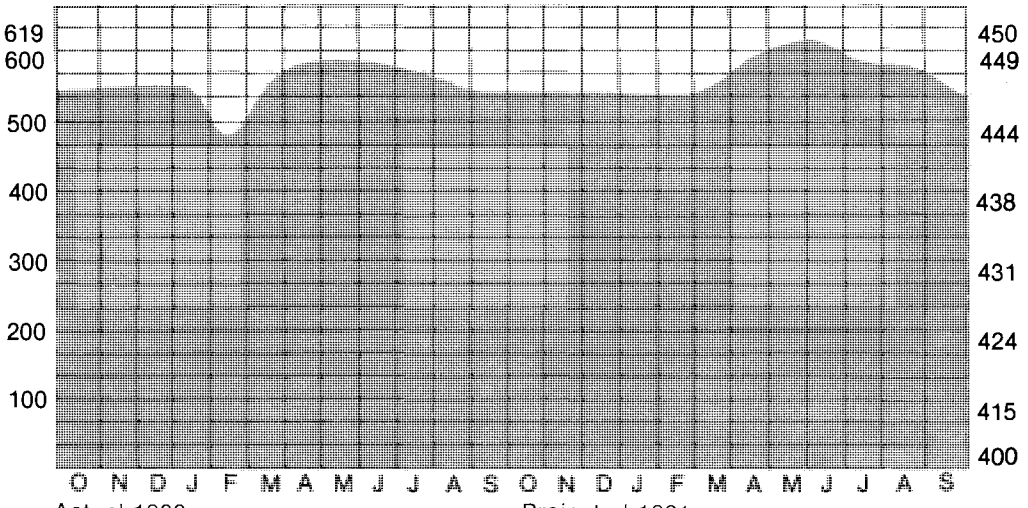

Average, Lower Quartile,
Most Adverse




**Storage**

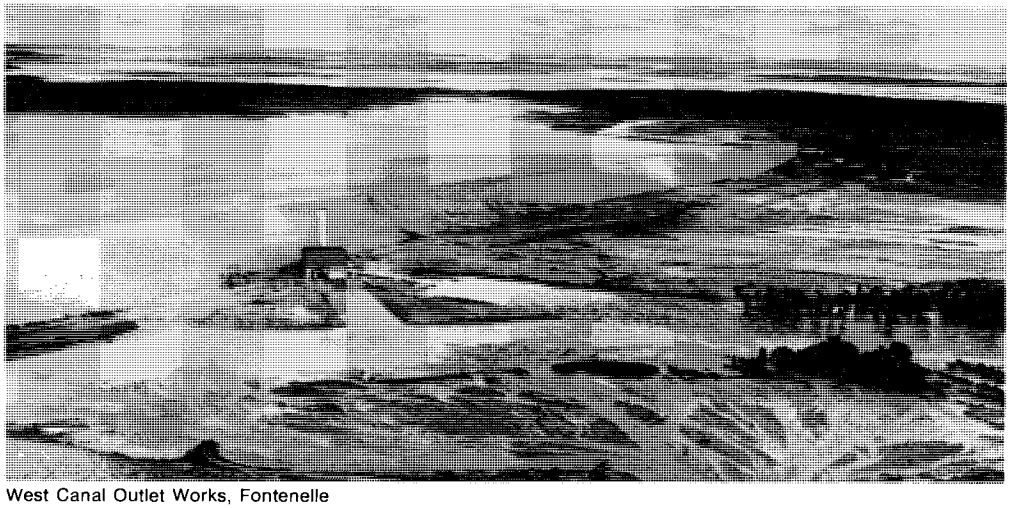
Usable Content in 1000 Acre-Feet

Elevation in Feet (Non-Linear Scale)

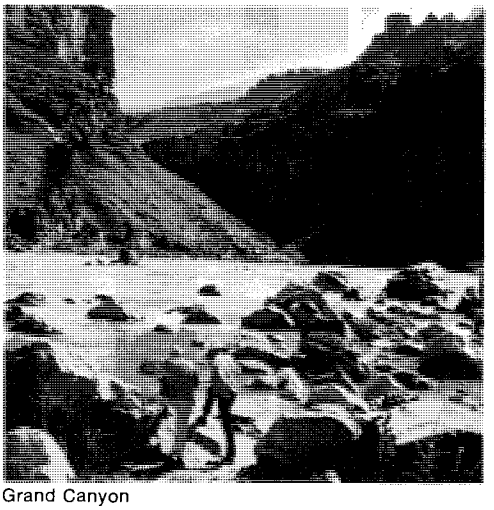



Actual 1980 Projected 1981

## River Regulation



West Canal Outlet Works, Fontenelle



Grand Canyon

The natural virgin runoff reaching the streams of the Colorado River drainage system above Glen Canyon Dam during water year 1980 was estimated at about 17.5 million acre-feet. Of this amount, about 4 million acre-feet of water was consumptively used within the Upper Colorado River Basin States.

Adjustments in storage in other mainstem reservoirs resulted in an inflow to Lake Powell of 13.2 million acre-feet. The release from Glen Canyon Dam, based on measurements at the gaging station at Lees Ferry, Ariz., was 10,920,000 acre-feet. For the 1-year and 10-year periods ending September 30, 1980, 10,967,000 acre-feet and 89,989,000 acre-feet, respectively, passed the compact point at Lees Ferry.

The projected release from Lake Powell based on the most probable forecast of runoff is 9,950,000 acre-feet. Releases could vary from a minimum of 8,230,000 acre-feet with most adverse and lower quartile runoff to 11,031,000 acre-feet with upper quartile runoff. When added to the flow of the Paria River, this would result in an Upper Basin delivery ranging from 89.6 to 92 million acre-feet for the 10-year period ending September 30, 1981.

Normally, daily releases are made from the storage reservoirs in the Lower Basin to meet the incoming orders of the water user agencies. All water passes through the powerplant units. The daily releases are regulated on an hourly basis to meet as nearly as possible the power loads of the electric power customers. Minimum daily flows are provided in the river to maintain fishery habitat. Adjustments to the normal releases are made when conditions permit to provide more satisfactory conditions for water oriented recreation activities, to provide transport for river-borne sediment to desilting facilities, and to assist in controlling water quality. Minimum releases from Lake Powell were 1,000 cubic feet per second ($ft^3/s$) during the winter months and were increased to 3,000 $ft^3/s$ during the summer months.

Anticipatory releases and river regulation below Hoover Dam were accomplished in a manner which resulted in a total delivery to Mexico of approximately 4,436,000 acre-feet in excess of the Treaty quantity during water year 1980. Of that amount 185,021 acre-feet of drainage waters were bypassed for salinity control pursuant to provisions of Minute No. 242 of the International Boundary Water Commission.

# Flood Control

Alamo Dam and Lake

Waterfall on Lake Fork River

Lake Mead is the only reservoir on the Colorado River in which a specified space is exclusively allocated for mainstream flood control. Flood control regulations for Hoover Dam are being updated and revised by the Water and Power Resources Service and the Army Corps of Engineers with the consultation and advice of State and local interests.

A draft report has been prepared and is in the review process. After the review process has been completed, a final report and revised regulations will be published.

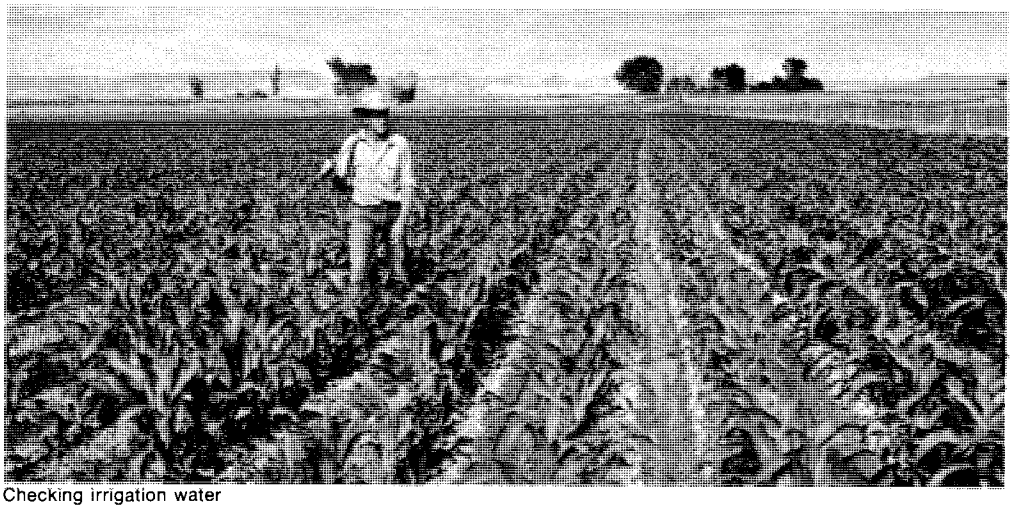
An interim agreement on flood control regulations prior to publication of the revised regulations is now in effect which takes into account the available effective space in CRSP reservoirs as well as in Lake Mead.

Extensive flood control protection was provided by the reservoirs within the Basin during water year 1980. Several storm systems swept across the watershed and saturated wide areas with damaging rains. Total Colorado River reservoir system storage at the start of water year 1980 was approximately 50.9 million acre-feet and about 54.5 million acre-feet at the end of the water year, representing a 3.6 million acre-feet decrease in total remaining available reservoir space.

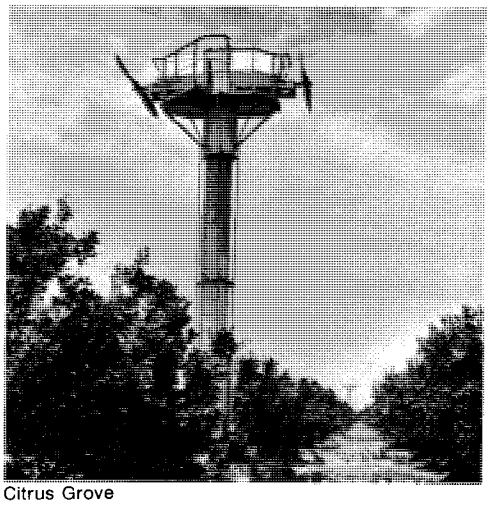
In addition to the mainstream structures, Alamo Dam on the Bill Williams River, and Painted Rock Dam on the Gila River (both in the Lower Basin) received unusually large amounts of flood inflow during the winter months. Painted Rock and Alamo Reservoirs are scheduled to be operated at minimum flood control levels during 1981.

Flood control storage space will be maintained in Lake Mead as stipulated in the new interim agreement between the Water and Power Resources Service and the U.S. Army Corps of Engineers.

## Beneficial Consumptive Uses



Checking irrigation water



Citrus Grove

**Upper Basin Uses and Losses**

The three largest sources of consumptive use in the Upper Colorado Basin are agricultural use within the drainage basin, diversion to adjacent drainage systems, and evaporation losses. During water year 1980, the estimated use for agriculture and municipal and industrial supply in the Upper Basin was 2,299,000 acre-feet. Estimated evaporation losses were 700,000 acre-feet from mainstem reservoirs plus 160,000 acre-feet from other reservoirs and stockponds. Approximately 640,000 acre-feet were diverted for use in adjacent drainage basins. Thus, total estimated consumptive use amounted to 3,790,000 acre-feet.

About 2.4 million acre-feet of water were added to storage in Upper Basin mainstem reservoirs during 1980. This water will be released to the Lower Basin in future years as required by the Colorado River Project Act and the laws, compacts, and treaties upon which the operating criteria were promulgated pursuant to Sec. 602(a) of the Act.

**Lower Basin Uses and Losses**

During water year 1980, an estimated 9,413,000 acre-feet of water were released from Lake Havasu to meet the requirements for water deliveries at Imperial Dam, as well as those of the Colorado River Indian Reservation near Parker, Ariz., the Palo Verde Irrigation District near Blythe, Calif., other miscellaneous users along the river, the anticipatory releases and transit losses between Parker Dam and Imperial Dam.

The major water diversion above Parker Dam was by The Metropolitan Water District (MWD) of Southern California. MWD pumped 818,000 acre-feet from Lake Havasu during water year 1980, which included 3,500 acre-feet for delivery to the City of Tijuana pursuant to a contract for temporary emergency delivery of a portion of Mexico's Treaty entitlement.

During water year 1980, releases of approximately 10,246,000 acre-feet were made from Lake Mohave to provide for releases at Parker Dam; to supply diversion requirements of the MWD, miscellaneous contractors, and other users; to offset evaporation and other transit losses between Davis and Parker Dams; and to maintain the scheduled levels of Lake Havasu.

During water year 1980, releases of approximately 9,958,000 acre-feet were made from Lake Mead at Hoover Dam to regulate the levels of Lake Mohave and to provide for the small uses and the losses from this reservoir. In addition, 123,000 acre-feet were diverted from Lake Mead for use by Lake Mead National Recreation area, Boulder City, Basic Management, Inc., and contractors of the Division of Colorado River Resources, State of Nevada. During water year 1980 the total releases and diversions from Lake Mead were an estimated 10,081,000 acre-feet. This amount included the anticipatory releases discussed elsewhere in this report.

Municipal pool

Cattle Feedlot—Imperial Valley

For water year 1981, a release of 9 million acre-feet from Lake Havasu has been projected, including consumptive use requirements in the United States below Parker Dam, transit losses in the river between Parker Dam and the Mexican Border, Treaty deliveries to Mexico and the additional releases from Hoover Dam.

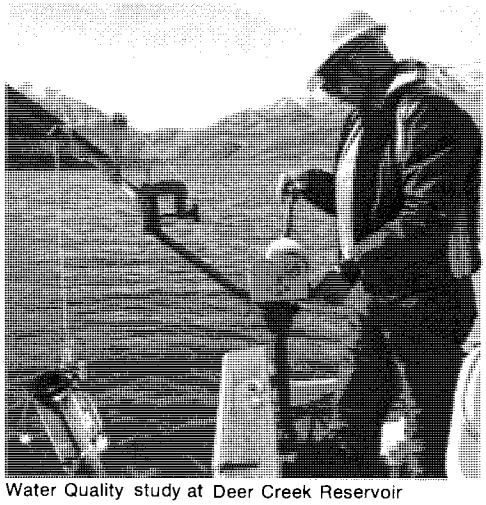
During water year 1981, The Metropolitan Water District of Southern California is expected to divert 868,000 acre-feet by pumping from Lake Havasu.

Consumptive uses by small users, river losses or gains, and reservoir losses between Davis Dam and Parker Dam are projected to be a net loss of 306,000 acre-feet.

There are no major users between Hoover Dam and Davis Dam. During water year 1981, consumptive uses by small users, river losses or gains, and reservoir losses between Hoover Dam and Davis Dam are projected to be a net gain of 127,000 acre-feet. The net diversions from Lake Mead are projected at 84,000 acre-feet. Evaporation from Lake Mead is expected to be about 950,000 acre-feet and net gain between Glen Canyon Dam and Lake Mead is expected to be about 883,000 acre-feet.

## Water Quality Operations

Imperial Dam desilting works,



Water Quality study at Deer Creek Reservoir

Since water quality aspects of Colorado River operations are extensively described in the biennial series of reports entitled "Quality of Water, Colorado River Basin," only minimal discussion of this aspect of operation is presented in this report. Report No.10 of the biennial series is scheduled to be issued in January 1981.

During water year 1980, the United States bypassed a total of 185,021 acre-feet through the Bypass Drain. This bypass water was replaced with a like amount of other water, pursuant to Minute No. 242 of the International Boundary and Water Commission.

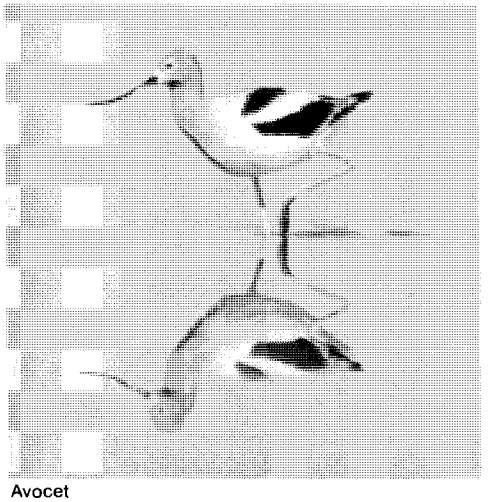
Under the provisions of Minute No. 242, the Republic of Mexico is entitled to receive at Morelos Dam water of a quality no worse than 115 parts per million (p/m) (± 30 p/m) greater than that arriving at Imperial Dam. However, due to the additional releases from Hoover, Davis, and Parker Dams and the flood control releases from Alamo Dam on the Bill Williams River and from Painted Rock Dam on the Gila River, the quality of water delivered above Morelos Dam during water year 1980 was better than that which occurred at Imperial Dam.

Due to the large amount of Colorado River infiltration to the Wellton-Mohawk Irrigation and Drainage District, it is expected that all drainage wells will be pumping at a maximum rate. As a result, the total flows in the Bypass Drain during water year 1981 are estimated to be 180,000 acre-feet. No bypass waters are expected to be returned to the Colorado River below Morelos Dam during water year 1981.

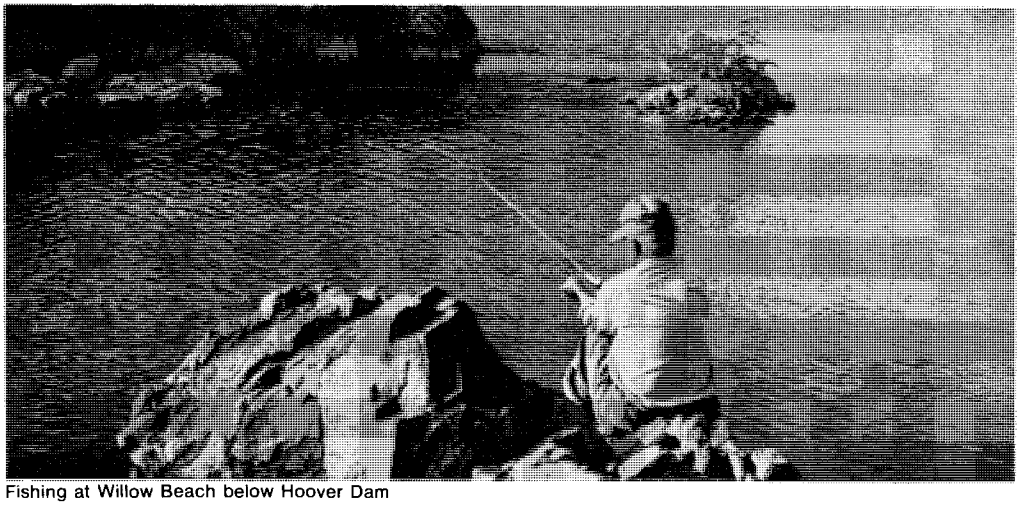
In recognizing the need to manage water quality of the Colorado River, it has been recommended that long term salinity increases in the river be controlled through a water quality improvement program generally described in the Water and Power Resources Service report, "Colorado River Water Quality Improvement Program," dated February 1972, and a status report of the same title dated January 1974.

The program calls for a Basin-wide approach to salinity control while the Upper Basin continues to develop its compact apportioned waters. The initial step towards improvement of the quality of the river's water was authorization by the Congress (Public Law 93-320) of the Colorado River Basin Salinity Control Project, June 24, 1974.

## Enhancement of Fish and Wildlife



Avocet



Fishing at Willow Beach below Hoover Dam

**Upper Basin**

To enhance fish habitat, the interim operating rules for Fontenelle Reservoir provide a continuous flow of at least 300 $ft^3/s$ in the channel immediately below Fontenelle Dam. During water year 1980, releases for power production and other purposes maintained flows of at least 400 $ft^3/s$.

The coordinated operation of Taylor Park Reservoir and the Wayne N. Aspinall Unit in delivering irrigation water to the Uncompahgre Project provided fishery and recreational opportunities. A minimum winter 1979-1980 release of 51 $ft^3/s$ from Taylor Park assured a suitable fish habitat in the reach between Taylor Park and Blue Mesa Reservoirs. Throughout the year, the flow below Gunnison Tunnel was at least 200 $ft^3/s$, the minimum necessary to maintain good fish habitat in the Gunnison River below Crystal Dam. Below Navajo Dam, a minimum flow of 300 $ft^3/s$ was maintained throughout the year for fish propagation.

Clear water and a minimum release of 1,000 $ft^3/s$ created a favorable habitat for species of fish introduced in the river below Glen Canyon Dam.

During water year 1980, studies were initiated to determine the impact of scheduling releases to meet power peaking demands should additional generating capacity be made available at Glen Canyon and Flaming Gorge Dams. These studies involved evaluating fish habitat and using computer modeling techniques to predict available fishery habitat under various flow regimes. Similarly, studies were undertaken on the San Juan River below Navajo Dam to accumulate comprehensive biological data necessary to assess the impact of various flow regimes in the event that a powerplant is constructed at Navajo Dam.

A 3-year study conducted by the Wyoming Department of Game and Fish and funded under Sec. 8 of the Colorado River Storage Act was completed. The study, undertaken to identify measures to improve trout productivity in the Green River below Fontenelle Dam, confirmed earlier opinions that trout production was being limited primarily by lack of cover in extensive rubbly glide-flat water areas. As a result, a new habitat improvement program is being initiated under the provisions of Sec. 8 in water year 1981.

Cooperative efforts between the Fish and Wildlife Service and Water and Power Resources Service to identify suitable habitat for the endangered Colorado River squawfish and humpback chub are continuing. Results of these studies, along with recommended flows to maintain habitat to conserve these endangered fish species in the Upper Colorado River System, are expected in 1981.

On February 27, 1980, an agreement was signed defining the course of action to be taken by the Water and Power Resources Service, the State of Utah, Utah Water Conservancy District, and other conservation agencies to mitigate adverse effects created by the Strawberry Aqueduct and Collection System on fisheries on the tributaries of the Duchesne River. The agreement provides for a minimum annual streamflow of 44,400 acre-feet, a significant increase from the 6,500 acre-feet previously mandated. According to the agreement the Central Utah Conservancy District will provide 15,800 acre-feet annually, while Water and Power Resources service, the State of Utah, and other involved agencies will secure an additional 22,100 acre-feet annually.

Lake Powell

Artist at Lake Powell

**Lower Basin**

During water year 1980, the Arizona Game and Fish Department (AGFD) and Nevada Department of Wildlife (NDW) completed the third year of the 5-year Lake Mead Black Bass Study. This year's spawning investigations, funded by the Upper and Lower Colorado Regions of Water and Power Resources Service, showed good nesting effort and success in the Upper Basin of Lake Mead. A total of 50 nests in two study coves were marked and monitored by AGFD biologists. Combined nesting success was 58 percent in these coves and two spawning peaks were observed in mid-March and late April. Spawning effort was not as great in the NDW coves in the Lower Basin of Lake Mead, but overall success was good. NDW marked and monitored 17 nests in two coves and showed a combined nesting success of 64.7 percent.

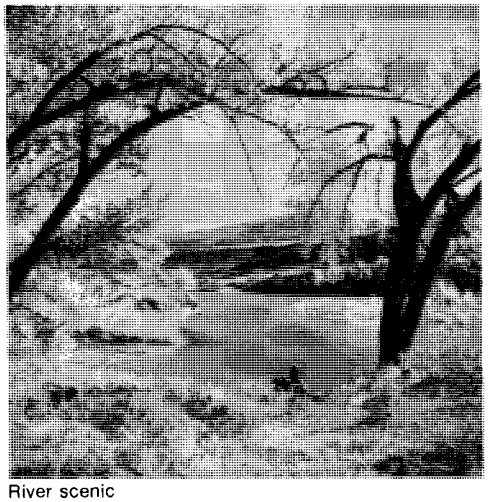
Investigations also continued on types and abundance of cover, selection of cover by young-of-year bass, food habits of fry and fingerling bass, and macroinvertebrate and plankton abundance and diversity. Findings to date suggest the fluctuating lake levels have not limited bass production during the 3 years of this study.

Results from the Creel census by NDW and AGFD show increased harvest of the striped bass. This has, in turn, favored a decrease harvest of largemouth bass which may help the overall largemouth fishery.

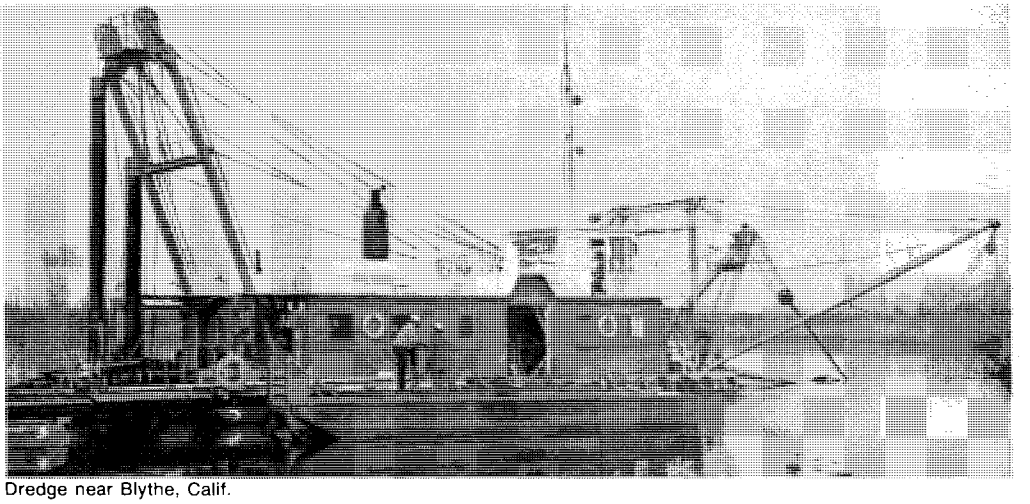
The remaining 2 years of this study will emphasize the largemouth bass spawning, food habits, and life history. The major objective of the study is to identify the factors contributing to the declining harvest of largemouth bass since 1959 and to recommend measures for restoring the fishery to its 1959 harvest level.

Water and Power biologists have actively participated in cooperative surveys of native fish in the Lower Basin. Attempts were made this past spring to capture brood stock of the endangered bonytail chub (*Gila elegans*) from Lake Mohave for propagation at the Willow Beach Hatchery. A total of five adults were taken, but all turned out to be females. These females are being held at the Willow Beach Hatchery. Water and Power has also been participating with the California Department of Fish and Game (CDFG), the Bureau of Land Management (BLM), and Fish and Wildlife Service (FWS), in a 1-year study on Senator Wash Reservoir to monitor movement patterns, population estimates and spawning behavior of the Razorback sucker (*Zyrauchen texanus*). Adults of this native sucker are relatively common in the lower Colorado River (primarily Lake Mohave and Senator Wash Reservoir), but evidence of recruitment in recent years is lacking. Water and Power is planning a 2½-year contracted study on razorback suckers and bonytail chubs in the Black Canyon area below Hoover Dam and Lake Mohave. This study will focus on the status, biology, and distribution of these native fishes in Lake Mohave. This information will be used to evaluate the impacts proposed Water and Power projects such as Hoover Modification, pump storage or Lake Mohave re-regulation might have on these fishes.

## Preservation of Environment



River scenic



Dredge near Blythe, Calif.

Dredging to renovate Beale Slough, a filled backwater area 7 miles south of Needles, California, was completed on January 30, 1980. Biologists and engineers of Water and Power, CDFG, FWS, and BLM hope to show that a suction hydraulic dredge can create and enhance fish and wildlife values at the slough. In addition, the project provides water conservation by removing phreatophytes. The project has created 33 surface acres of backwaters and an island in the slough.

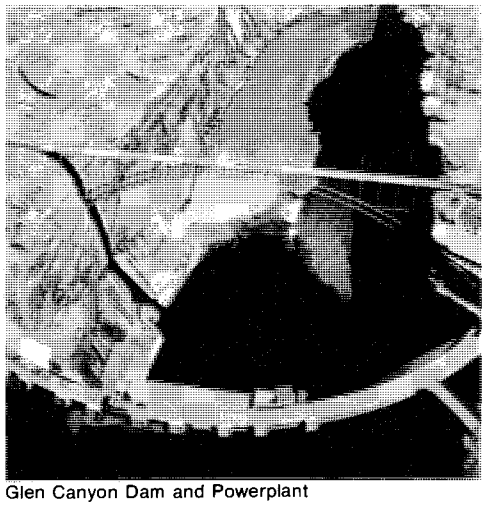
In addition, the dredge attempted to create coves of different bottom configurations to compare the relative habitat values of such configurations. Cottonwoods and willows will be planted on the island and adjacent dredge spoil areas over the next few years. CDFG biologists will evaluate the project's success in creating and enhancing fish and wildlife habitat.

Water and Power biologists will direct an intensive fishery inventory on selected sections of the unlined Coachella Canal to be completed in late October and early November of water year 1981. The inventory will gather data on species composition, relative abundance, standing crop, and age of fish in the canal. This study is one of the first of its kind in the southwest and should contribute much to understanding the value of canals as fishery habitat. The final results of this study will be published in late January 1981.

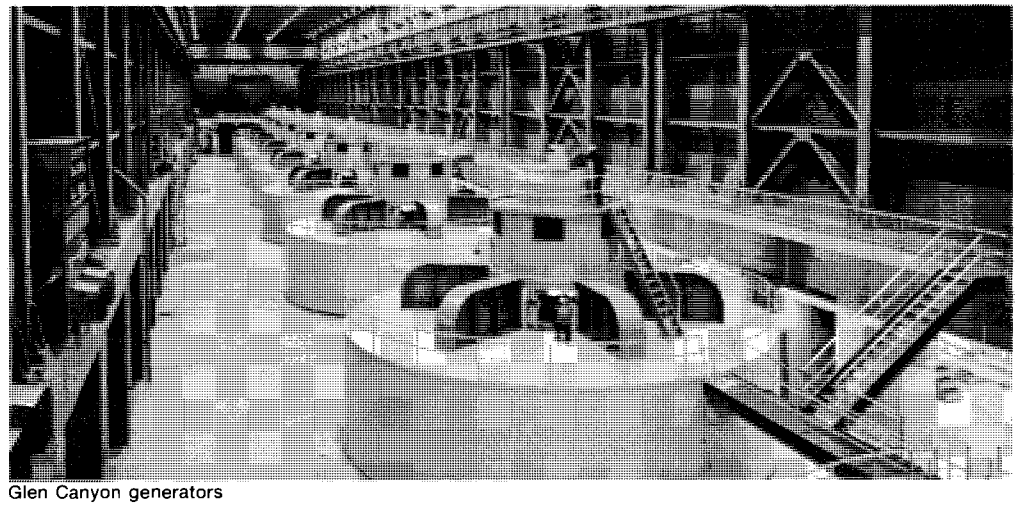
Water and Power will conduct a selective strip clearing project in the Cibola Division of the Lower Colorado River below Palo Verde, Calif. The proposed study area is a 6.5-mile fringe of riparian vegetation inside the flood control levees. A 2-year biological followup study will evaluate the effects of the clearing on wildlife. Hydraulic and engineering studies indicate that a major flood in this area could overtop the levees. Selective clearing of vegetation could decrease the chance of this happening. The study area includes an estimated 700 acres of vegetation; the proposed study would remove about 180 acres of this. Vegetation would be cleared in 50-, 75-, and 100-foot linear strips parallel to the Colorado River. If the followup study shows significant impacts to wildlife, mitigation will be developed. The project is being planned and coordinated with other State and Federal agencies.

Several deer drowned this past summer while trying to drink from the newly lined reach of the Coachella Canal. Ground and aerial observations revealed several deer in the pockets of vegetation on the east flank of the Algondones Dunes. These deer were probably traveling west to water at the canal. The newly lined portion of the Coachella Canal poses a problem to these deer and mitigation agreements have been made between Water and Power, the FWS, and CDFG to alleviate the problem. Water and Power and YACC personnel are patrolling the canal nightly to cut down on deer losses. Five earthen ponds and 11 metal stock tanks have been placed near the canal. In addition, a windmill and watering hole have been placed on the east side of the Algondones Dunes. Two more windmills have been planned for the near future.

## Power Operations



Glen Canyon Dam and Powerplant



Glen Canyon generators

**Upper Basin—Colorado River Storage Project (CRSP)**
The following table summarizes the CRSP generation, purchases, disposition, and revenue from power operations for fiscal year 1981.

The total revenue from power operations in fiscal year 1980 was $75,636,637. For fiscal year 1981, estimated revenues are $84 million.

**Water Year 1980**

**Sources of Energy**

| **Net Generation** | **kWh** |
|---|---|
| Flaming Gorge | 410,245,000 |
| Blue Mesa | 342,722,000 |
| Morrow Point | 447,295,000 |
| Fontenelle | 65,624,600 |
| Glen Canyon | 5,113,461,000 |
| Crystal | 209,371,000 |
| Subtotal-Net Generation | 6,588,718,600 |
| **Purchases (for)** | |
| Hoover Deficiencies | 104,000,000 |
| Parker Davis Firming | 0 |
| Rio Grande Firming | 0 |
| CRSP Firming | 0 |
| Fuel Replacement | 554,107,000 |
| Subtotal Purchases | 658,107,000 |
| Transmission for others | 224,371,131 |
| Power Deliveries from others (Interchange) | 1,736,188,221 |
| Total Energy Receipts | 9,207,384,952 |

**Disposition of Energy**

| | |
|---|---|
| Firm Energy Sales | 5,992,745,148 |
| Non-Firm Energy Sales | 1,079,705,121 |
| Delivery to Hoover allottees | 104,000,000 |
| Power Delivered to other (Interchange) | 1,434,666,912 |
| System Losses | 596,267,771 |
| | 9,207,384,952 |

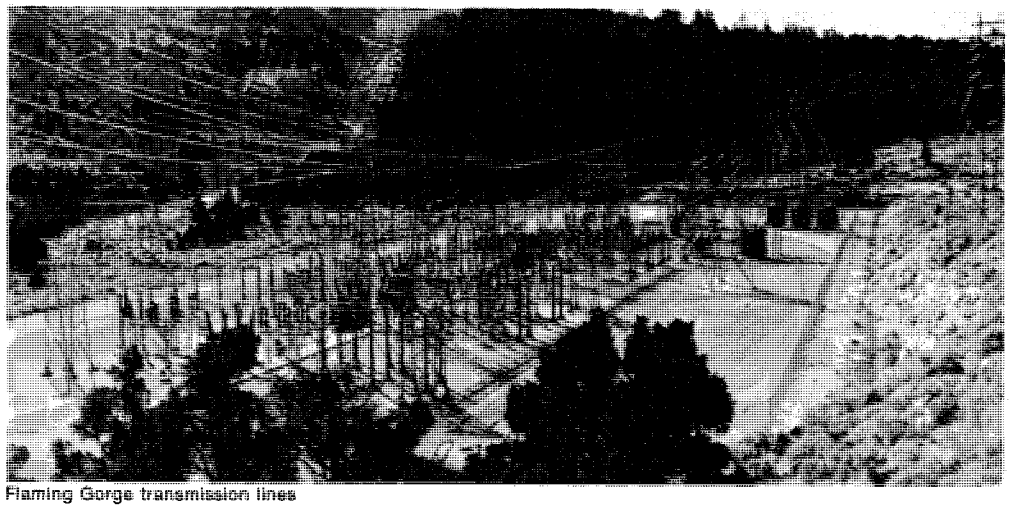
**Revenue**

| | |
|---|---|
| Firm Energy Sales | $42,012,565 |
| Nonfirm Energy Sales (Oil Conservation) | 28,761,335 |
| Hoover Deficiencies reimbursement | 500,000 |
| Parker Davis Firming | 0 |
| Wheeling for others | 3,358,499 |
| Miscellaneous Income | 1,004,238 |
| Total Revenue | $75,636,637 |

**Water Year 1981**

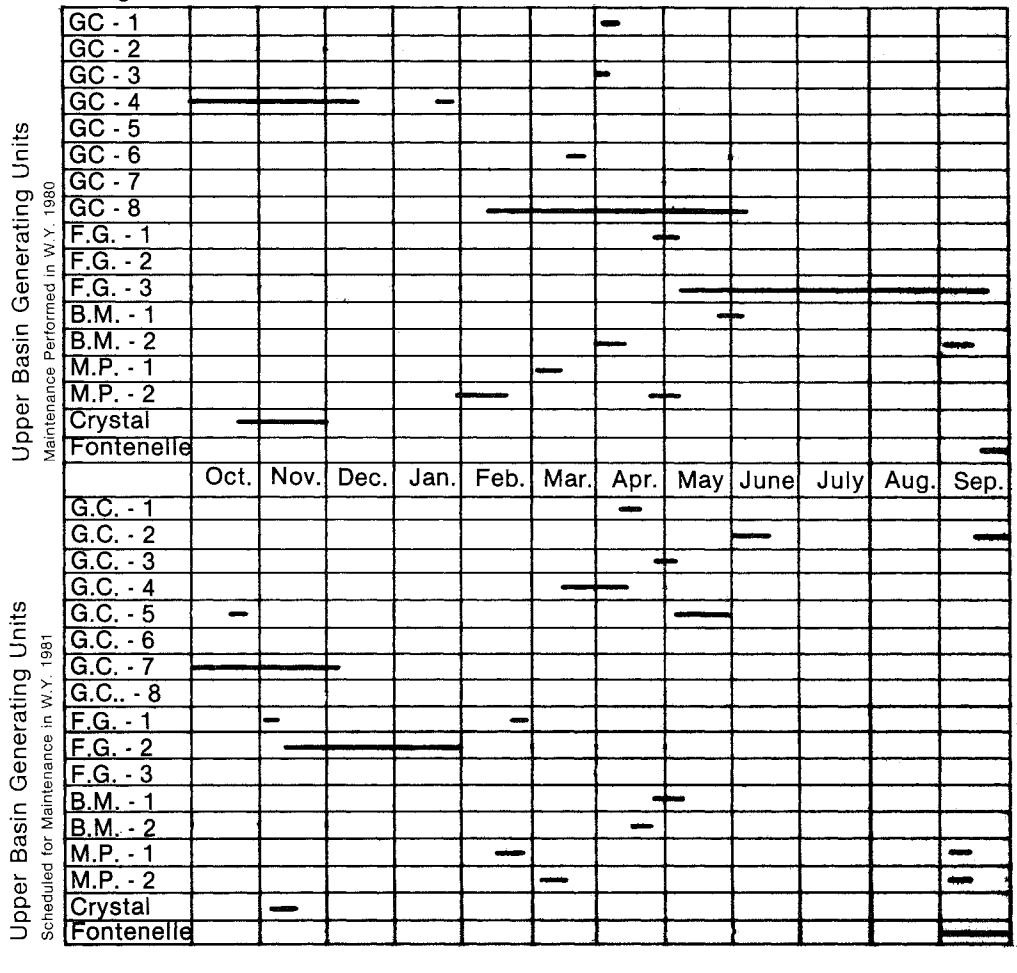
| | **Kilowatt-hours** |
|---|---|
| Estimated Energy Sales | 6,655,000,000 |
| Estimated Purchases | 1,938,000,000 |
| Estimated Peaking Capacity Sales (kW) | |
| Winter 80-81 | 243,000 |
| Summer - 81 | 82,000 |
| Estimated Revenue | $84,000,000 |

Refinery needs 1½ millions gallons of water per day

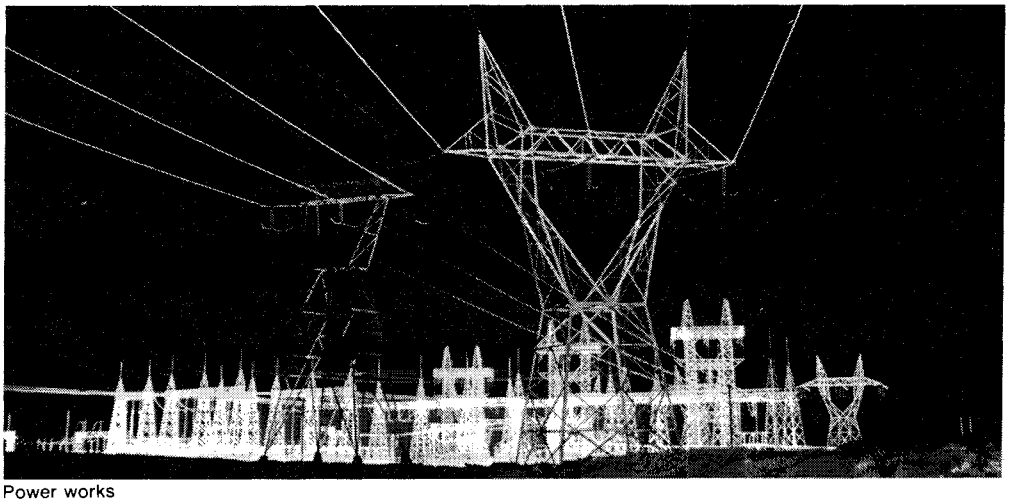


Flaming Gorge transmission lines

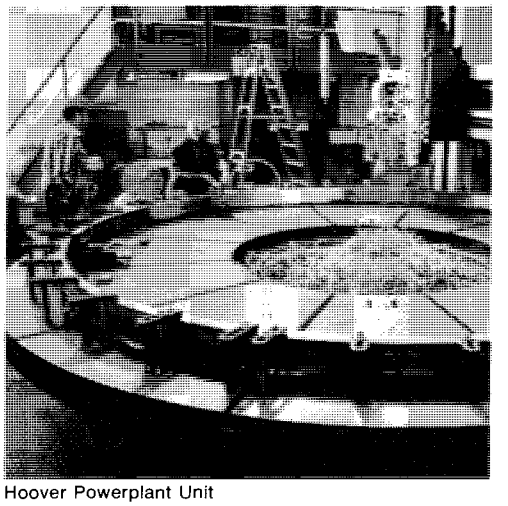
**Generating Unit Maintenance**



## Power Operations



Power works



Hoover Powerplant Unit

**Lower Basin**
**Water Year 1980**
As discussed in the section on additional releases, on June 13, 1979, the Secretary of the Interior declared that extra water would be released from Hoover Dam sufficient to generate contract-defined firm energy during the year of operation ending May 31, 1980.

The total energy delivery to the Hoover allottees during the 1980 operating year was 4,228,291,849 kilowatt-hours (kWh). Of this total delivery, firm energy amounted to 3,962,080,000 kWh, deferred replacement energy amounted to 100,000,000 kWh, and the balance was disputed and secondary energy. Due to the June 22, 1980, termination of filling criteria for Lake Powell, replacement energy will no longer be available to the Lower Basin.

All scheduled periodic maintenance at Hoover, Parker, and Davis Powerplants was performed in water year 1980. The program for installation of high pressure thrust bearing lubrication was completed for all generating units at Hoover with the completion of unit N5. New stainless steel runners are scheduled to be installed in Hoover units A4 and A7 in water year 1981. These runners will improve the efficiency of the unit and replace the existing worn runners.

The lower Nevada penstock at Hoover was out of service for a 3-week period during water year 1980 and the lower Arizona penstock was out of service for 3 weeks after the lower Nevada penstock was again in service. Both of these measures were for the purpose of inspection and repair of the penstock linings.

The control wiring for two of the generating units at Davis Dam was replaced for automation in water year 1980 so that these units could be controlled from the Department of Energy's Phoenix Dispatch Center. This brings to a total of three units which have been automated at the Davis Powerplant. The remaining two units at Davis will be automated in water year 1981.

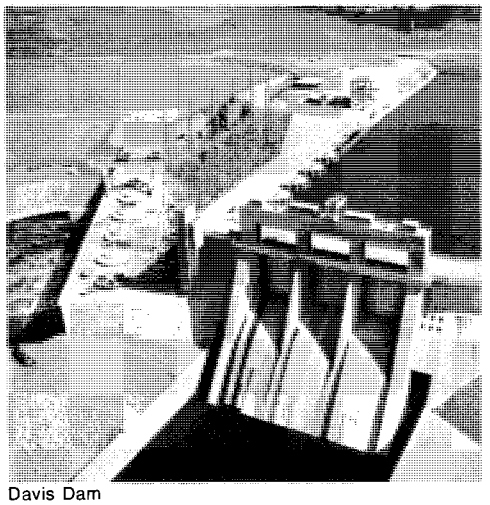
Phase 02 switchyard construction was finished at Davis in water year 1980. This construction consisted of new electrical bus work and replacement of existing power circuit breakers. Phase 02 increased the electrical capabilities at Davis to handle the future electrical load needed for the new Central Arizona pumping plants.

During water year 1980 the Parker Dam Powerplant was modified for remote automatic control for the four 30-megawatt units. An inspection and preventative maintenance program was carried out during the time each of the units was out of service for the installation of the remote control equipment.

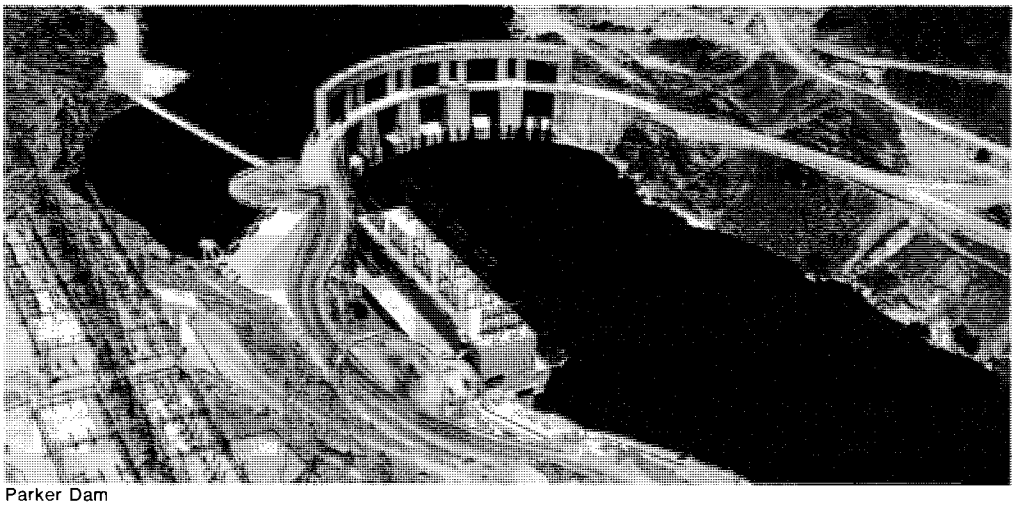
**Water Year 1981**
In operation studies of Lake Mead and Lake Powell for the Hoover operating year which ends May 31, 1981, the releases at Hoover Dam have been estimated to exceed minimum downstream requirements, including diversions by The Metropolitan Water District, while complying with the overall requirement to meet Compact and operating criteria release provisions. The excess water will generate 100 percent of the defined firm energy. The estimated monthly Hoover releases during the operating year total 11.2 million acre-feet. It is estimated that generation from these Hoover releases, along with the Hoover to Parker-Davis interchange, will result in delivery to the allottees of about 5,232,200,000 kWh of electrical energy.

Deficiency power purchases have not been budgeted for operating year 1981.

The following charts illustrate Lower Basin generator unit outage schedules for water year 1980 and water year 1981.



Davis Dam



Parker Dam

## Generating Unit Maintenance