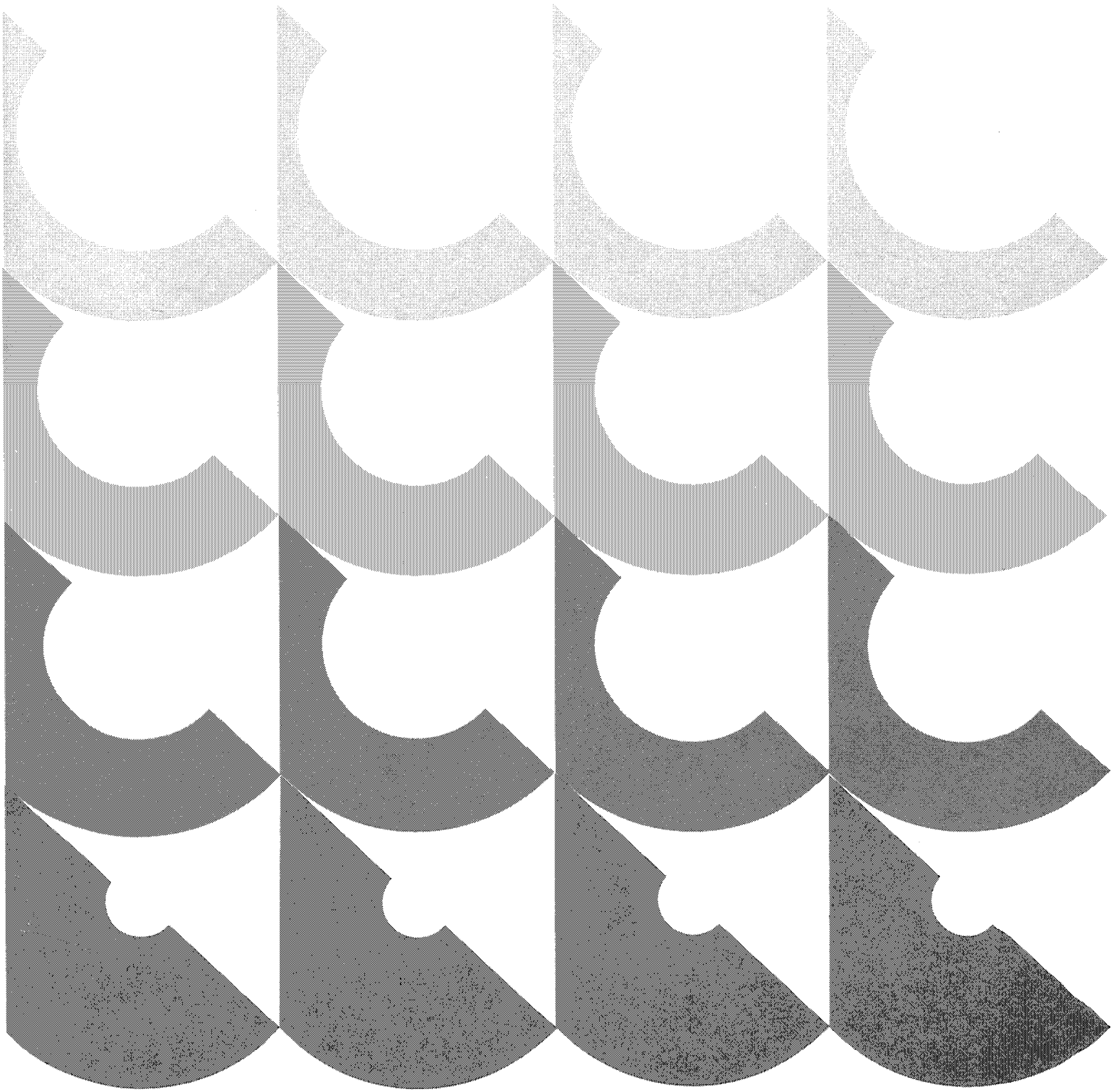
Annual Report

# Operation of the Colorado River Basin 1979 Projected Operations 1980



## Colorado River Basin


0 50 100 150

Scale of Miles

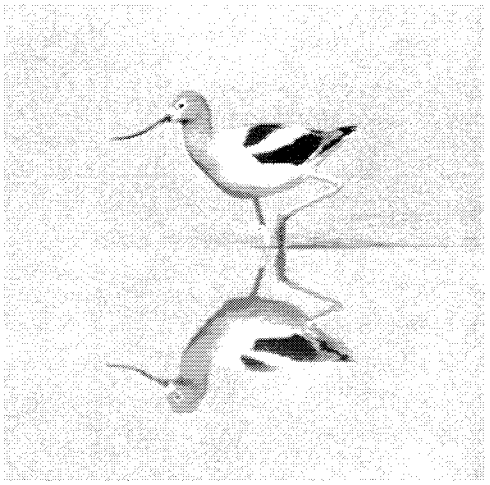
## Contents

U.S. Department of the Interior
Cecil D. Andrus, Secretary

Water and Power Resources Service
(Formerly the Bureau of Reclamation)
R. Keith Higginson, Commissioner

January 1980
(Prepared pursuant to the Colorado River Basin Project Act of 1968, Public Law 90-537)

Morrow Point Dam, Colo.



Avocet

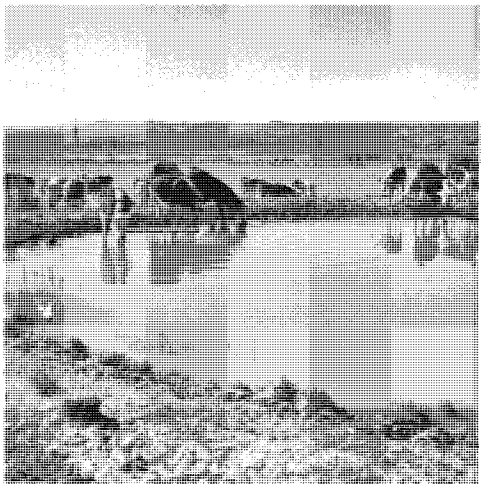
## Introduction

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, water quality control, fish and wildlife propagation, recreation, flood control, and Colorado River Compact requirements.

Storage and release of water from the Upper Basin reservoirs recognize all applicable laws and relevant factors governing the Colorado River, including the impoundment and release of water in the Upper Basin required by section 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).

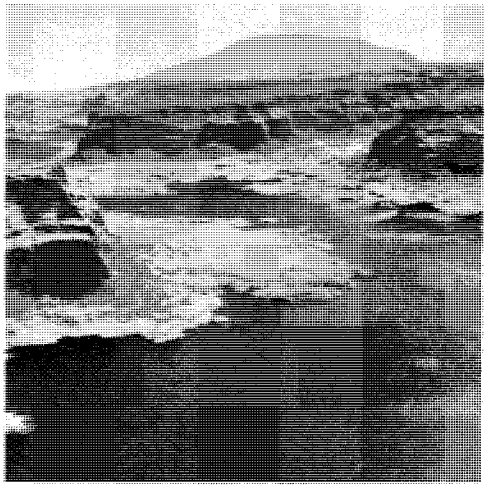
## Authority for Report



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 ninth 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 1979 and the projected operation of these reservoirs during water year 1980 under the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs," published in the Federal Register June 10, 1970.

Cecil D. Andrus, Secretary
U.S. Department of the Interior

## Actual Operations under Criteria-Water Year 1979



Lake Powell, Ariz.

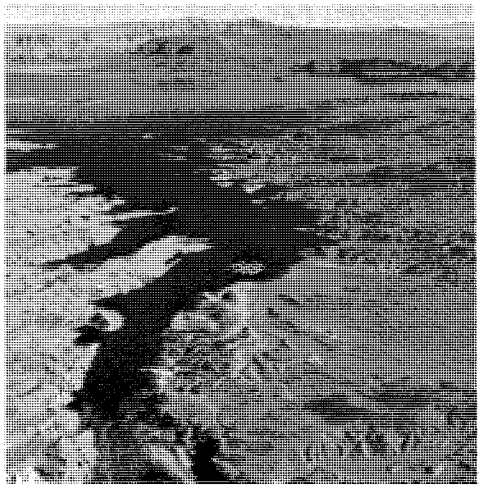
Water supply in the Colorado River Basin during 1979 was about 124 percent of average, ranging from 70 percent for the Green River at Flaming Gorge Dam to 177 percent for the San Juan River at Navajo Dam.

Since the active content of Lake Powell was less than the active content of Lake Mead, 8,222,000 acre-feet were released from Lake Powell. Releases from the other reservoirs through September 1979 were made accordingly to meet the power productions and other multiple-purpose requirements of the system. At the beginning of January and each month thereafter through June, the forecast was revised based on precipitation and snow data collected through the month, and the scheduled operation was revised accordingly.

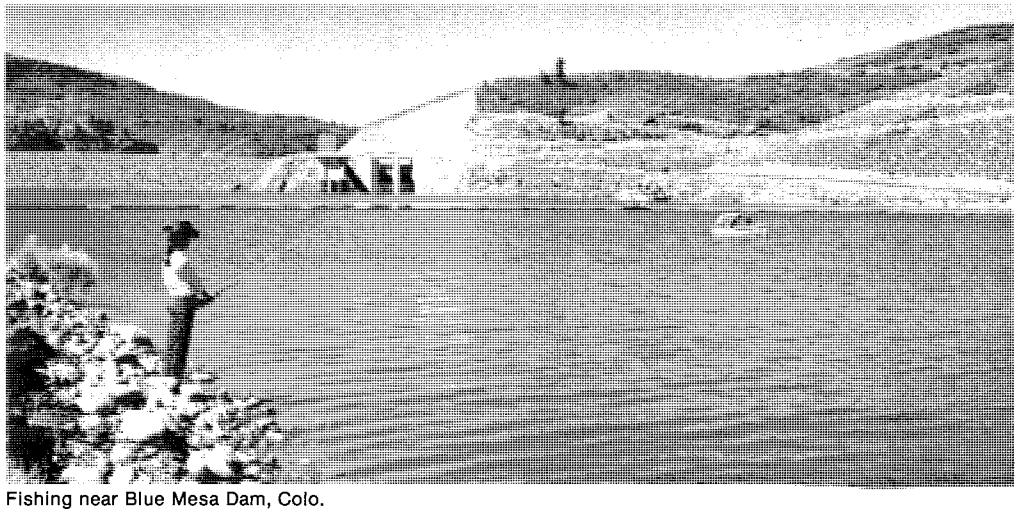
The major storage reservoirs in the Colorado River Basin stayed within the normal operating range during water year 1979. Aggregate storage at the end of water year 1979 was 50,939,000 acre-feet which represented an increase of 6,076,000 acre-feet from water year 1978.

A description of the operations of each of the reservoirs in the Colorado River Basin follows. Charts 1-8 show the monthly outflow from the reservoirs, water surface elevations, and active storage in the reservoirs for water year 1979.

## Projected Plan of Operation under Criteria - Water Year 1980



Las Vegas Bay, Lake Mead, Nev.



Fishing near Blue Mesa Dam, Colo.

**Determination of "602(a) Storage"**
Section 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: (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 section 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, 1980, 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.

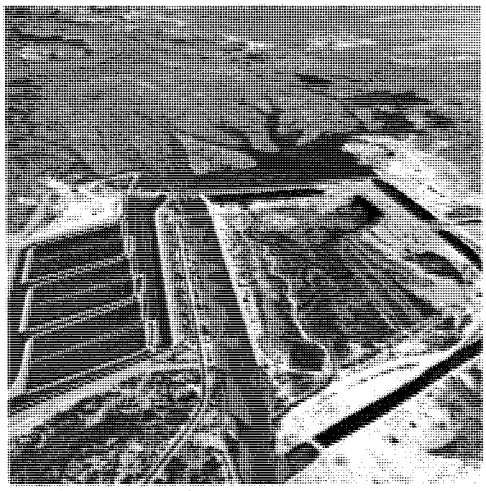
**Mexican Treaty Obligations**
Annual calendar year schedules of monthly deliveries of water in the limitrophe section of the Colorado River, allotted in accordance with the Mexican Water Treaty signed in 1944, are formulated by the Mexican Section and presented to the United States Section, International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

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 1979, Mexico received a total delivery of 2,766,278 acre-feet at the Northern International Boundary. This larger-than-usual amount was due to the additional 688,500 acre-foot release from the Lower Basin reservoirs and to flood control releases from Painted Rock Dam on the Gila River.

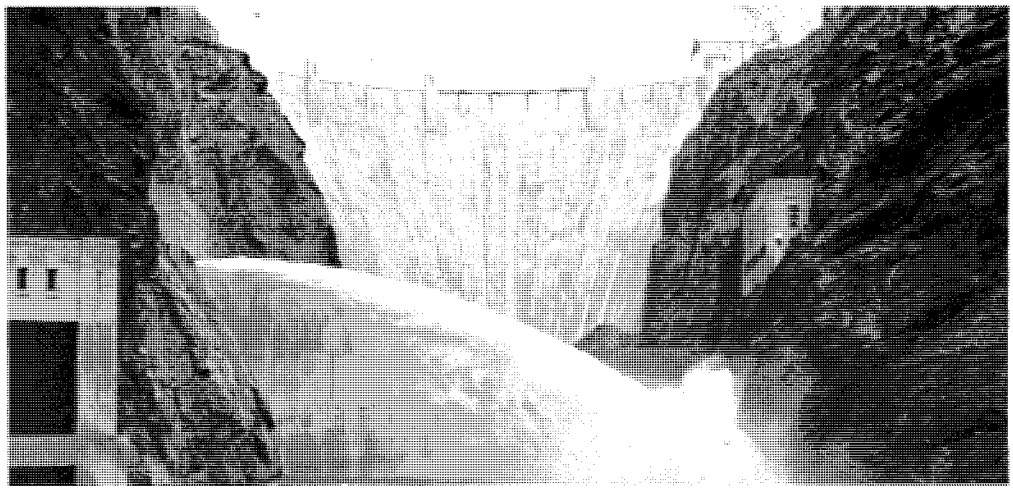
The United States will make scheduled deliveries of 1,700,000 acre-feet of Colorado River water to the Republic of Mexico in water year 1980. This includes an additional 200,000 acre-feet of water surplus to United States uses, pursuant to the Mexican Water Treaty of 1944.

The additional water release is based in part on average runoff conditions assumed for the Colorado River Basin during water year 1980. Should runoff during that time be above average, substantially larger releases for flood control purposes could be required from Hoover Dam. Representatives of the Republic of Mexico will be kept informed of operating schedules through the United States Section of the Commission.

## Additional Releases



Imperial Dam, Ariz.-Calif.



Hoover Dam, penstock flushing, Nev.-Ariz.

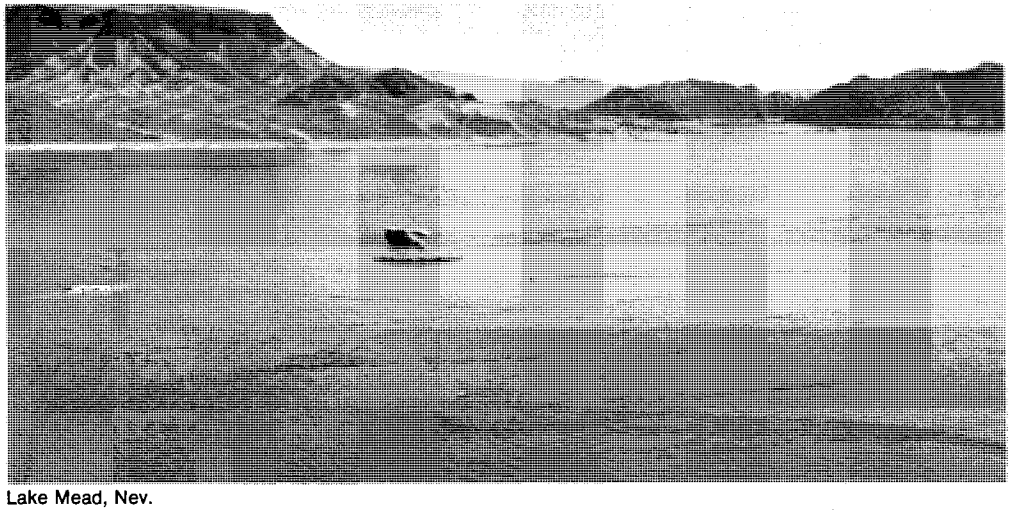
**Regulatory Wastes**
Deliveries to Mexico consist of river water delivered to Imperial Dam and waste and drainage return flows from water users below Imperial Dam. In addition to assuring normal water deliveries the small amount of regulatory storage space in Imperial, Laguna, and Senator Wash Reservoirs was used at times to limit potential downstream flood damages during water year 1979.

A regulatory waste of 30,000 acre-feet has been projected as being lost from the lower Colorado River for water year 1980 pursuant to Minute 242.

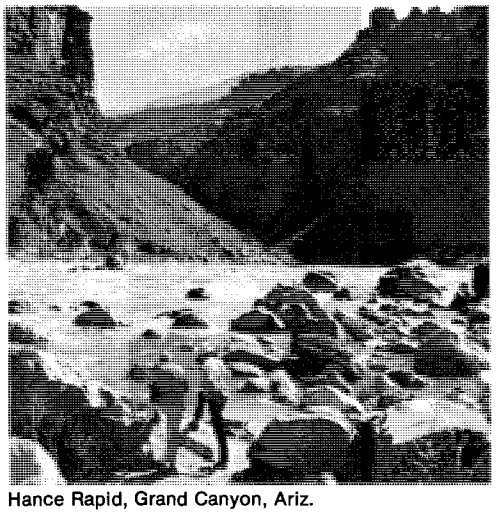
**Water Year 1979**
At the integration meeting in Boulder City, Nev., on June 14, 1978, the Representative of the Secretary of the Interior declared that Lower Colorado River releases would be made to meet only minimum downstream water requirements for the operating year ending May 31, 1979. Operation of Lower Colorado River dams was consistent with this policy through April 1979. During the winter months, however, precipitation in the Upper Basin resulted in much higher than average runoff flowing into 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 and this indirectly required more water to be stored behind Hoover Dam. On April 27, 1979, the Secretary of the Interior approved the scheduled release of about 700,000 acre-feet of excess water from Hoover Dam to reduce the probability and magnitude of mandatory flood releases in 1979 or 1980.

The Secretarial decision to release additional water from Lake Mead during 1979 stipulated that the extra releases be accounted for as if still stored in Lake Mead. Therefore, a water accounting procedure was developed to reflect the reservoir storage level that would have existed without the additional releases. On September 30, 1979, the actual elevation of Lake Mead was 1195.30 feet (22,242,000 acre-feet). Had the additional 688,500 acre-feet not been released, Lake Mead's September 30, 1979, elevation would have been, allowing for additional losses to evaporation and bank storage, approximately 1199.78 feet (22,884,000 acre-feet).

## Projected Plan of Operation—Water Year 1980



Lake Mead, Nev.



Hance Rapid, Grand Canyon, Ariz.

**Water Year 1980**

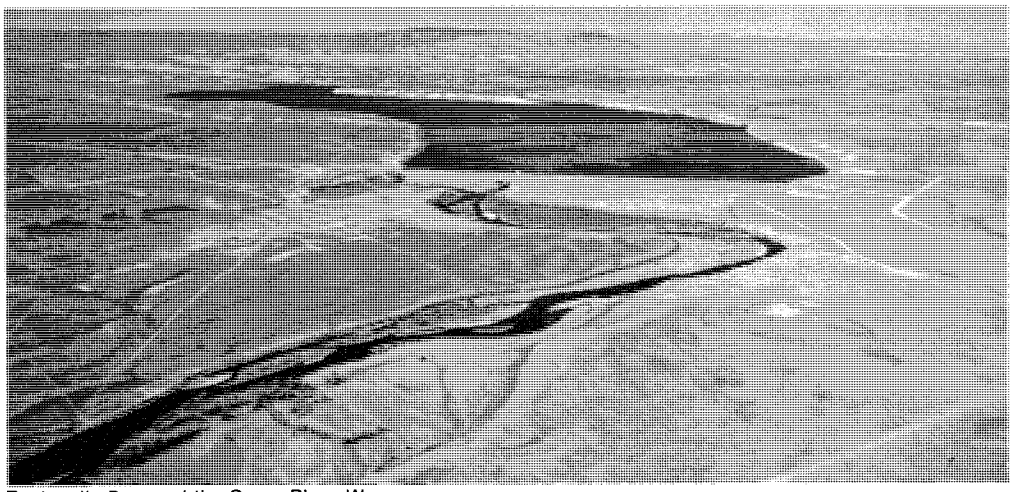
On August 21, 1979, the Colorado River Basin States and other interested parties met in Salt Lake City, Utah, to consult regarding the best operational plan for releases from Lake Mead during water year 1980. Due to the high probability of flood control releases being required during 1980 or 1981, there was general concurrence to continue with the plan to release about 700,000 acre-feet of water from Lake Mead in excess of downstream requirements. This operating plan is consistent with the declaration made by the representative of the Secretary of the Interior at the integration meeting held June 13, 1979, in Boulder City, Nev. to release water from Hoover Dam sufficient to generate contract defined firm energy during operating year 1980. In connection with the "Filling Criteria" and equalization of storage, these releases will be accounted as stored in Lake Mead, consistent with the treatment of the excess releases during water year 1979. The projected water year 1980 operation study of the system indicates that if the additional 700,000 acre-foot releases were not made, flood control releases would be required from Lake Mead during water year 1980.

On September 30, 1979, storage in Lake Powell was only 606,000 acre-feet less than the storage in Lake Mead. Projected operation with normal inflow and minimum release from Lake Powell would cause an imbalance of storage in favor of Lake Powell. Therefore, the plan of operation must incorporate the equalization of storage concept. Since releases from Hoover in addition to downstream requirements were made during water year 1979 and a similar plan is made for water year 1980, the Secretary determined for "Operating Criteria" purposes that Lake Powell shall be operated as if those additional releases were to remain in Lake Mead. Consequently, the Glen Canyon release will be determined by equalizing storage in Lake Powell and Lake Mead as if the additional water released had remained in Lake Mead.

For average runoff conditions during water year 1980, the projected operation of each of the reservoirs in the Colorado River Basin is described in the following pages. Charts 1 through 8 show the projected monthly outflow from the reservoirs and the projected end-of-month elevation and active storage in the reservoirs for average and three other assumptions of 1980 modified runoff from the Basin. The four assumptions are: (1) Average based on the 1906-78 record of runoff; (2) Upper Quartile based on the level of annual streamflow which has been exceeded 25 percent of the time during 1906-78; (3) Lower Quartile based on flows exceeded 75 percent of the time during 1906-78; and (4) Most Adverse based on the lowest year of record, which was 1977.

The projected operations of Lake Mead, Lake Mohave, and Lake Havasu are the same under all of the runoff assumptions, except for Lake Mead flood control releases under Upper Quartile conditions.

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



Fontenelle Dam and the Green River, Wyo.

**Water Year 1979**
Fontenelle Reservoir is operated for power generation, water supply, flood control, fish and wildlife enhancement and recreation. During the fall and winter of 1978-79 the water surface was gradually reduced from elevation 6503 feet at the beginning of the water year to a low elevation of 6485 in April prior to the spring runoff. The minimum release during the fall and winter was 600 cubic feet per second ($ft^3/s$). The maximum inflow of 8,000 $ft^3/s$ occurred on the 30th of May. The maximum release was 4,750 $ft^3/s$. The maximum elevation of 6501 feet was five feet below capacity. The minimum possible power generating release through the powerplant is 500 $ft^3/s$. The maximum release through the powerplant is 1750 $ft^3/s$ at rated head.

**Water Year 1980**
At the beginning of water year 1980 the elevation of Fontenelle Reservoir was 6499 with a content of 290,000 acre-feet. The release, having been 800 $ft^3/s$, will be adjusted, depending upon inflow, to draw down the reservoir to elevation 6478. This elevation is 7 feet lower than the usual draw-down which is made to facilitate maintenance in the spring.

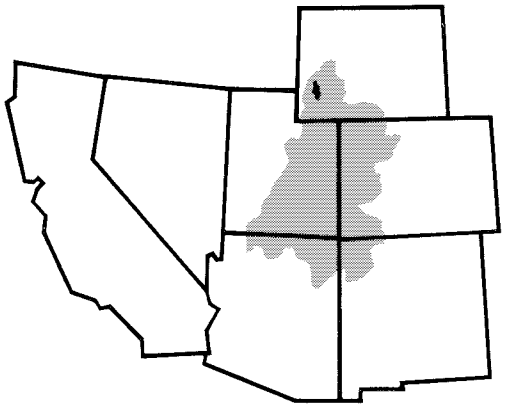
The reservoir will fill in June 1980 unless the inflow is less than average. After the spring runoff, the reservoir level will be controlled by adjusting the releases through the powerplant to reduce slowly the elevation to 6504 feet by the end of the summer of 1980.

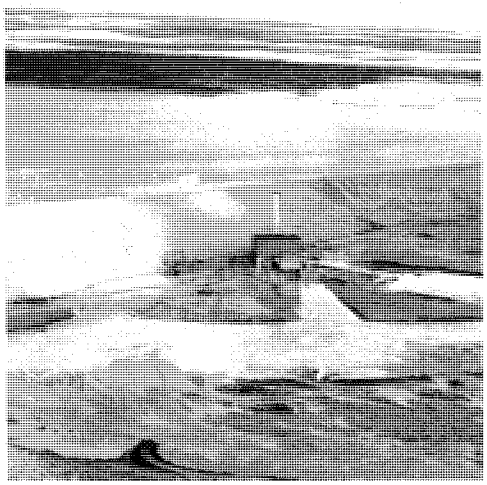
The maximum release will depend mostly on the magnitude of the inflow but also on the forecast error. The maximum release will probably be less than 15,000 $ft^3/s$ unless the inflow is larger than has historically been experienced. If the inflow is in the upper quartile amount, the peak outflow will probably be less than 10,000 $ft^3/s$. If the inflow is average, the peak outflow will probably be less than 7,000 $ft^3/s$. If the inflow is at about the lower quartile, the peak outflow will probably be less than 3,000 $ft^3/s$.

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

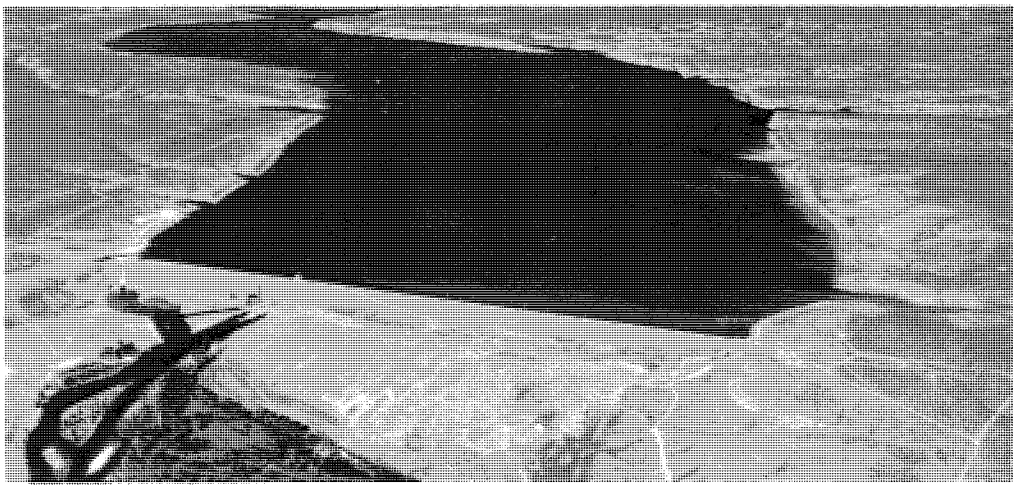
| Reservoir | (Acre-Feet) | El.(Ft.) |
|---|---|---|
| Maximum Storage | 344,834 | 6506 |
| Rated Head | 233,789 | 6491 |
| Minimum Power | 194,962 | 6485 |
| Surface Area (Full) | 8058 Acres | |
| Reservoir Length (Full) | 18 Miles | |
| Power Plant | | |
| Number of Units | 1 | |
| Total Capacity |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

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





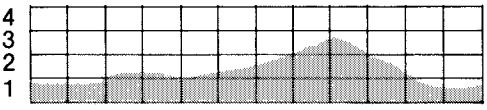
Fontenelle Powerplant, Wyo.



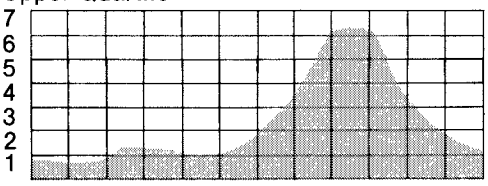
Fontenelle Dam and Reservoir, Wyo.

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

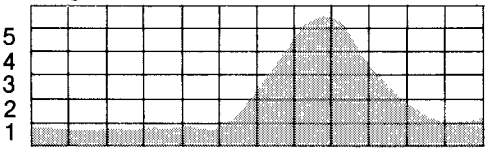
Actual Operation 1979



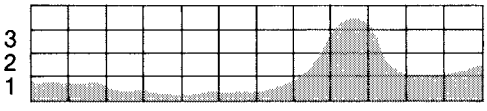

Projected Operation 1980
Upper Quartile



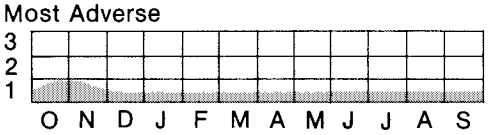

Average




Lower Quartile

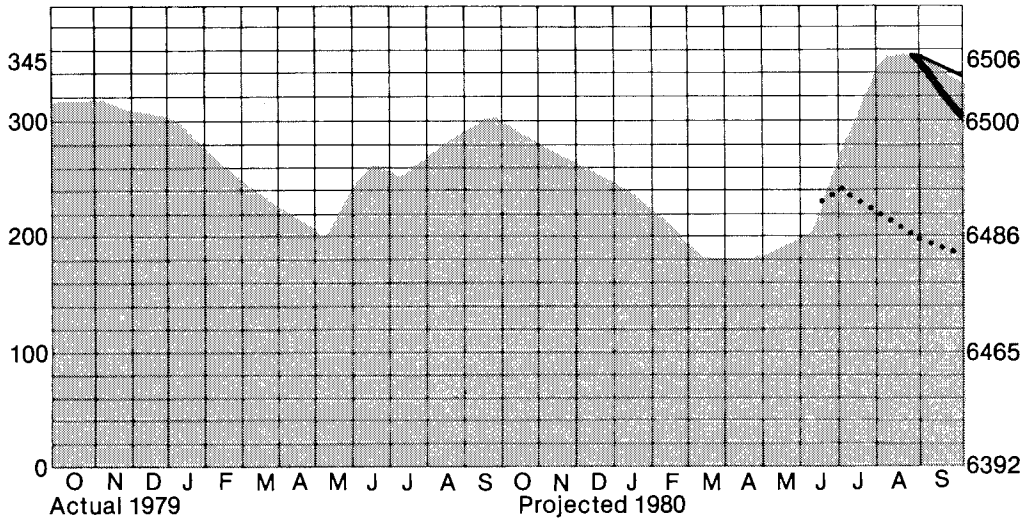



Most Adverse




**Storage**

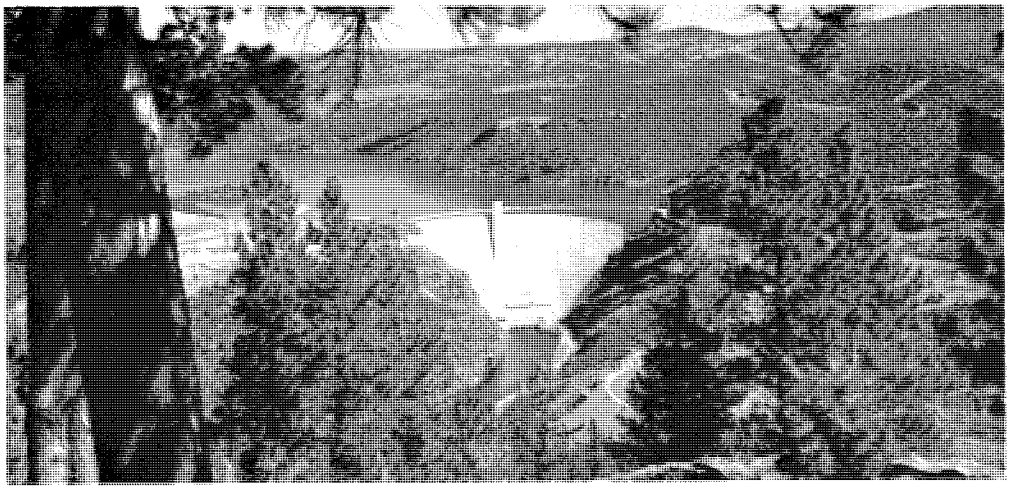
Usable Content in 1000 Acre-Feet — Elevation (Feet) Non-linear Scale



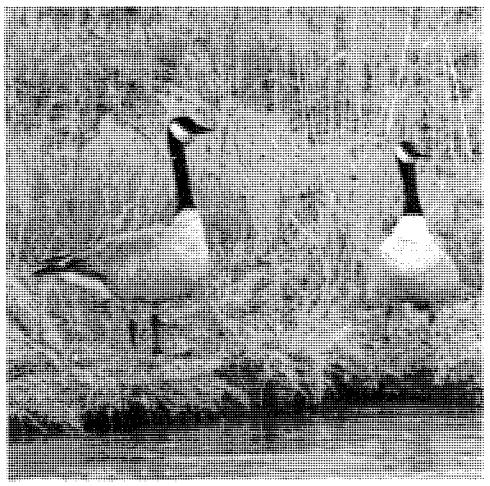

**Legend**

Most Probable
Upper Quartile
Lower Quartile
Most Adverse

## Flaming Gorge Reservoir (Green River)



Flaming Gorge Dam, Utah-Wyo.



Canadian Geese

**Water Year 1979**
At the beginning of water year 1979, the reservoir water surface was at elevation 6015 feet with a content of 2,825,000 acre-feet. The April through July 1979 runoff above Flaming Gorge was 777,000 acre-feet which is 68 percent of the long-time average. With this runoff, the reservoir reached its seasonal maximum elevation of 6015 feet the last of June 1979 with a content of 2,715,000 acre-feet. By the end of September, the elevation was 6008 feet with a content of 2,571,000 acre-feet.

The normal minimum release is 800 $ft^3/s$. The maximum release through the powerplant is 4600 $ft^3/s$ at rated head.

**Water Year 1980**
At the beginning of water year 1980, the active storage at Flaming Gorge was 2,571,000 acre-feet with the water surface elevation at 6008 feet. The reservoir level will be drawn down to about 5999 feet before the spring of 1980 and should remain high enough so boats can be launched from the nine boat ramps. Average inflow would cause the reservoir to reach elevation 6015 feet with an active storage of 2,800,000 acre-feet during July. Under average conditions, summertime flow in the river below the dam is not expected to exceed 4600 $ft^3/s$, or fall below 800 $ft^3/s$.

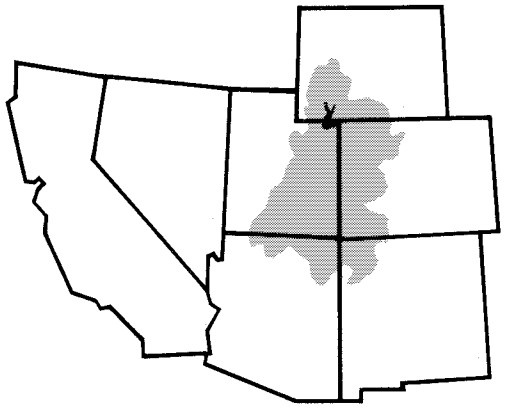
Since there is enough space to store a high inflow and enough water in storage in case of low inflow, the release from Flaming Gorge Reservoir is not dependent upon the inflow for water year 1980.

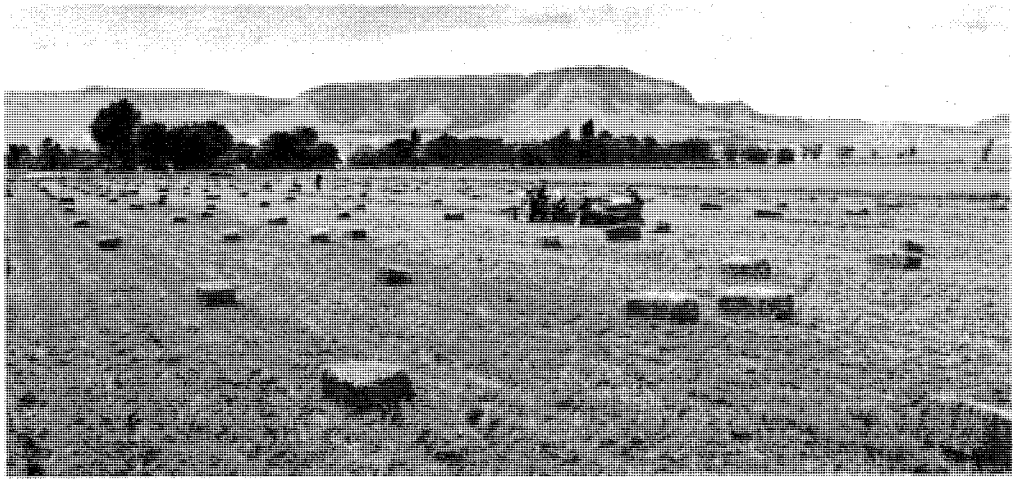
The release is dependent upon the demand for electric power and the availability of energy for purchase and exchange. In projecting the 1980 operation, it has been assumed, based on past experience, that if the inflow is high there would be more low-cost energy available to purchase; therefore, the release would be less. Also, if the inflow is low, there would be less energy available and the release would be increased to produce the required energy.

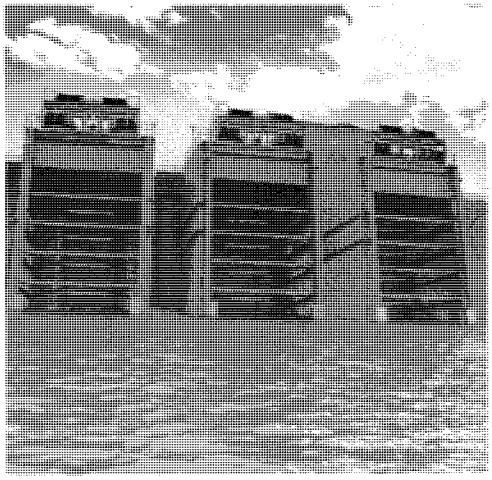
**Flaming Gorge** Active Storage* **Chart 2**

| 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



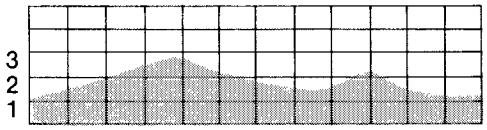




Flaming Gorge Selective Withdrawal Structures, Utah-Wyo.

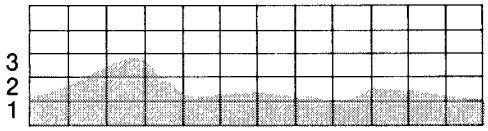
**Outflow** Release in 1000 Cubic Feet/Second

Actual 1979

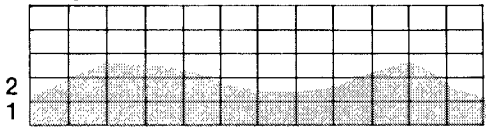



Projected Operation 1980

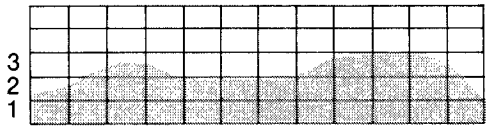
Upper Quartile



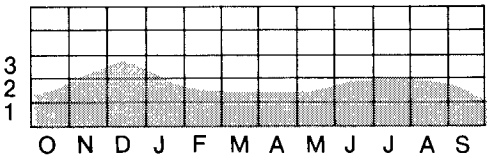

Average




Lower Quartile



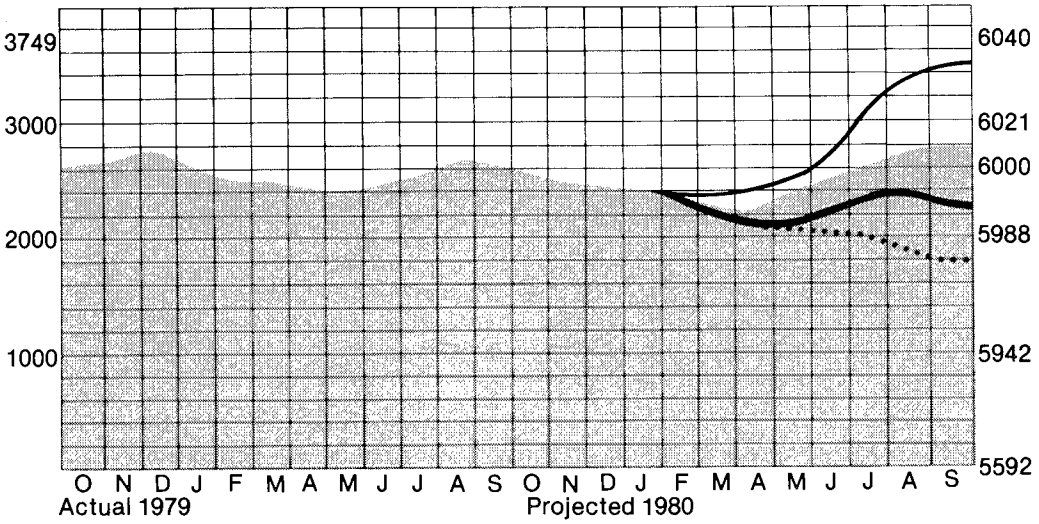

Most Adverse




**Storage**

Usable Content in 1000 Acre-Feet

Elevation in Feet (Non-Linear Scale)




**Legend**

Most Probable

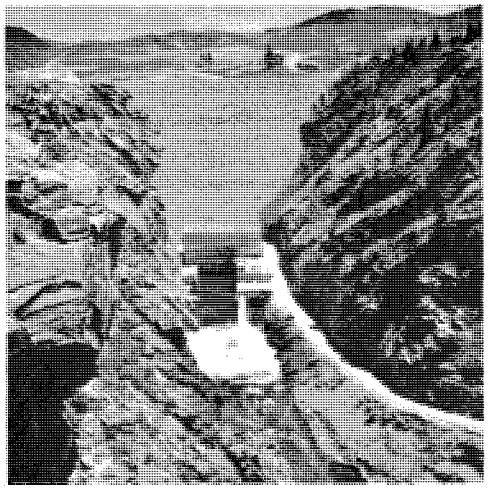
Upper Quartile

Lower Quartile

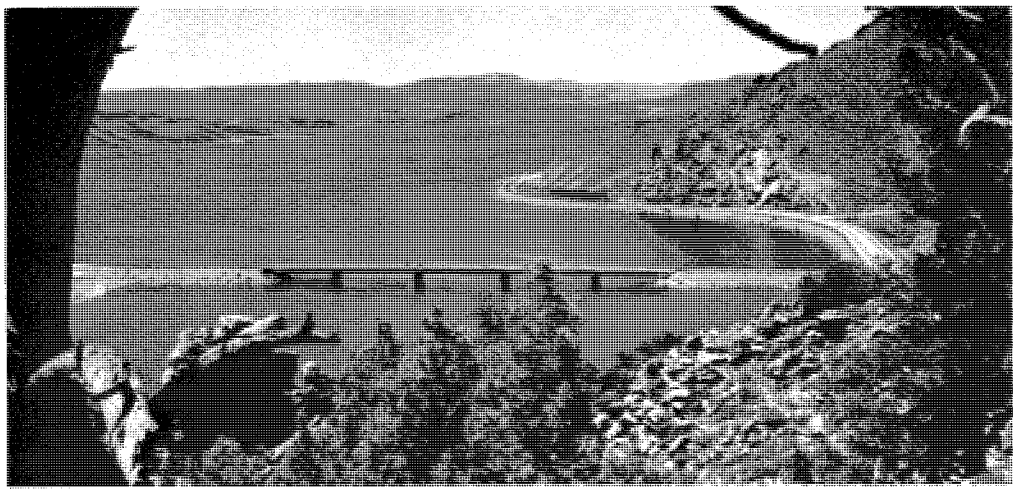
Most Adverse

## Curecanti Unit (Gunnison River)

**Blue Mesa Reservoir**
**Morrow Point Reservoir**
**Crystal Reservoir**



Blue Mesa Dam and Powerplant, Colo.



Blue Mesa Reservoir - Colorado 149 Bridge, Colo.

**Water Year 1979**
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 1978, Blue Mesa Reservoir contained 728,000 acre-feet of active storage with a water surface elevation of 7508 feet. The April through July 1979 inflow to Blue Mesa was 935,000 acre-feet, which was 119 percent of normal. The 1979 water year total was 1,146,000 acre-feet. The water surface of Blue Mesa was raised to within one-half foot of capacity. This was done to prevent a spill from occurring.

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

During water year 1979, 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 1980**
During the current year, water level in Blue Mesa should reach a low elevation of 7468 feet in April 1980; at that elevation the active storage would be about 424,000 acre-feet. With average inflow during the spring of 1980, the reservoir should reach elevation 7514 with an active storage of 780,000 acre-feet. At that elevation the reservoir has a surface area of 8,884 acres.

Morrow Point Reservoir will be operated during the current year at or near its maximum storage capacity. Crystal Reservoir will be operated nearly full except for daily fluctuations as required to regulate 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 will probably average 2800 $ft^3/s$ for several weeks in June and July 1980. The powerplant capacity is 3000 $ft^3/s$. For the average lower quartile and most adverse inflows, the highest monthly release is projected to be about 1400 $ft^3/s$ in July 1980.

**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*

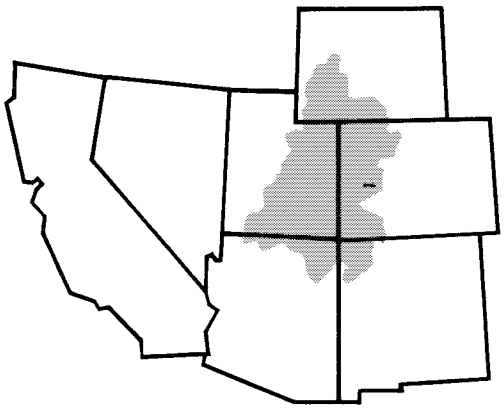
| | | |
|---|---|---|
| Maximum Storage | 117,025 | 7160 |
| Rated Head | 79,805 | 7108 |
| Minimum Power | 74,905 | 7100 |
| Surface Area (Full) | 817 Acres | |
| Reservoir Length (Full) | 11 Miles | |
| Power Plant Number of Units | 2 | |
| Total Capacity | 120,000 Kilowatts | |

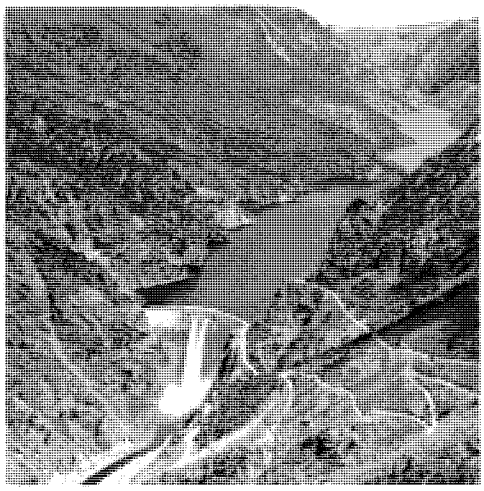
*does not include 165 acre-feet of dead storage below 6808 feet

**Crystal** Active Storage*

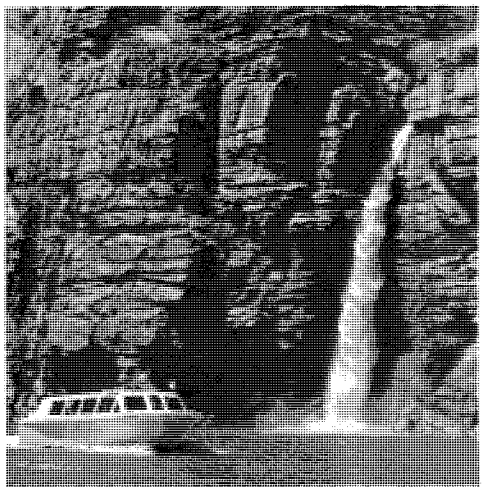
| | | |
|---|---|---|
| Maximum Storage | 17,573 | 6755 |
| Rated Head | 13,886 | 6742 |
| Minimum Power | 10,619 | 6729 |
| Surface Area (Full) | 301 Acres | |
| Reservoir Length (Full) | 7 Miles | |
| Power Plant Number of Units | 1 | |
| Total Capacity | 28,000 Kilowatts | |

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





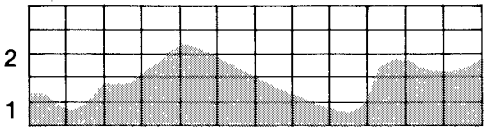
Morrow Point Dam and Reservoir, Colo.



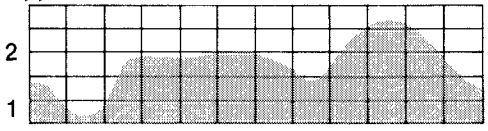
Morrow Point Reservoir scenic cruise, Colo.

Crystal Dam and Reservoir, Colo.

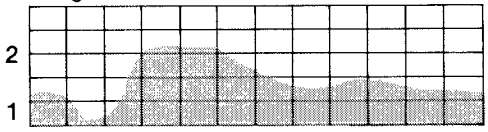
**Outflow Blue Mesa Reservoir**
Actual 1979 Release in 1000 Cubic Ft/Sec



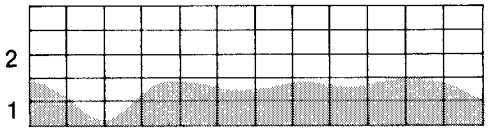

Projected Operation 1980
Upper Quartile



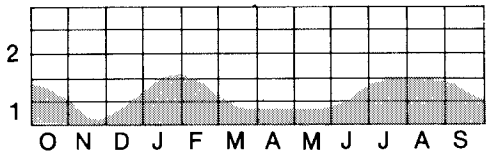

Average



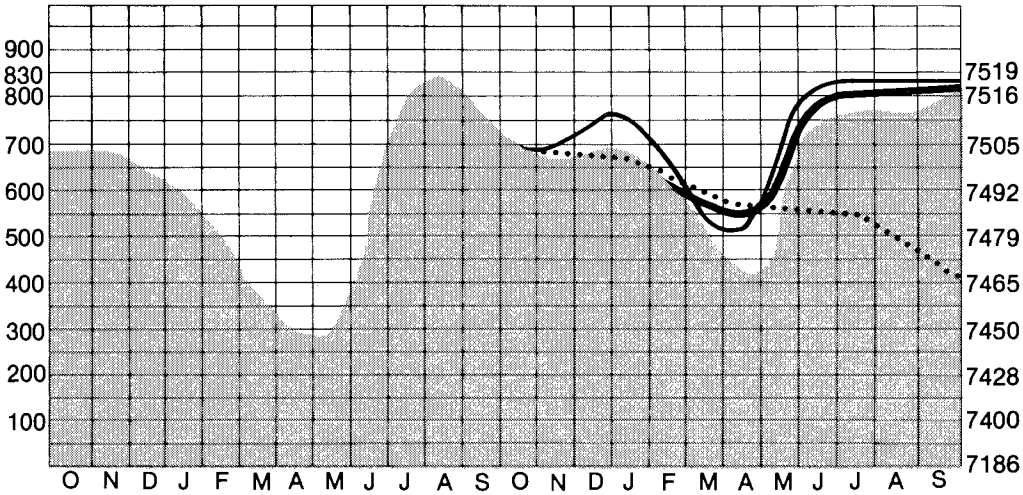

Lower Quartile




Most Adverse




**Storage Blue Mesa Reservoir**
Usable Content in 1000 Acre-Feet — Elevation in Feet (Non-Linear Scale)




**Legend**
Most Probable
Upper Quartile
Lower Quartile
Most Adverse

## Navajo Reservoir (San Juan River)

Navajo Dam and Lake, N. Mex.-Colo.

**Water Year 1979**
During the first part of water year 1979, a minimum release of 530 ft³/s was made from Navajo Reservoir for consumptive use and maintenance of fish and wildlife.

Because a record amount of snow fell during 1979 in the San Juan Basin, water releases were gradually increased to approximately 5000 ft³/s. This rate of release was maintained for several months in order to maintain storage space to contain the expected high runoff.

Operations for flood control decreased the flow at Navajo Dam from more than 12,000 ft³/s to 5280 ft³/s, thus reducing flood damage. Since there was no need to fill Navajo Reservoir and to provide extra flood control space in case inflow was greater than expected, the reservoir was not completely filled. The maximum content was 1,559,000 acre-feet, which is 137,000 acre-feet less than maximum capacity.

The April-July inflow was 1,570,000 acre-feet, which is 217 percent of the long-time average.

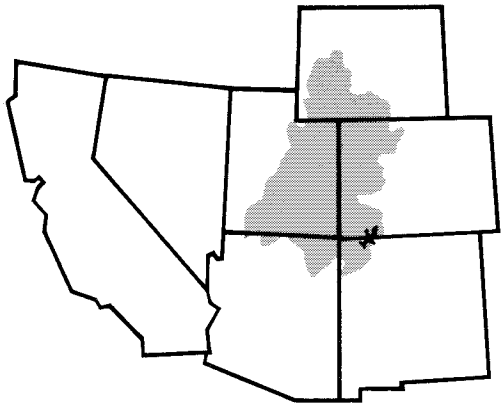
**Water Year 1980**
On September 30, 1979, Navajo Reservoir had 1,364,000 acre-feet of storage at an elevation of 6062. Assuming average inflow, the elevation is projected to be 6037, with a content of 1,080,000 acre-feet, before the snowmelt runoff starts. Average inflow would cause the reservoir to reach elevation 6063 feet with a content of 1,384,000 acre-feet in July 1980. This approximate elevation would be maintained the remainder of the summer to enhance recreational use.

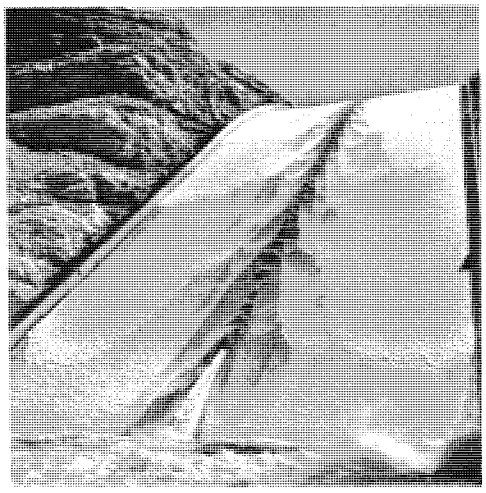
The release from Navajo Reservoir for an upper quartile inflow is projected to be about 1700 ft³/s for the winter, spring, and summer of 1980. The release for an average inflow is expected to be 1700 ft³/s for the winter and spring, then decrease to 800 ft³/s for the summer. The release for the lower quartile is projected to be about 1500 ft³/s for the winter, 1200 ft³/s for the spring, and 700 ft³/s for the summer. The release for a most adverse inflow is projected to be about 1200 ft³/s for the winter, and 530 ft³/s for the spring and summer of 1980.

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

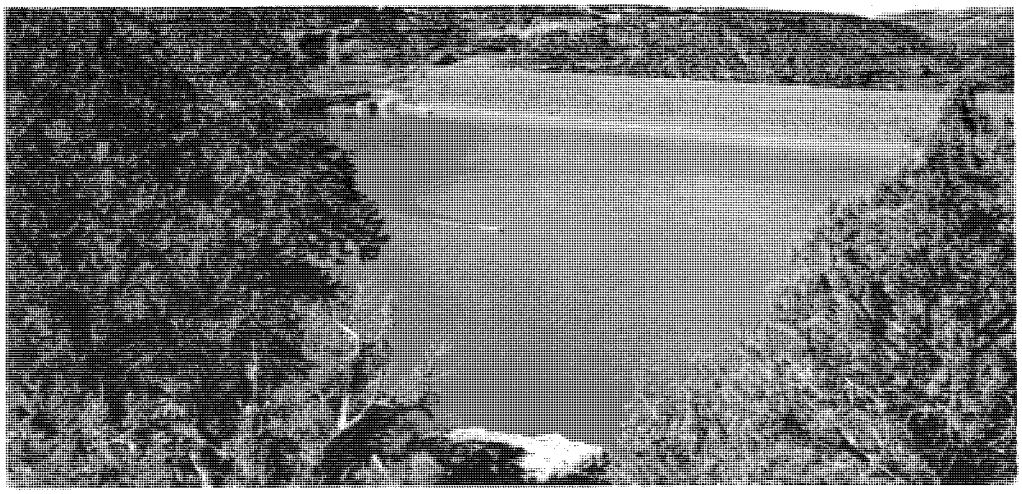
| Reservoir | (Acre-Feet) | El. (Ft.) |
|---|---|---|
| Maximum Storage | 1,696,400 | 6085 |
| Inactive Storage | 660,500 | 5990 |
| Surface Area (Full) | 15,610 Acres | |
| Reservoir Length (Full) | 33 Miles | |

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





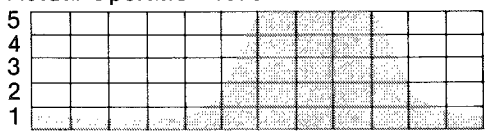
Navajo Dam Spillway, 1973.



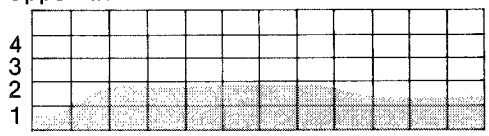
Navajo Dam and Lake, N. Mex.-Colo.

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

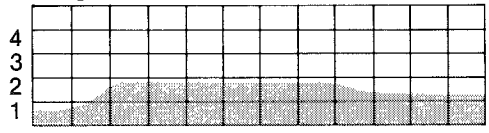
Actual Operation 1979



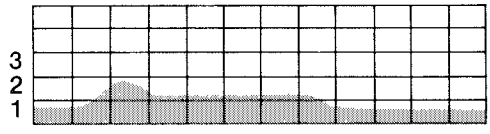

Projected Operation 1980
Upper Quartile



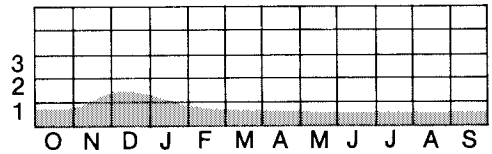

Average




Lower Quartile

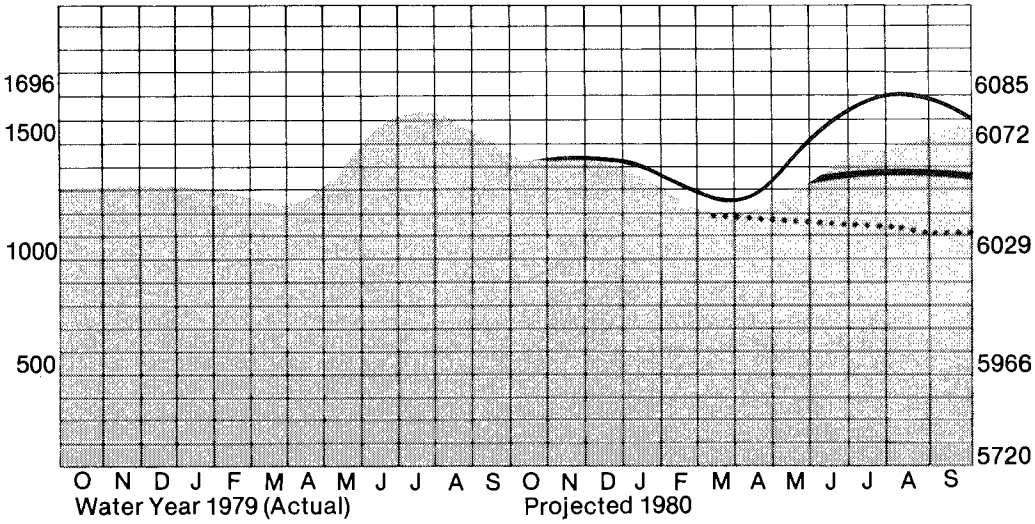



Most Adverse




**Storage**

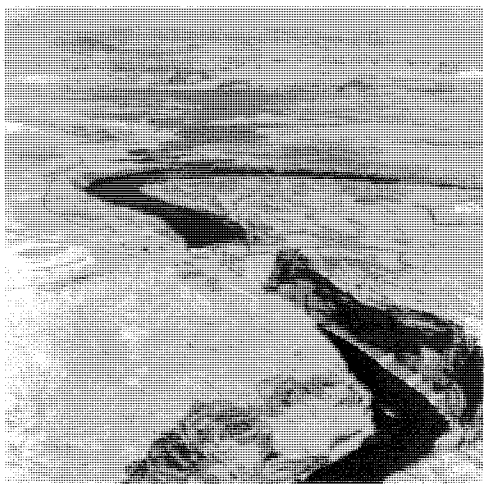
Usable Content in 1000 Acre-Feet — Elevation in Feet (Non-Linear Scale)



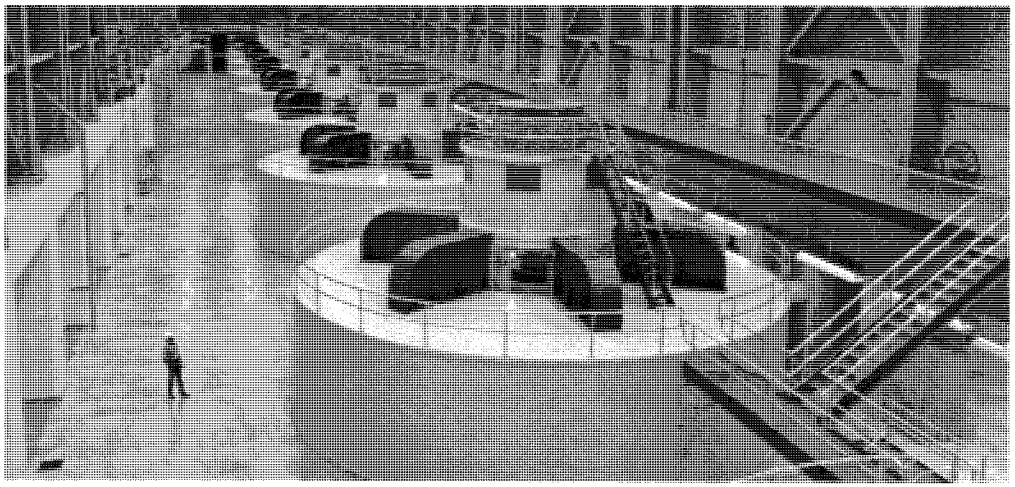

**Legend**

Most Probable
Upper Quartile
Lower Quartile
Most Adverse

## Lake Powell (Colorado River)



Glen Canyon Dam and Lake Powell, Utah-Ariz.



Glen Canyon generators.

**Water Year 1979**
During water year 1979, Lake Powell, 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 opportunities, and fish and wildlife benefits.

On September 30, 1978, Lake Powell water surface elevation was at 3640 feet with an active storage of 16,563,000 acre-feet. During the fall and winter months of 1978-79, the reservoir water level dropped about 12 feet to elevation 3628 feet. Low releases from Glen Canyon during March and April allowed the Water and Power Resources Service to integrate purchased power into the Colorado River Storage Project system when it was readily available. The April-July 1979 runoff of the Colorado River at Lees Ferry, Ariz., was 10,045,000 acre-feet, or 139 percent of the long-time average. This inflow raised the level of Lake Powell to an all-time high of 3685 feet in July of 1979.

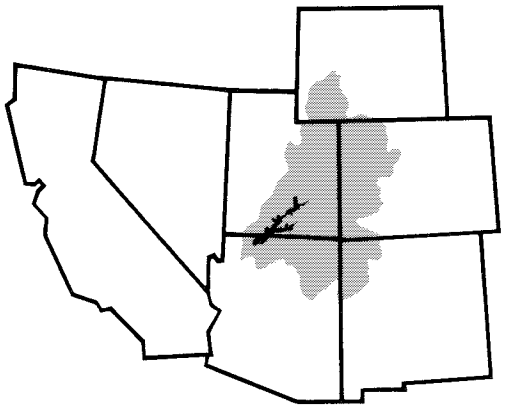
**Water Year 1980**
The elevation of Lake Powell at the end of September 1979 was 3678. It is expected to be drawn down to elevation 3670 by the spring of 1980. Assuming an average April-July inflow of about 8 million acre-feet, the elevation would reach 3694 in July 1980 with a content of about 24 million acre-feet which is 96 percent of active capacity. The surface area would be 157,000 acres with a length of 185 miles. Assuming average conditions, 8,330,000 acre-feet are scheduled for release from Lake Powell in water year 1980. This release will split the storage with Lake Mead after accounting for additional releases made from Lake Mead during 1979 and 1980 in anticipation of flood control operations. This is more than the minimum release of 8,230,000 acre-feet identified as an objective in by the operating criteria.

If the inflow to Lake Powell is at the lower quartile or less, the release will be 8,230,000 acre-feet. If the inflow is average, the release is projected to be 8,330,000 acre-feet. If the inflow is at the upper quartile, the release will be 9,742,000 acre-feet as required by the filling criteria to split storage with Lake Mead, after accounting for the additional releases from Hoover Dam as if still stored in Lake Mead. Most of the difference in release would be in the summer of 1980.

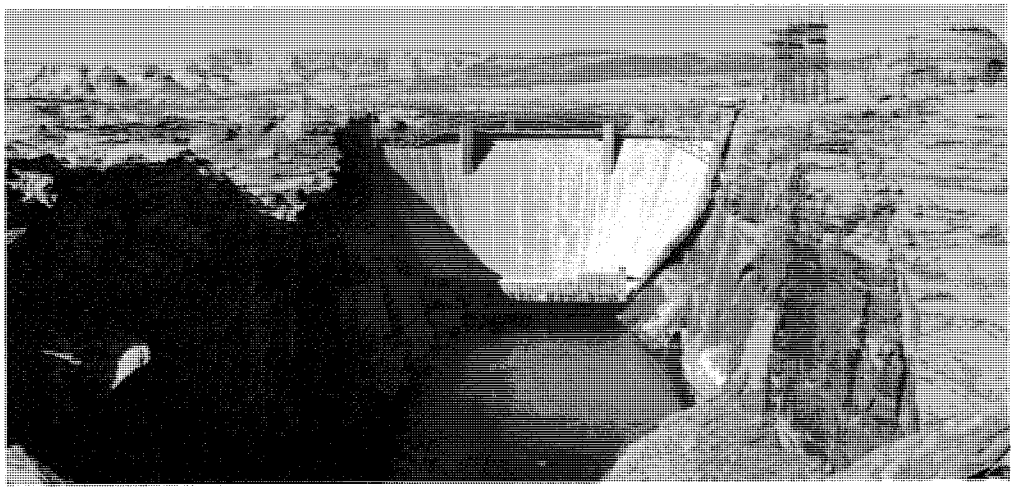
**Lake Powell** Active Storage* **Chart 5**

| 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



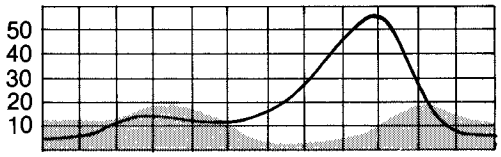
Electricity for home use



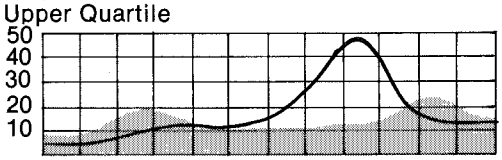
Glen Canyon Dam, Utah-Ariz.

**Inflow** —— **Outflow**

Actual 1979 in 1000 Cubic Feet/Second

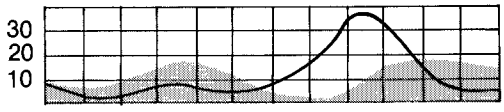



Projected 1980
Upper Quartile

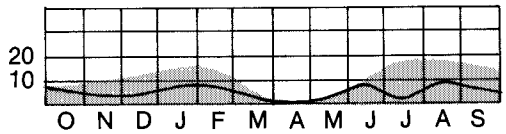



Average


Lower Quartile



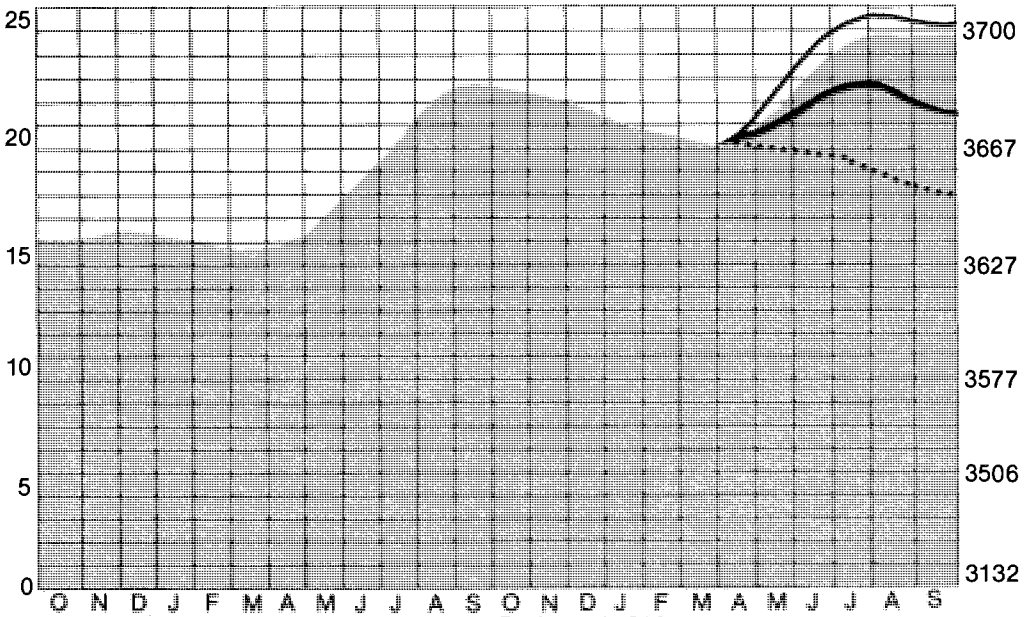

Most Adverse




**Storage**

Content in Million Acre-Feet

Elevation in Feet (Non-Linear Scale)

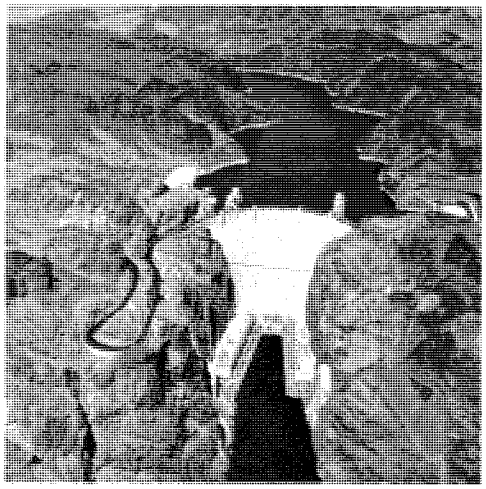


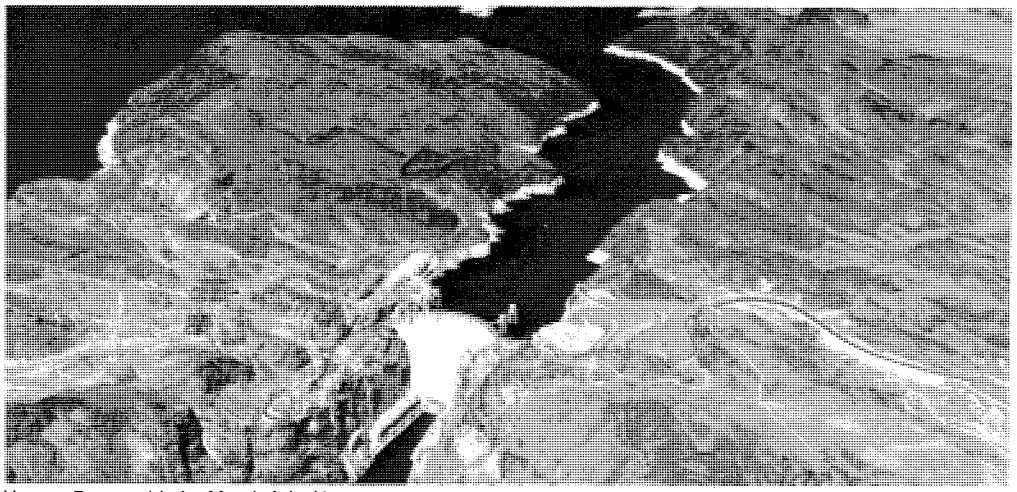

**Legend**

Most Probable
Upper Quartile
Lower Quartile
Most Adverse

## Lower Basin Reservoirs

## Lake Mead (Colorado River)





Hoover Dam and Lake Mead, Ariz.-Nev.

**Water Year 1979**
At the beginning of water year 1979, Lake Mead, impounded by Hoover Dam, had a water surface elevation of 1185 feet and an active storage of 20,890,000 acre-feet. During the water year, releases were made to meet downstream water use requirements in the United States and Mexico, programmed levels of Lake Mohave and Havasu, and transit losses which include river and reservoir evaporation, uses by phreatophytes, changes in bank storage, unmeasured inflows, and diversions. Additional anticipatory releases totaling 688,500 acre-feet were made from Hoover Dam and downstream reservoirs during water year 1979 to decrease the likelihood of having to make flood control releases during 1980 and 1981. The total release from Lake Mead through Hoover Dam was 7,388,000 acre-feet. At the end of the water year, Lake Mead had a water surface elevation of 1195 feet and an active storage of 22,242,000 acre-feet, which, in spite of additional releases, reflects an increase in storage during the water year of 1,352,000 acre-feet.

On September 30, 1979, the active storage of Lake Mead was 606,000 acre-feet more than the active storage in Lake Powell.

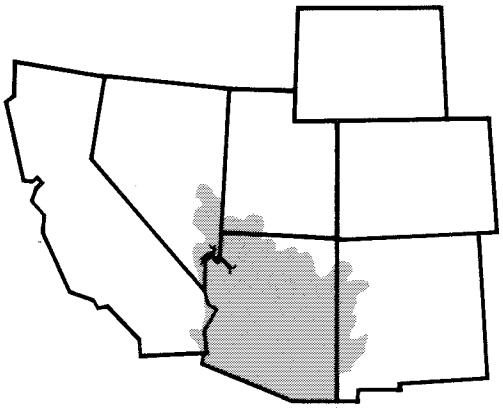
**Water Year 1980**
During the 1980 water year, the Lake Mead water level is scheduled to rise to elevation 1203 feet at the end of February 1980, then be drawn down to a low elevation of 1192 feet at the end of June 1980. At that level the lake will have an average active storage of about 21.8 million acre-feet. During water year 1980, a total of 8.2 million acre-feet is scheduled to be released from Lake Mead to meet all downstream requirements; this includes about 700,000 acre-feet additional scheduled release. All releases are scheduled to pass through the turbines for electric power production.

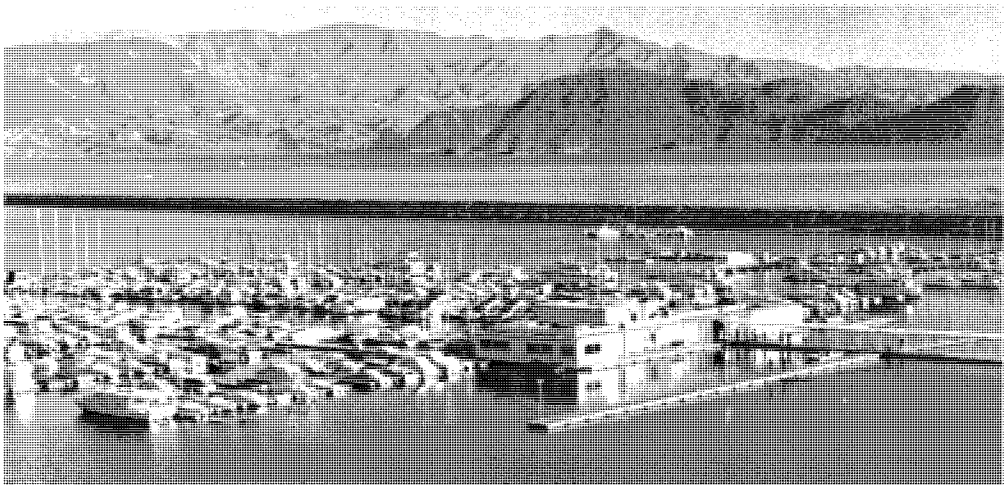
With an upper quartile inflow to the system's reservoirs, it is anticipated that instantaneous peak discharges from Hoover, Davis, and Parker Dams would not be greater than normal year peaks; however, sustained discharges may pose minor problems in the United States portion of the Lower Basin and more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



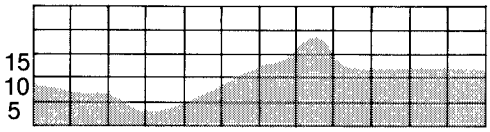


Lake Mead Marina

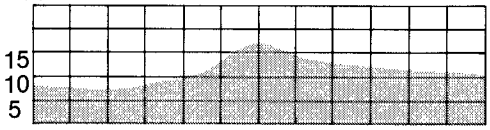
19 Millionth Visitor - Hoover Dam

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

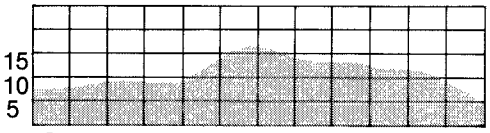
Actual 1979




Projected Operation 1980
Upper Quartile



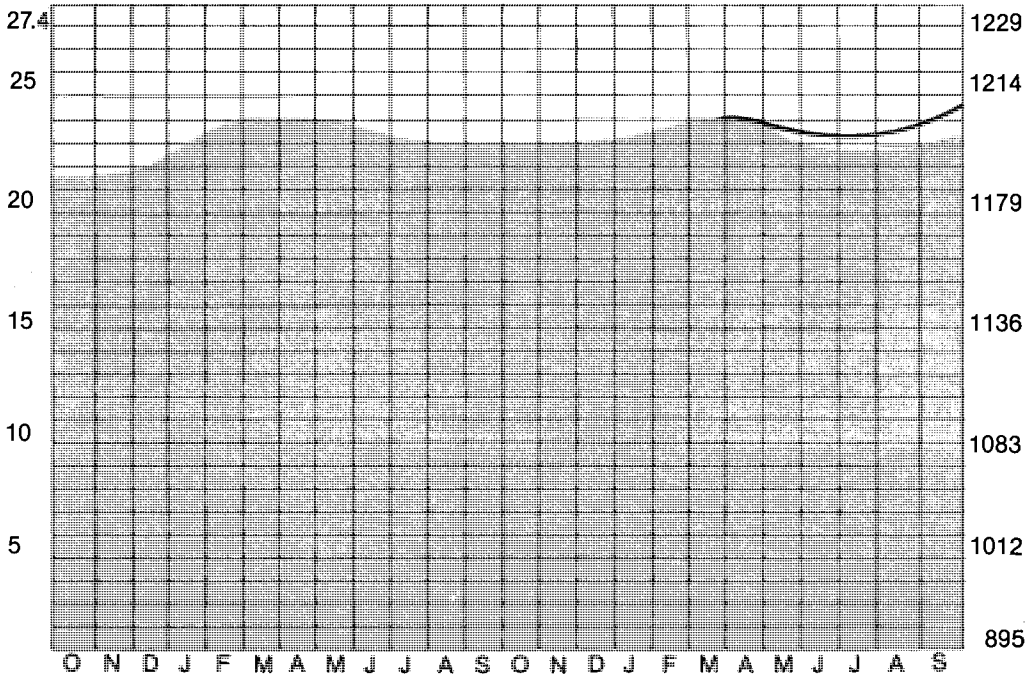

Average, Lower Quartile,
Most Adverse




**Storage**

Active Content in Million Acre-Feet

Elevation in Feet (Non-Linear Scale)



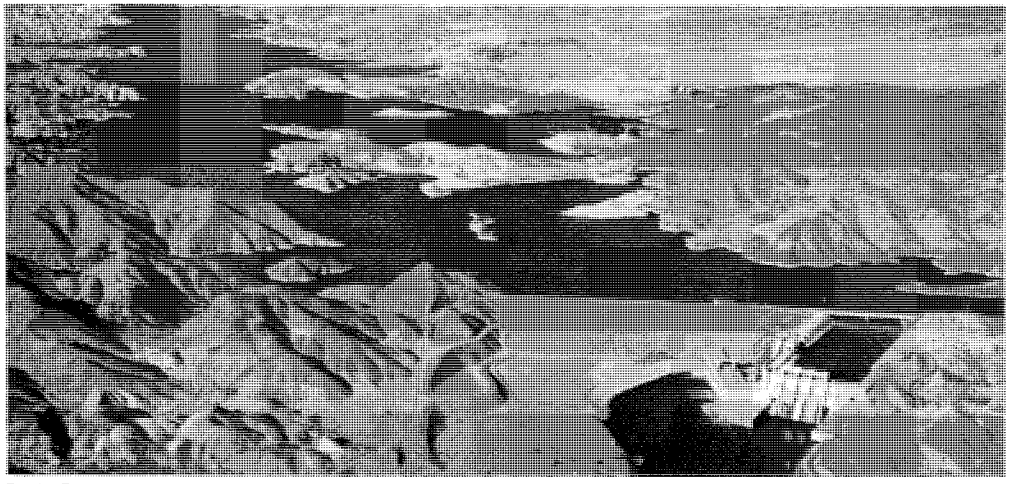

Actual 1979 Projected 1980

**Legend**

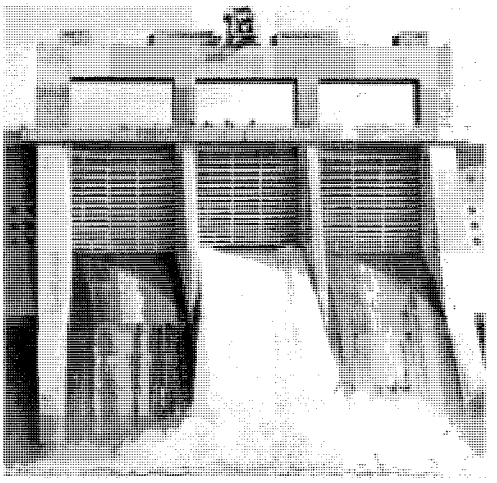
Most Probable

Upper Quartile

## Lake Mohave (Colorado River)



Davis Dam and Lake Mohave, Nev.-Ariz.



Davis Dam spillway

**Water Year 1979**
At the beginning of water year 1979, the water surface elevation of Lake Mohave, which is impounded by Davis Dam, was 635 feet with an active storage of 1,479,000 acre-feet.

During the winter months, the water level was raised to 645 feet, with an active storage of 1,760,000 acre-feet on February 6, 1979. The water level was drawn down during the summer months to its lowest elevation of the year, 633 feet. The reservoir ended the water year at elevation 633 feet with 1,428,000 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 688,500 acre-feet of additional releases from Hoover Dam were also routed through Lake Mohave. During the water year, 7,646,000 acre-feet were released at Davis Dam, all of which passed through the turbines for power generation.

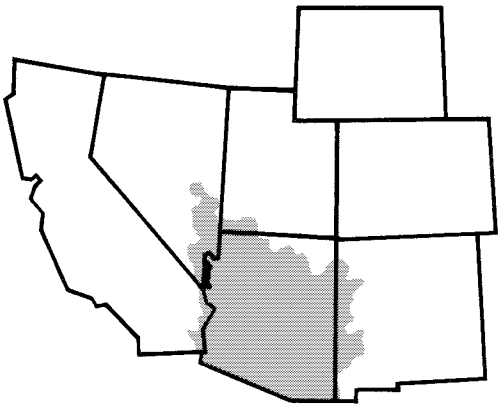
**Water Year 1980**
The water level of Lake Mohave is scheduled to rise through the fall and winter months and reach elevation 643 feet by the end of February 1980. It should remain near that yearly high elevation through May 1980. Because of heavy irrigation use during the summer months, the water level in Lake Mohave is expected to be drawn down to elevation 631 feet by the end of water year 1980. During that time, a total of 8.3 million acre-feet is scheduled to be released from Lake Mohave to meet all downstream requirements and the additional 700,000 acre-feet release. 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 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

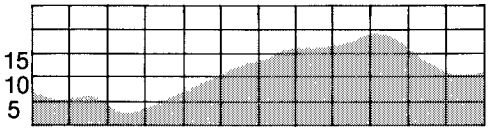


Citrus groves, Ariz.

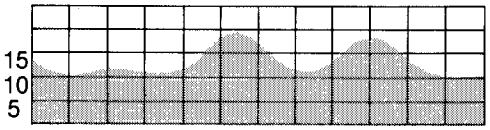
Palo Verde squash, Calif.

**Lake Mohave Outflow**

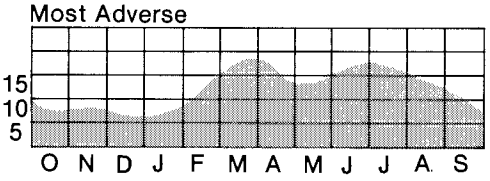
Actual Operation 1979



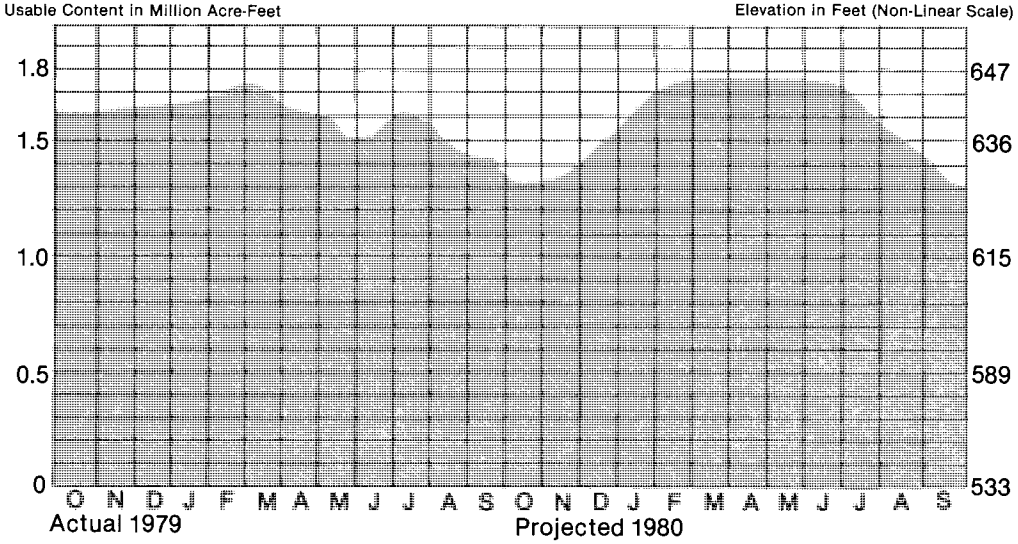

Projected Operation 1980
Upper Quartile



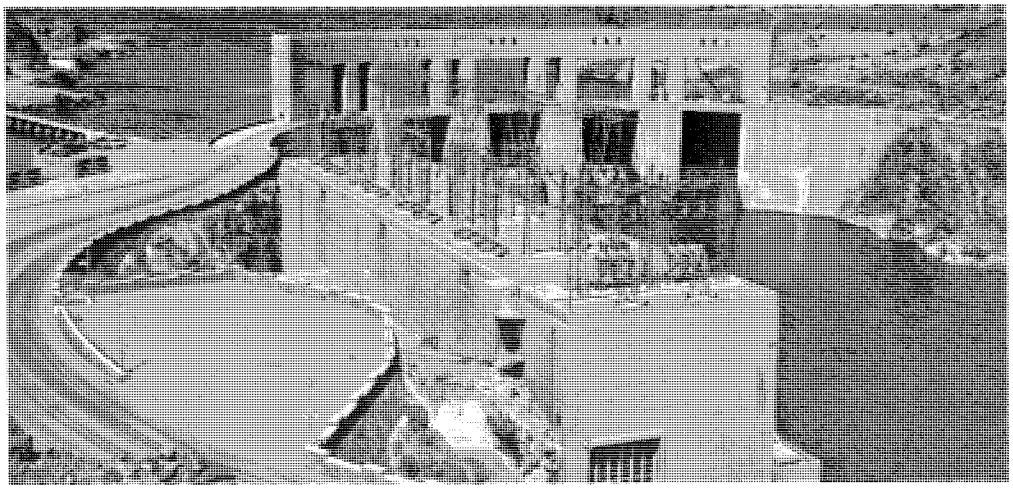

Average, Lower Quartile,
Most Adverse



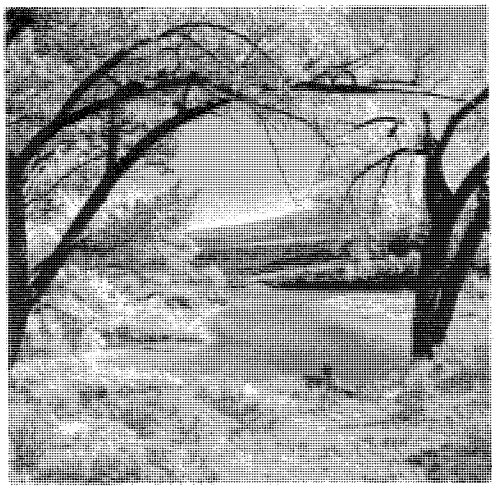

**Lake Mohave Storage**



## Lake Havasu (Colorado River)



Parker Dam and Powerplant, Ariz.



Colorado River

**Water Year 1979**
At the beginning of water year 1979, the water level of Lake Havasu, impounded by Parker Dam, was at elevation 447 feet, with an active storage of 565,000 acre-feet. The reservoir was drawn down to about elevation 444 feet with an active storage of about 509,000 acre-feet in February. This provided flood control space for runoff from the drainage area between Davis and Parker Dams. The water level was then raised to about elevation 448 feet by mid-May. During mid-May through June, the reservoir water level was maintained between 448 and 447 feet, with an active storage of about 562,000 acre-feet at the end of June. By the end of the water year, Lake Havasu was at 447 feet, with an active storage of 565,000 acre-feet.

During the water year, 6,729,000 acre-feet were released at Parker Dam, all of which passed through the turbines for power generation. That amount included the additional releases from Lake Mead which totaled 688,500 acre-feet during the year, and flood control releases of approximately 226,000 acre-feet 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 flood control and other uses, including river regulation. Normally, only about the top 4 feet, or 77,000 acre-feet, have been used for this purpose since Alamo Reservoir on the Bill Williams River has been in operation.

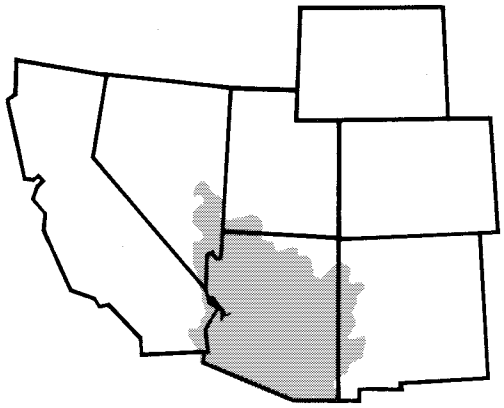
**Water Year 1980**
Lake Havasu is scheduled at the highest levels consistent with the requirements for maintaining flood control space. The yearly low elevation of 445 feet is scheduled for the high-flood hazard period of October through March. The yearly high of 450 feet is scheduled for the low-flood-hazard month of June. During water year 1980, a total of 7.3 million acre-feet is scheduled to be released from Lake Havasu to meet all downstream requirements, including the additional 700,000 acre-foot release. All releases are scheduled to pass through the turbines for power production.

With an upper quartile inflow into 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.

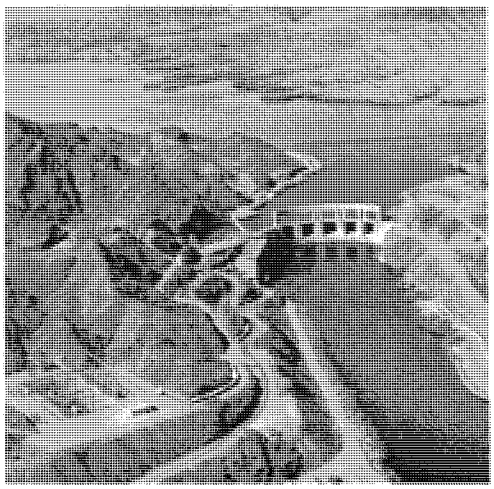
**Lake Havasu** Active Storage* **Chart 8**

| 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



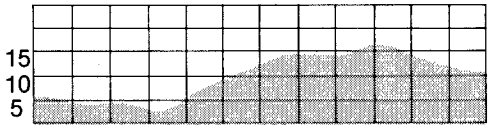
Hay bales



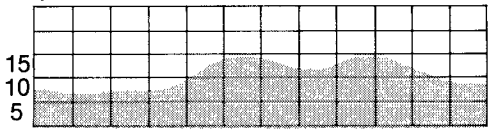
Parker Dam and Lake Havasu, Ariz.

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

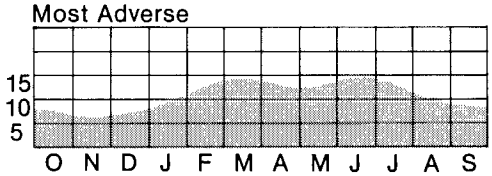
Actual Operation 1979




Projected Operation 1980
Upper Quartile



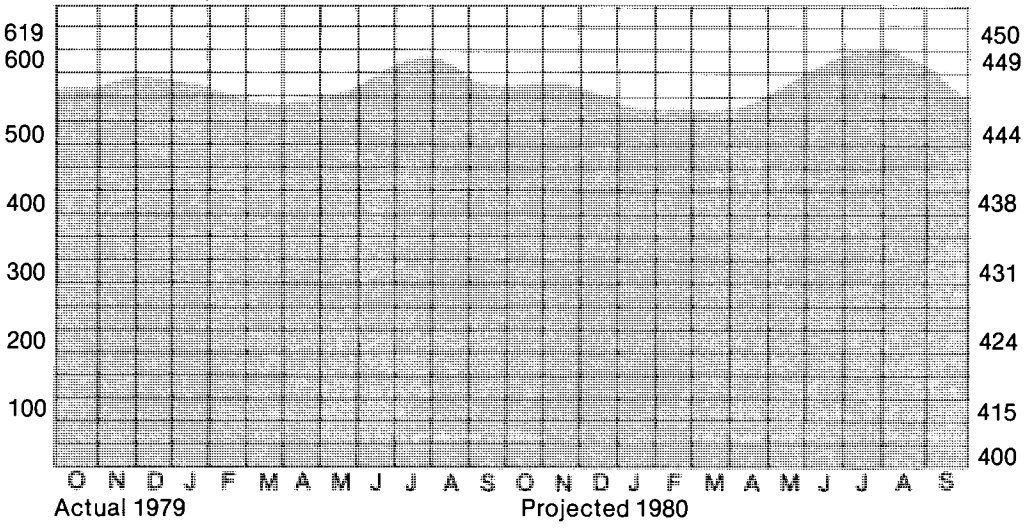

Average, Lower Quartile,
Most Adverse




**Storage**

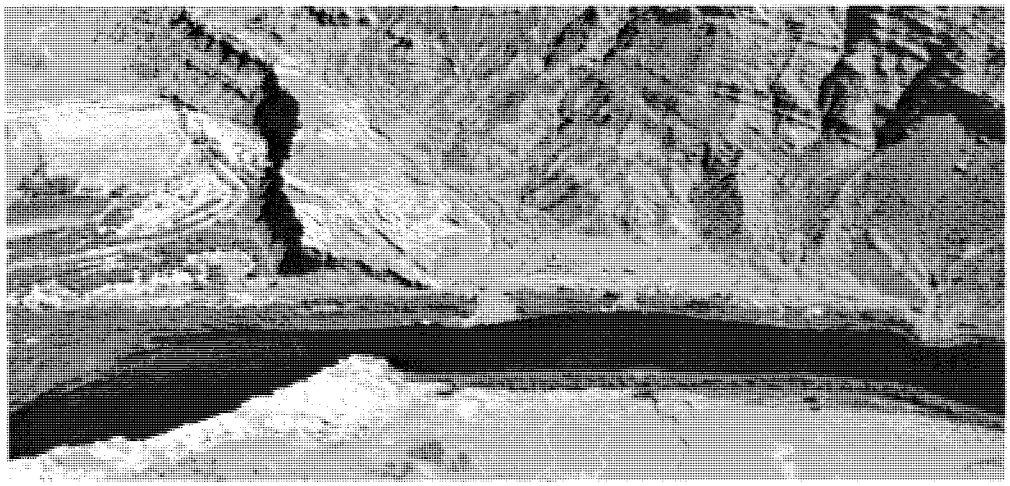
Usable Content in 1000 Acre-Feet

Elevation in Feet (Non-Linear Scale)




Actual 1979 Projected 1980

## River Regulation



Lees Ferry on the Colorado River

Lake Powell

The natural virgin runoff reaching the streams of the Colorado River drainage system above Glen Canyon Dam during water year 1979 was estimated at about 17.9 million acre-feet. Of this amount, about 3.5 million acre-feet of water was consumptively used within the Upper Colorado River Basin States.

Adjustments in storage in other mainstream reservoirs resulted in an inflow to Lake Powell of 14.6 million acre-feet. The release from Glen Canyon Dam, based on measurements at the gaging station at Lees Ferry, Ariz., was 8,222,000 acre-feet. For the 1-year and 10-year periods ending September 30, 1979, 8,293,000 acre-feet and 87,565,000 acre-feet, respectively, passed the compact point at Lee Ferry, Ariz.

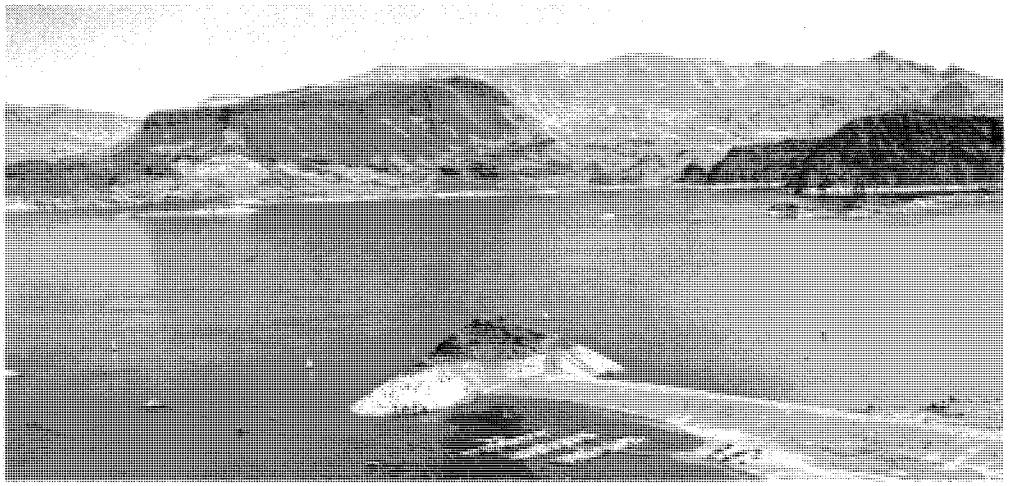
The projected release from Lake Powell, based on the most probable forecast of runoff is 8,330,000 acre-feet. This could vary from a minimum of 8,230,000 acre-feet with most adverse or lower quartile runoff to 9,635,000 acre-feet with upper quartile runoff. When added to the flow of the Paria River, this would result in an Upper Basin delivery ranging from about 87.1 to 88.6 million acre-feet for the 10-year period ending September 30, 1980.

Water releases scheduled for the Colorado River Storage Project and participating project reservoirs were planned to accommodate all of the multiple purposes for which the project was designed, in addition to the many day-to-day demands which develop throughout the year.

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 closely 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 satisfactory water recreational activities. Adjustments are also made to transport riverborne sediment to desilting facilities, and to assist in controlling water quality. Minimum releases from Lake Powell were 1,000 $ft^3/s$ during the winter months and were increased to 3,000 $ft^3/s$ during the summer months with an average daily flow of 8,000 $ft^3/s$. These flows in the Grand Canyon are typical of a normal water year. They are similar to flows in past years and have proven satisfactory to recreational users in the Grand Canyon.

River regulation below Hoover Dam resulted in delivery to Mexico of 1,266,278 acre-feet in excess of the normal treaty-guaranteed quantity of 1,500,000 acre-feet during water year 1979. Of that quantity, 170,593 acre-feet of drainage waters were bypassed for salinity control pursuant to provisions of Minute No. 242 of the International Boundary and Water Commission.

# Flood Control



Lake Mead

The "Temple", Lake Mead

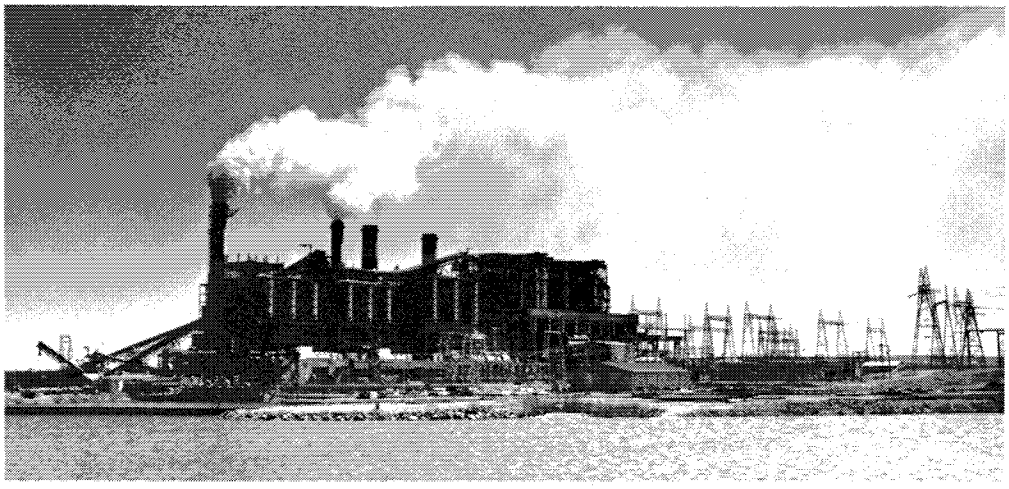
Lake Mead is the only reservoir on the Colorado River in which space is exclusively allocated for mainstream flood control. Flood control regulations for Hoover Dam are being updated and revised by the Water and Power Resources Service and the Army Corps of Engineers with the consultation and advice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

An interim agreement on flood control regulations prior to the formulation and approval of the revised regulations takes into account the available effective space in CRSP reservoirs as well as in Lake Mead. Modified terms for this agreement will go into effect during calendar year 1980.

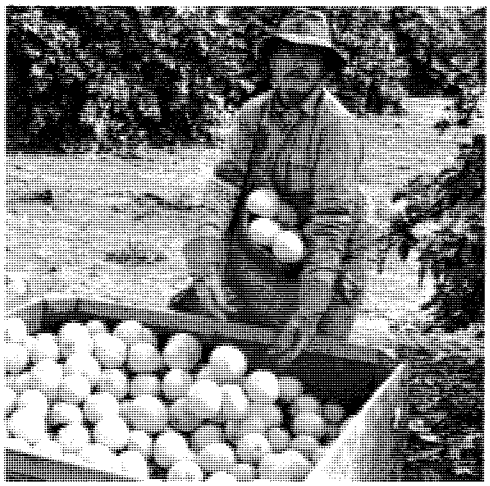
Extensive flood control protection was provided by the reservoirs within the basin during water year 1979. Several severe storm systems swept across the watershed and saturated wide areas with damaging rains. In addition to the mainstem structures, Alamo Dam on the Bill Williams River and Painted Rock Dam on the Gila River (both in the Lower Basin) received unusually large amounts of flood inflow during the winter months. As a result of flood control protection within the basin, major flood damages were prevented in the Palo Verde ($3.0 million), Yuma ($2.0 million), Parker ($1.3 million), and Gila ($1.2 million) areas along the lower Colorado River.

Flood control storage space will be maintained in Lake Mead as stipulated in the new interim agreement between the former Bureau of Reclamation and the U.S. Army Corps of Engineers. This agreement was also formulated with the consultation and advice of State and local interests. Alamo Reservoir and Painted Rock Reservoir are continuing to be drawn down and, barring further inflow, will each reach minimum flood control elevations during 1980.

## Beneficial Consumptive Uses



Thermal powerplants



Grapefruit harvest, Palo Verde Valley, Calif.

**Upper Basin Uses and Losses**
Agricultural use within the drainage basin, diversion for all purposes to adjacent drainage systems, and evaporation losses from all reservoirs are the three largest categories of depletion in the Upper Basin. During water year 1979, agricultural and municipal and industrial depletions in the Upper Basin were estimated to be 2,700,000 acre-feet. Approximately 640,000 acre-feet evaporated from mainstem reservoirs in the Upper Basin and approximately 600,000 acre-feet were diverted to adjacent drainage basins. It is estimated that an additional 160,000 acre-feet evaporated from other reservoirs and stockponds in the Upper Colorado River Basin, for a total annual depletion of 4,100,000 acre-feet.

Consumptive uses and losses in the Upper Basin for the 5 years beginning with 1971 are summarized in the following table:

| Year | 1,000 acre-feet* |
|---|---|
| 1971 | 3,413 |
| 1972 | 3,500 |
| 1973 | 3,403 |
| 1974 | 3,819 |
| 1975 | 3,653 |

*Published in the "Colorado River System Consumptive Uses and Losses Report" for the 5-year period ending in 1975

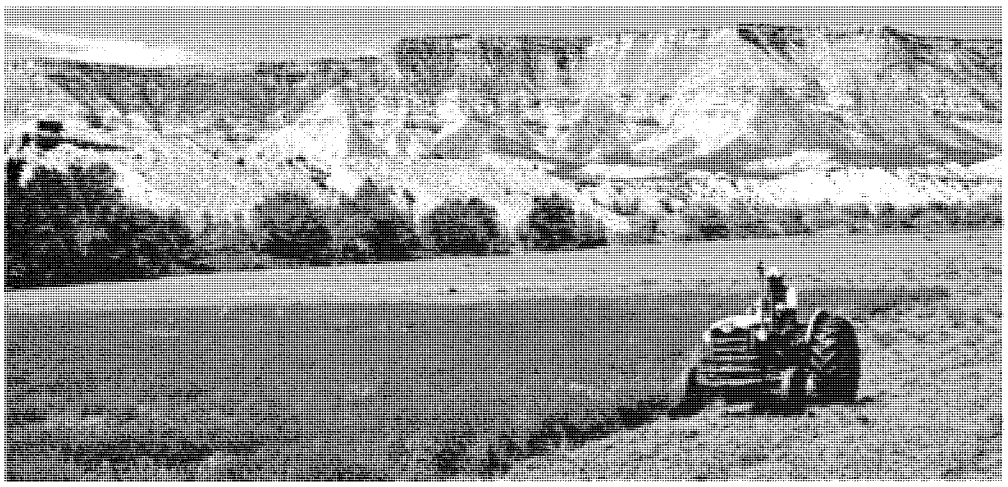
About 5.5 million acre-feet of water were added to storage in Upper Basin mainstem reservoirs during 1979. This water will be released to the Lower Basin in future years as required by the Colorado River Basin Project Act and the laws, compacts, and treaties upon which the operating criteria were promulgated pursuant to Section 602(a) of the Act.

**Lower Basin Uses and Losses**
During water year 1979, 6,729,000 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, and transit losses between Parker Dam and Imperial Dam.

The major water diversion above Parker Dam was made by The Metropolitan Water District (MWD) of Southern California. MWD pumped 783,000 acre-feet from Lake Havasu during water year 1979. This included 890 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 1979, releases of 7,646,000 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 1979, releases of 7,388,000 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, 107,000 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 1979, the total releases and diversions from Lake Mead were 7,495,000 acre-feet. The 688,500 acre-feet anticipatory releases from Hoover Dam also were passed through Davis and Parker Dams.

Lower Basin consumptive uses and losses for the 5-year period ending in 1975, as published in the "Colorado River System Consumptive Uses and Losses Report" were as follows:



Harvesting hay, Utah

Oil refinery

| Year | Mainstream[1] | Tributaries[2] | Lower Basin total | Water Passing to Mexico |
|---|---|---|---|---|
| | | | *(1,000 acre-feet)* | |
| 1971 | 7,795 | 3,759 | 11,554 | 1,561 |
| 1972 | 7,959 | 4,096 | 12,055 | 1,600 |
| 1973 | 7,766 | 4,267 | 12,033 | 1,594 |
| 1974 | 8,315 | 4,470 | 12,785 | 1,721 |
| 1975 | 7,693 | 4,482 | 12,175 | 1,656 |

[1]Includes reservoir and channel losses.
[2]Includes uses supplied from ground water overdraft.

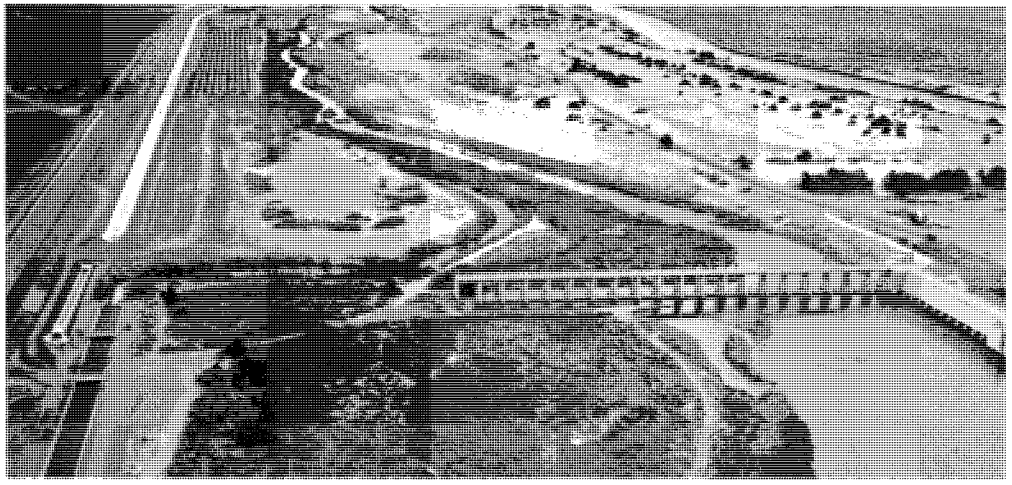
For water year 1980, a release of 7,302,000 acre-feet from Lake Havasu has been projected, including consumptive use requirements in the United States below Parker Dam, transit losses in the river between Parker Dam and the Mexican Border, Treaty deliveries to Mexico and the 700,000 acre-feet additional releases from Hoover Dam.

During water year 1980, The Metropolitan Water District of Southern California is expected to divert 773,000 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 211,000 acre-feet.

There are no major users between Hoover Dam and Davis Dam. During water year 1980, 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 60,000 acre-feet. The net diversions from Lake Mead are projected at 105,000 acre-feet. Evaporation from Lake Mead is expected to be about 926,000 acre-feet and net gain between Glen Canyon Dam and Lake Mead is expected to be about 872,000 acre-feet.

## Water Quality Operations



Partly constructed salinity by-pass drain, U.S.-Mexico border

Desalting facility, Gila Gravity Main Canal

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 will be issued in January 1981.

During water year 1979, the United States bypassed only 3.4 acre-feet to the Colorado River below Morelos Dam and 170,590 acre-feet through the Bypass Drain for a total of 170,593.4 acre-feet which was replaced with a like amount of other water, pursuant to Minute No. 242 of the International Boundary and Water Commission.

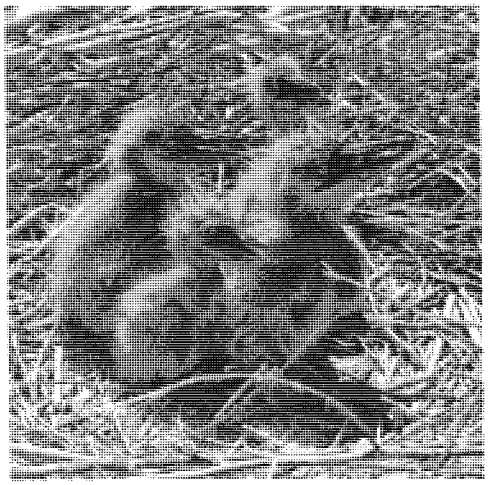
Under the provisions of Minute No. 242, the Republic of Mexico is entitled to receive at Morelos Dam water of a quality no worse than 115 parts per million (p/m) ($\pm$ 30 p/m) greater than that arriving at Imperial Dam. Due to the additional releases from Hoover, Davis, and Parker Dams and the flood 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 1979 was only about 762 p/m. The average salinity of the waters reaching Imperial Dam during water year 1979 was 816 p/m, resulting in a salinity differential of approximately $-54$ p/m.

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 1980 are estimated to be 200,000 acre-feet. No bypass waters are expected to be returned to the Colorado River below Morelos Dam during water year 1980.

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 Resource's 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 basinwide 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



Blue Heron chicks

Gunnison River, Colo.

**Upper Basin**
For the benefit of 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 1979, releases for power production and other purposes provided flows of at least 500 $ft^3/s$.

A release at least 76 $ft^3/s$ throughout the winter of 1976-77 assured good fish habitat in the river below Taylor Park and Blue Mesa Reservoirs. Coordinated operation between Taylor Park and Blue Mesa Reservoirs in delivering irrigation water to the Uncompahgre Project provided additional fishery and recreational opportunities between the two reservoirs. The interim operating rules specify a minimum of 200 $ft^3/s$ to maintain fish habitat below Crystal Dam and below the Gunnison Tunnel.

A continuous flow of at least 530 $ft^3/s$ was maintained throughout the year immediately below Navajo Dam for fish propagation.

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

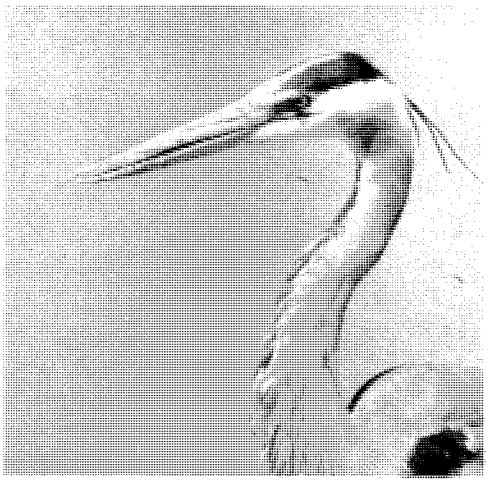
**Flaming Gorge Penstock Intake Modification**
The shutter system of the three selective withdrawal structures, now part of Flaming Gorge Dam, went into operation on June 20, 1978, and was found to function properly. It affects the downstream water temperatures as predicted by withdrawing water from the warmer surface level of the reservoir. Water released last summer was at a constant 56° F until the reservoir surface started to cool in the fall. When the surface temperature approached 39° F, the lower shutters on the 30- x 30- x 200-foot withdrawal structure were used to maintain the 39° F temperature until spring when the surface water temperature begins to rise. The upper shutters on the structures are used during the warm months to raise the temperatures of the downstream water releases by withdrawing water from the warm upper layers which range in depth from 40 to 70 feet.

Operation of the penstock modification has already resulted in some apparent changes in the downstream fishery. However, studies documenting the fishery changes, being conducted by the Utah Division of Wildlife Resources and Bio/West, Inc. under a three-year contract with the former Bureau of Reclamation, report that results are not yet conclusive and that definitive measurements of the fishery are not yet available.

Despite inconclusive results, it appears that there was a significant improvement in fish growth this past season. Rainbow trout planted in the Green River below the Dam—from Greendale to Indian Crossing at the head of Browns Park—have grown approximately four inches during the five-month period during which the withdrawal structure was in operation. By comparison, the 1977 growth reports noted a one-half inch growth during an eight-month period; and in a 1976 report, three inches of growth during a 12-month period was recorded. Cutthroat trout showed a similar growth rate increase. Rainbow trout stocked in 1978 almost doubled in weight, and both the catch rate and the number of fish in the creel increased significantly.

These changes indicate that the fish are feeding more actively since the water temperature increase. There has been a significant increase in the numbers of invertebrates, commonly called scuds, on which trout feed. These are the same invertebrates that populate the Colorado River below Glen Canyon Dam and support one of the top trout fisheries in the western United States.

Canadian Geese



Great Blue Heron

Other changes indicate the downstream fishery is improving. For example, catfish are being caught at Little Hole and carp are now in the river where they have not been recorded for a number of years. The increased water temperature also appears to be affecting the composition and reproduction of fish species in Ladore Canyon and as far downstream as Jensen, Utah. Precise changes are not yet known but will be analyzed and reported when the three-year study is completed in 1980.

Fishing activity was the highest last year since 1970 and other recreational use, especially rafting, has also increased.

The Water and Power Resources Service and the Fish and Wildlife Service are presently consulting over the impacts of various water development projects on endangered Colorado River fish, specifically,the Colorado squawfish (*Ptychocheilus lucius*) and humpback chub (*Gila cypha*).

The Fish and Wildlife Service has conducted preliminary examinations of several Water and Power projects under the formal Section 7 consultation procedures, as provided for by the Endangered Species Act of 1978 as amended. Conclusions from these initial examinations and other documentation indicate that the proposed actions may jeopardize the continued existence of both fish species. Fish and Wildlife has stressed the need for Water and Power to develop additional data on the habitat requirements of these species. Therefore, a team has been charged with studying the problem and preparing the necessary biological opinions and assessments.

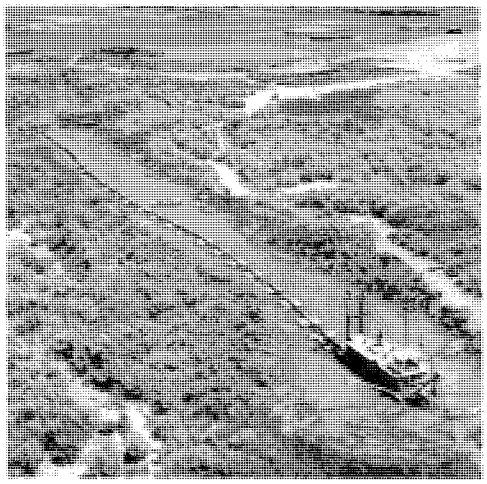
The team will determine habitat requirements, monitor existing habitats, and expand life history information on the endangered Colorado squawfish and humpback chub. The study will be conducted on the Green and Colorado Rivers above Lake Powell.

**Lower Basin**

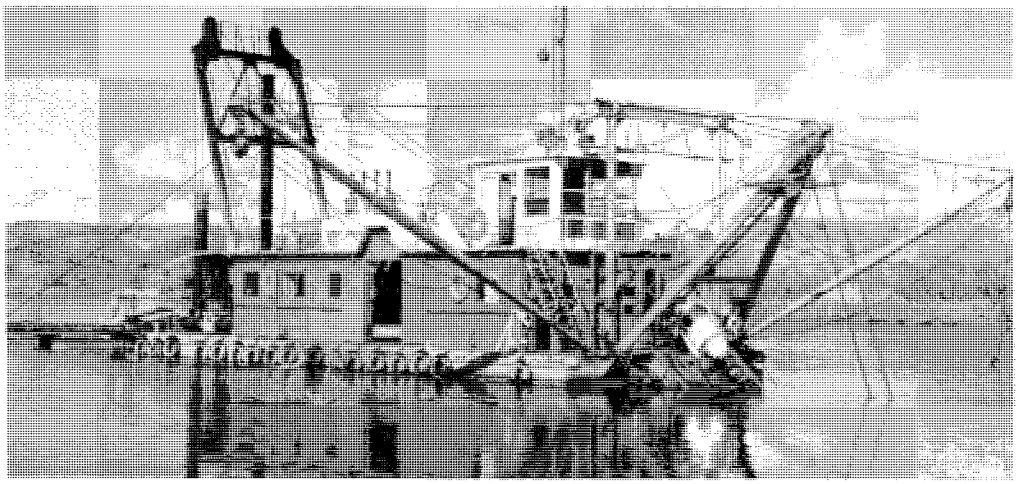
During the 1979 bass spawning season, the Lake Mead water level declined approximately 5 feet and temperatures were cooler than the previous year. Bass nesting on the Nevada side was good, with a 48 percent nesting success, but nesting was not as frequent or as intense this year as last. Nesting attempts were fewer this year in portions of the Arizona side, possibly due to a shorter spawning period. However, there was increased nesting in other portions of the Arizona side, possibly because of increased habitat. Arizona had an overall sucess rate of approximately 37 percent, which represents a decrease of 1 percent from last year. However, the success rate was higher than 2 years ago.

To provide satisfactory fish habitat along the lower river and in Lake Havasu, releases from Lakes Mohave and Havasu were regulated so that minimum flows were 2,000 $ft^3/s$ and the level of Lake Havasu remained relatively stable during the spring spawning season.

## Preservation of Environment



Topock March dredge



A dredge on the Lower Colorado River.

Preservation or enhancement of the environment is a matter of high importance in the planning, construction, and operation of all Colorado River storage features. Contracts for water services, supplies, grants of rights-of-way and indentures of leases for use of Federal land, and participating agreements approved by the Secretary of the Interior include language to control water and air pollution, to require restoration and reseeding of lands scarred by construction and operation activities, and to encourage conservation of the aesthetic beauty of nature.

In operating the reservoirs of the Colorado River system, releases from Fontenelle Reservoir are scheduled so the flow pattern will not adversely affect the downstream goose nesting areas. Minimum flows are maintained below all dams to provide a desirable habitat for fish, animal, and plant life. Flood control operations at Navajo Reservoir and Lake Mead protect the downstream channels and flood plains from erosion and scouring during periods of high flow. Recent proposals for several large thermal electric generating plants cooled with water and for coal gasification plants using water from Water and Power facilities in the Colorado River system have required special consideration to protect the environment of the area. The Secretary of the Interior's responsibility for water pollution control has been delegated to the Commissioner of Water and Power Resources and redelegated to the Regional Director of the Upper Colorado Region. The Regional Director of the Lower Colorado Region has been delegated responsibility for water pollution control at the Mohave Powerplant.

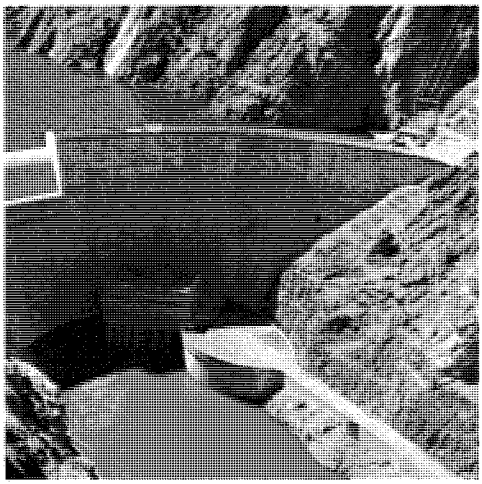
This past year was the second year of a 3-year study, jointly funded by the Water and Power Resources Service and the Fish and Wildlife Service. The study is designed to develop vegetation management procedures for the lower Colorado River. The study program will replant native riparian communities in selected spots to determine the economic and biological feasibility of reestablishing native riparian communities along the lower Colorado River.

The first year of a 3-year study was spent on the relationship between wildlife productivity and irrigated agriculture on the lower Colorado River. This study, which is assessing the influence of agriculture on wildlife, will assist management decisions on water savings in the irrigation disticts.

The Water and Power Resources Service's 12-inch dredge "Little Colorado" spent several months in Beale's Slough just south of Needles, Calif., creating a back-water with scalloped banks for fisheries. This project was developed by the Bureau of Land Management and the California Department of Fish and Game to enhance fisheries along the lower Colorado River.

The Hoover Powerplant Modification Investigation, being conducted to study the feasibility of increasing the electrical output of Hoover Dam to provide greater peaking power, is continuing. This modification study, if implemented, would change the releases from Hoover Dam, which in turn would affect the fisheries below the dam. Studies are now in progress to determine what these affects would be. These data will be collected and evaluated before any modification is made.

# Power Operations



Crystal Dam, Colo.

**Upper Basin-**
**Colorado River Storage Project (CRSP)**

The following table summarizes the CRSP generation, purchases, disposition, and revenue from power operations for fiscal year 1979. The last part of the table is a projection for fiscal year 1980.

The total revenue from power operations in fiscal year 1979 was $58,095,000. For fiscal year 1980 it is estimated to be $72,500,000. This increase is anticipated partly because of an estimated power rate increase and partly because of increased sales resulting from oil conservation.

**Water Year 1979**

**Sources of Energy**

| **Net Generation** | **kW•h** |
|---|---|
| Flaming Gorge | 480,236,000 |
| Blue Mesa | 332,449,000 |
| Morrow Point | 442,904,000 |
| Fontenelle | 63,846,000 |
| Glen Canyon | 3,829,791,000 |
| Crystal | 223,285,000 |
| Subtotal-Net Generation | 5,372,511,000 |
| **Purchases (for)** | |
| Hoover Deficiencies | 549,296,000 |
| Parker-Davis firming | 63,658,000 |
| Rio Grande firming | 10,523,000 |
| CRSP firming | 420,951,000 |
| Fuel Replacement | 287,880,000 |
| Subtotal Purchases | 1,332,308,000 |
| Transmission for others | 134,517,000 |
| Total Energy Receipts | 6,839,336,000 |

**Disposition of Energy**

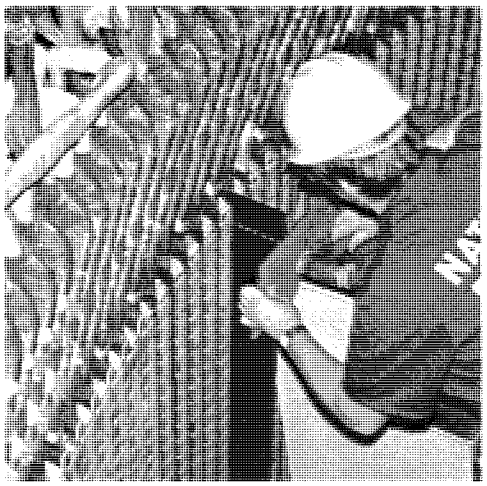
| | |
|---|---|
| Firm Energy Sales | 5,467,000,000 |
| Nonfirm Energy Sales (Oil Conservation) | 287,880,000 |
| Del. to Hoover allottees | 549,296,000 |
| Parker-Davis | 63,658,000 |
| Rio Grande firming | 10,523,000 |
| Net Interchange | 141,408,000 |
| System Losses | 319,571,000 |
| | 6,839,336,000 |

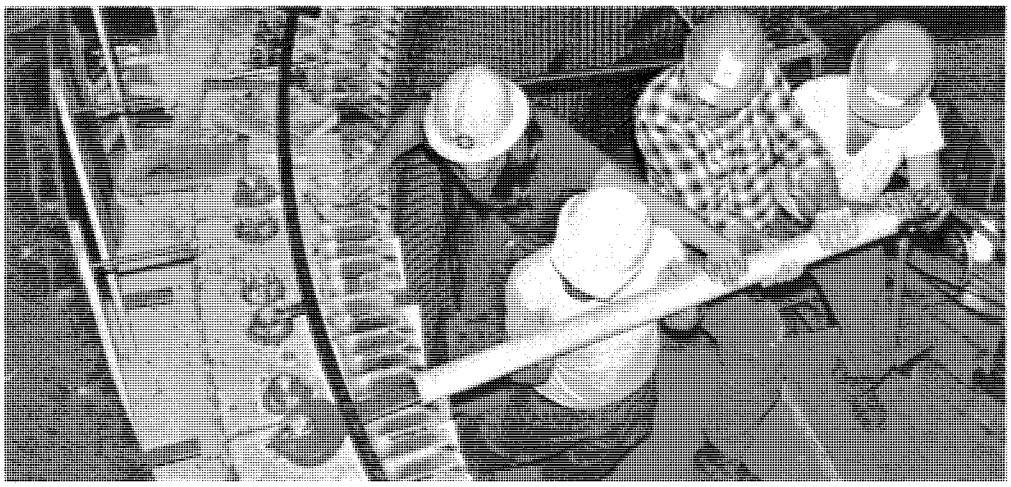
**Revenue**

| | |
|---|---|
| Firm Energy Sales | $39,900,000 |
| Nonfirm Energy Sales (Oil Conservation) | 9,062,000 |
| Hoover Def. reimbursement | 500,000 |
| Parker-Davis firming | 2,293,000 |
| Wheeling for others | 3,040,000 |
| Miscellaneous Income | 300,000 |
| | $55,095,000 |

**Water Year 1980**

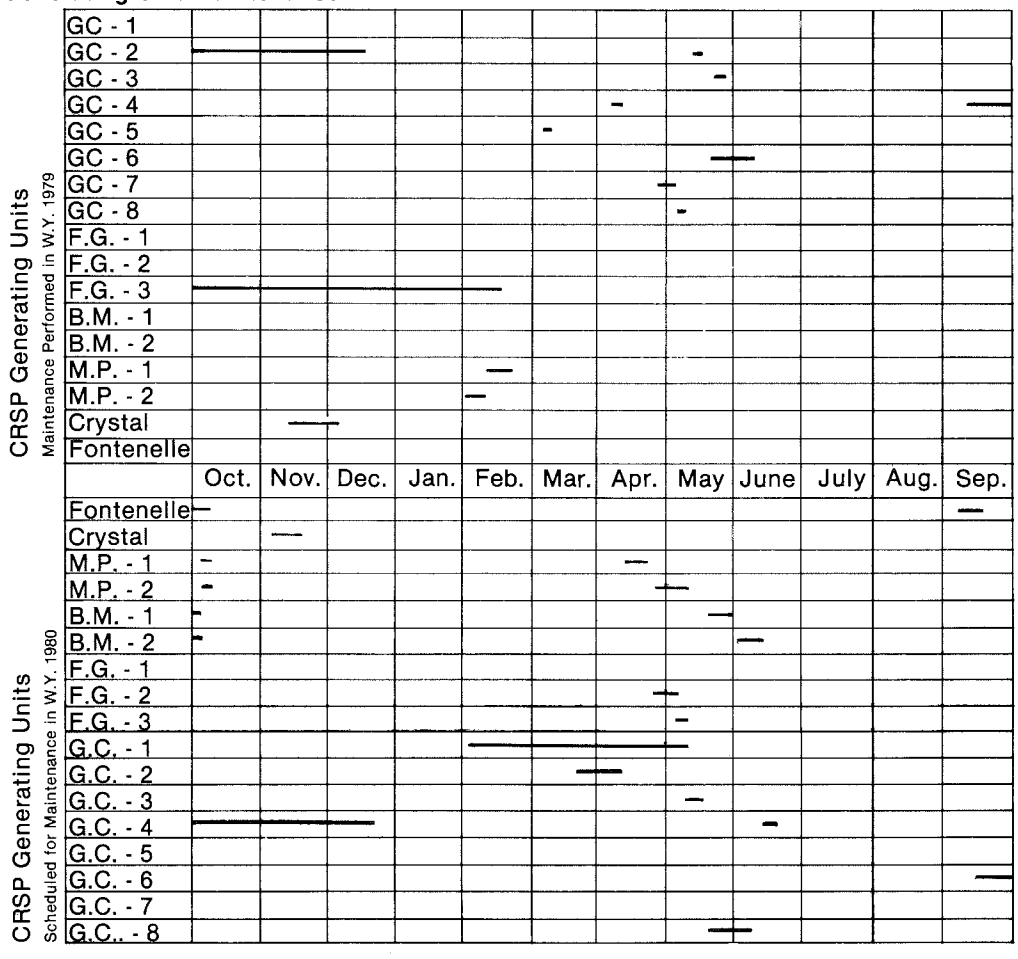
| | |
|---|---|
| Estimated Energy Sales | 6,489,000,000 |
| Estimated Purchases | 1,000,000,000 |
| Estimated Peaking Capacity Sales | |
| Winter 79/80 375,000 kW | |
| Summer 80 183,000 kW | |
| Estimated Revenues | $72,500,000 |



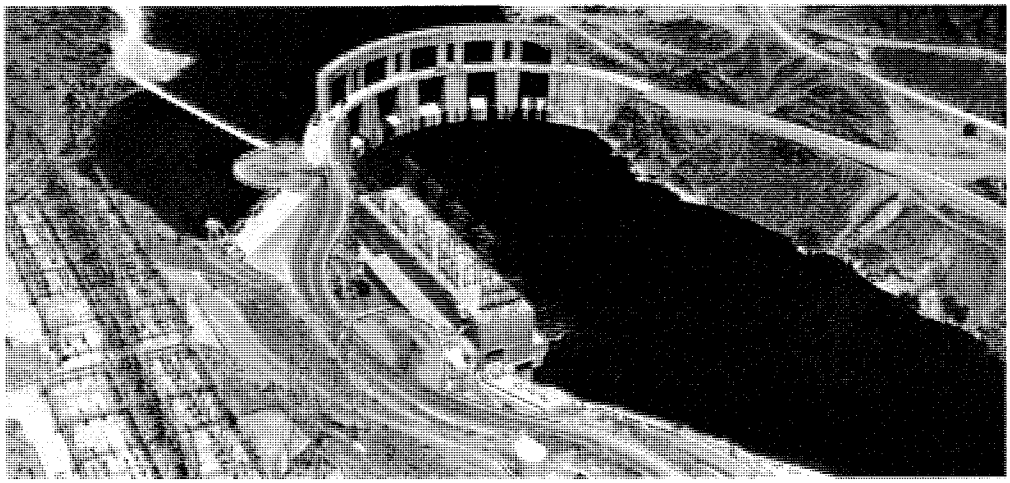


Generator rewinding, Glen Canyon Powerplant

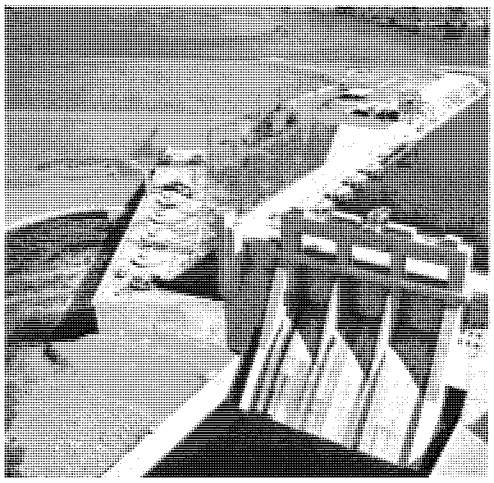
**Generating Unit Maintenance**



## Power Operations



Parker Dam, Ariz.-Calif.



Davis Dam

### Lower Basin

**Water Year 1979**
As discussed in the section on additional releases, on April 27, 1979, the Secretary of the Interior declared that extra water would be released from Hoover Dam to reduce the probability and magnitude of mandatory flood releases in1979 or 1980.

The total energy delivery to the Hoover allottees during the operating year ending May 31, 1979, was 3,838,327,402 kilowatt-hours (kW•h). Of this total delivery, Hoover generation plus Parker-Davis interchange amounted to 3,287,243,402 kW•h and replacement energy amounted to 551,084,000 kW•h.

**Water Year 1980**
In operation studies of Lake Mead and Lake Powell for the Hoover operating year which ends May 31, 1980, the releases at Hoover Dam have been estimated to exceed minimum downstream requirements. These include diversions by The Metropolitan Water District, and comply with the overall requirement to meet Compact and operating criteria release provisions. The excess water will generate 100 percent of defined firm energy. The estimated monthly Hoover releases during the operating year total 8,496,000 acre-feet. It is estimated that generation from these Hoover releases, along with the interchange between Hoover and Parker-Davis interchange, will result in delivery to the allottees of about 3,962,080,000 kW•h of electrical energy.

No deficiency power purchases have been budgeted for operating year 1980.

All scheduled periodic maintenance at Hoover, Davis, and Parker Dams was performed in water year 1979. The program for installation of high pressure thrust bearing lubrication will be completed during water year 1980 for all generating units at Hoover Dam.

The lower Nevada penstock at Hoover was scheduled to be out of service for approximately three weeks starting December 1, 1979. This measure was for the purpose of inspection and repair of the penstock lining.

During water year 1980, the Parker Dam Powerplant will be modified for remote automatic control for the four 30-megawatt units and Davis Dam will have remote automatic control completed for three of its five units. An inspection and preventative maintenance program is carried out during the time each of those units is out of service for the installation of the remote control equipment.



☆U.S. GOVERNMENT PRINTING OFFICE: 1980-0-678-524

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources, and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.