STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
Carson City

*Photo by U.S. Bureau of Reclamation*

View of Rye Patch Dam and Reservoir.

# WATER RESOURCES—INFORMATION SERIES

# REPORT 13

## BATHYMETRIC RECONNAISSANCE OF RYE PATCH RESERVOIR AND THE PITT–TAYLOR RESERVOIRS, PERSHING COUNTY, NEVADA

By
F. Eugene Rush
and
Bruce L. Rice

Prepared cooperatively by the U.S. Geological Survey
and the Nevada Division of Water Resources

1972

ELMO J. DeRICCO
*Director*

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
201 South Fall Street, Carson City, Nevada 89701

ROLAND D. WESTERGARD
*State Engineer*

In reply refer to
No.

Address All Communications to
the State Engineer, Division
of Water Resources

Bathymetric reconnaissance of Rye Patch Reservoir and the Pitt-Taylor Reservoirs, Pershing County, Nevada, by F. E. Rush and B. L. Rice: Nevada Water Resources-Information Series Report 13, 1972.

## Explanation of Figure 5

Figure 5 shows the water-storage efficiency of Rye Patch and the two Pitt-Taylor Reservoirs, based on a comparison of (1) amount of water in storage at various stages and (2) the corresponding average annual evaporation loss that would occur at various stages. In figure 5, the ratio of water in storage to evaporation loss (that is, water-surface area x net evaporation rate) is scaled across the bottom of the graph and water in storage along the left side of the graph. Moving to the right along the bottom scale corresponds to an increase in efficiency of the reservoir (or a decrease in evaporation in relation to storage). For example, a scale value of 3 means that the storage volume is 3 times the net volume of average annual evaporation. Moving up the left scale corresponds to an increase in reservoir stage and storage volume.

Figure 5 shows, for example, that with a storage volume of less than 13,000 acre-feet, Lower Pitt-Taylor Reservoir is more efficient than Upper Pitt-Taylor Reservoir. With 5,000 acre-feet of water stored in each, the ratio of water in storage to evaporation loss is 1.7 for the lower reservoir and 1.0 for the upper reservoir. This means that if the reservoirs were held at a stage wherein 5,000 acre-feet of water were maintained in each reservoir for a long-term period, the average annual evaporation loss from the upper reservoir would equal the stored volume of 5,000 acre-feet, but for the lower reservoir would be about 3,000 acre-feet (that is, 5,000 ÷ 1.7). For Rye Patch Reservoir, the corresponding ratio of storage to evaporation loss is 2.4. The computed loss from Rye Patch Reservoir would be 2,100 acre-feet.

In general terms, Rye Patch Reservoir is more efficient than either of the Pitt-Taylor Reservoirs because the ratio of storage to evaporation loss for Rye Patch Reservoir is generally larger.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES

WATER-RESOURCES—INFORMATION SERIES
REPORT 13

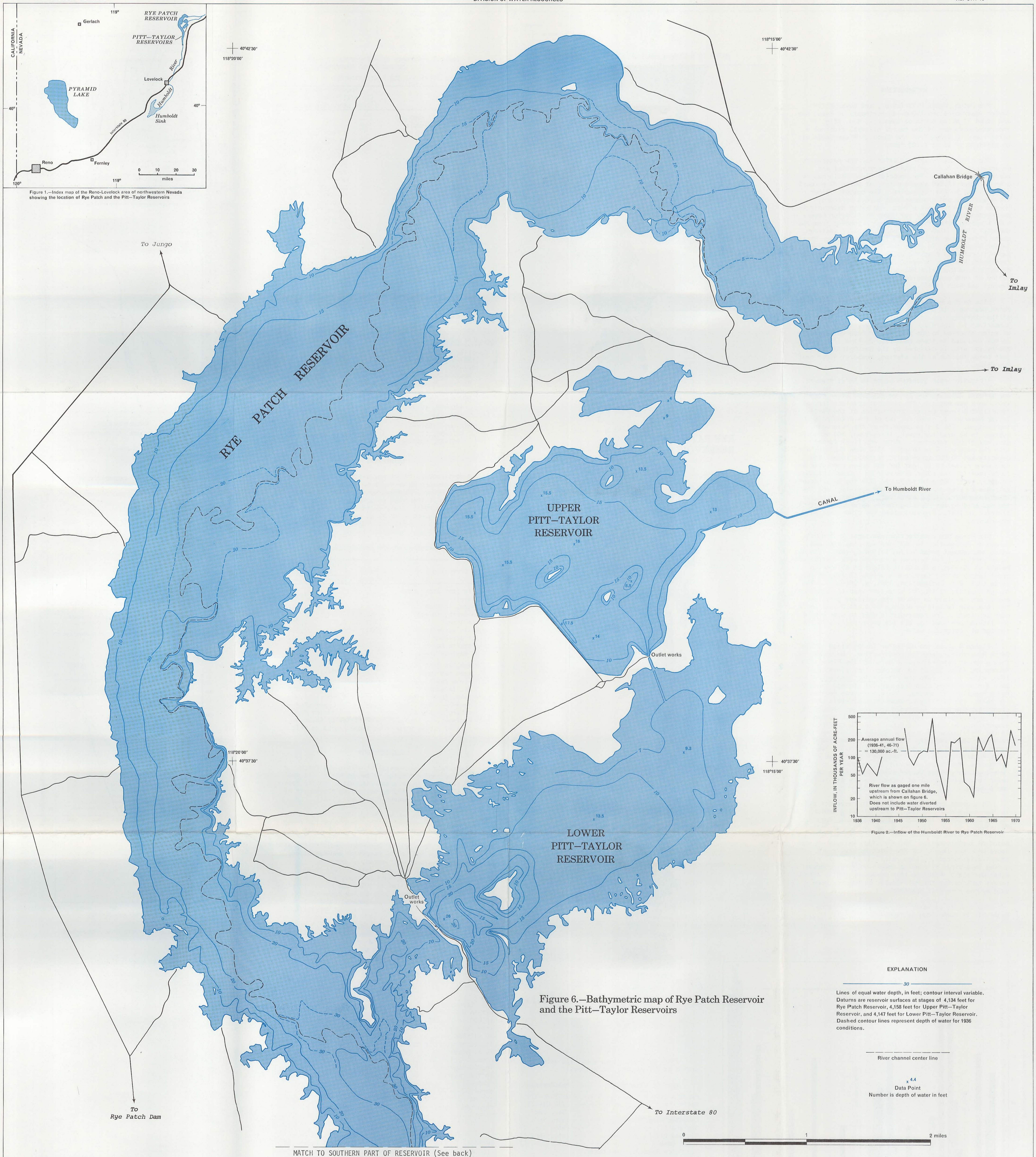


Figure 6.—Bathymetric map of Rye Patch Reservoir and the Pitt—Taylor Reservoirs

**EXPLANATION**

—— 30 ——
Lines of equal water depth, in feet; contour interval variable. Datums are reservoir surfaces at stages of 4,134 feet for Rye Patch Reservoir, 4,158 feet for Upper Pitt—Taylor Reservoir, and 4,147 feet for Lower Pitt—Taylor Reservoir. Dashed contour lines represent depth of water for 1936 conditions.

— — — — —
River channel center line

x 4.4
Data Point
Number is depth of water in feet

0 1 2 miles

Base: U.S. Geological Survey 1:24,000 topographic series: Imlay 3 NE (preliminary draft, 1971) and Imlay 3 SE (preliminary draft, 1971); and aerial photographs 1:19,000, 1971

Cartography by Charles Bosch

# BATHYMETRIC RECONNAISSANCE OF RYE PATCH RESERVOIR AND THE PITT—TAYLOR RESERVOIRS, PERSHING COUNTY, NEVADA

By
F. Eugene Rush and Bruce L. Rice

1972

## INTRODUCTION

Rye Patch, Upper Pitt-Taylor, and Lower Pitt-Taylor Reservoirs are 110 miles northeast of Reno, Nev., and about 35 miles north of Lovelock, Nev. (fig. 1). The reservoirs are on the narrow alluvial floor of a north-trending segment of the Humboldt River Basin at an altitude of about 4,100 feet.

The principal source of water for the reservoirs is snowmelt in the mountains of north-central and northeastern Nevada. The Humboldt River Basin has an area of about 17,000 square miles, of which 95 percent is tributary to the reservoirs. The Humboldt River flows westward and southwestward across northern Nevada to the reservoir sites. Rye Patch Reservoir is an on-channel reservoir, but Upper Pitt-Taylor Reservoir receives water through a canal extending from the Humboldt River; diversion is about 12 miles upstream. Lower Pitt-Taylor Reservoir is filled from Upper Pitt-Taylor Reservoir. To drain the Pitt-Taylor Reservoirs, water is released from the upper reservoir to the lower reservoir, and then to Rye Patch Reservoir. Releases of water from Rye Patch Reservoir are used for irrigation of land near Lovelock (fig. 1), as described by Everett and Rush (1965).

Flow of the Humboldt River a few miles above Rye Patch Reservoir is measured by the Geological Survey at the station, Humboldt River near Imlay, and is summarized in figure 2. The relatively small amount of water diverted to the Pitt-Taylor Reservoirs (fig.3) is not included in these amounts. Outflow from the reservoirs also is measured by the Geological Survey just below the dam at the station, Humboldt River near Rye Patch.

Irrigation near Lovelock began in 1862; however, full-season water supply was not available because of the erratic natural flow of the Humboldt River. In 1909, work was begun by the Humboldt-Lovelock Irrigation Light & Power Co. on construction of the Pitt-Taylor Reservoirs, named for two of the principals in the company. The design capacity of the reservoir system, to be used for power, irrigation, and domestic use, was 57,000 acre-feet. Water was first turned into the reservoirs in November 1912 when the completed capacity was 30,000 acre-feet. In 1915, levees and dams were raised to 19 feet for the upper reservoir and to 38 feet for the lower reservoir to increase storage capacity to 50,000 acre-feet. In 1935 the upper reservoir has a rated capacity of 29,000 acre-feet and the lower reservoir, 21,000 acre-feet. The reservoir system was sold to the Pershing County Water Conservation District in 1947. Figure 3 shows the diversions to the reservoirs.

Rye Patch Dam construction was begun by the U.S. Bureau of Reclamation in 1935 and was completed and water impoundment began in the following year. The dam is an earth-fill, rock-faced structure with a structural height of 75 feet, a hydraulic height of 63 feet, a crest length of 914 feet, and a volume of 356,000 cubic yards (U.S. Bur. Reclamation, 1961, p. 261-265). The design capacity is 190,000 acre-feet when 12-inch flashboards are in place on top of the spillway gates and the reservoir is full at a stage of 4,134.0 feet above mean sea level. The reservoir is used to some extent for fishing and boating, but its principal use is for storage of irrigation water.

Figure 4 shows the variation in the stage of Rye Patch Reservoir, since its construction. By comparing this graph to water-diversion data for the Pitt-Taylor Reservoirs (fig. 3), it can be seen that since about 1940, water is put into the Pitt-Taylor Reservoirs only during periods when supplemental storage for Rye Patch Reservoir is needed. There are three reasons for this: (1) Pitt-Taylor Reservoirs are less efficient than Rye Patch Reservoir for storage because of their generally lower ratio of stored-water volume to evaporation, as shown in figure 5; (2) water stored in the Pitt-Taylor Reservoirs leaches salts from the reservoir beds, reducing the quality of the stored water, whereas the quality of water stored in Rye Patch Reservoir remains better; and (3) in case of earthquake, Rye Patch Reservoir is considered by the Pershing County Water Conservation District to be a safer reservoir because of higher quality of its dam's design.

To convert staff gage readings to reservoir stage, in feet above mean sea level, the following factors should be added to the staff gage readings: Upper Pitt-Taylor Reservoir, 4,098.0 feet and Lower Pitt-Taylor Reservoir, 4,099.6 feet. These factors are based on the assumption that the stage values, in feet above mean sea level, for Rye Patch Reservoir are essentially correct. These relations were determined during this study by running levels between reservoir water surfaces. Prior to this survey, slightly different factors for the Pitt-Taylor Reservoirs were used by the reservoir operators.

The quality of water released from Rye Patch Reservoir is summarized in table 1.

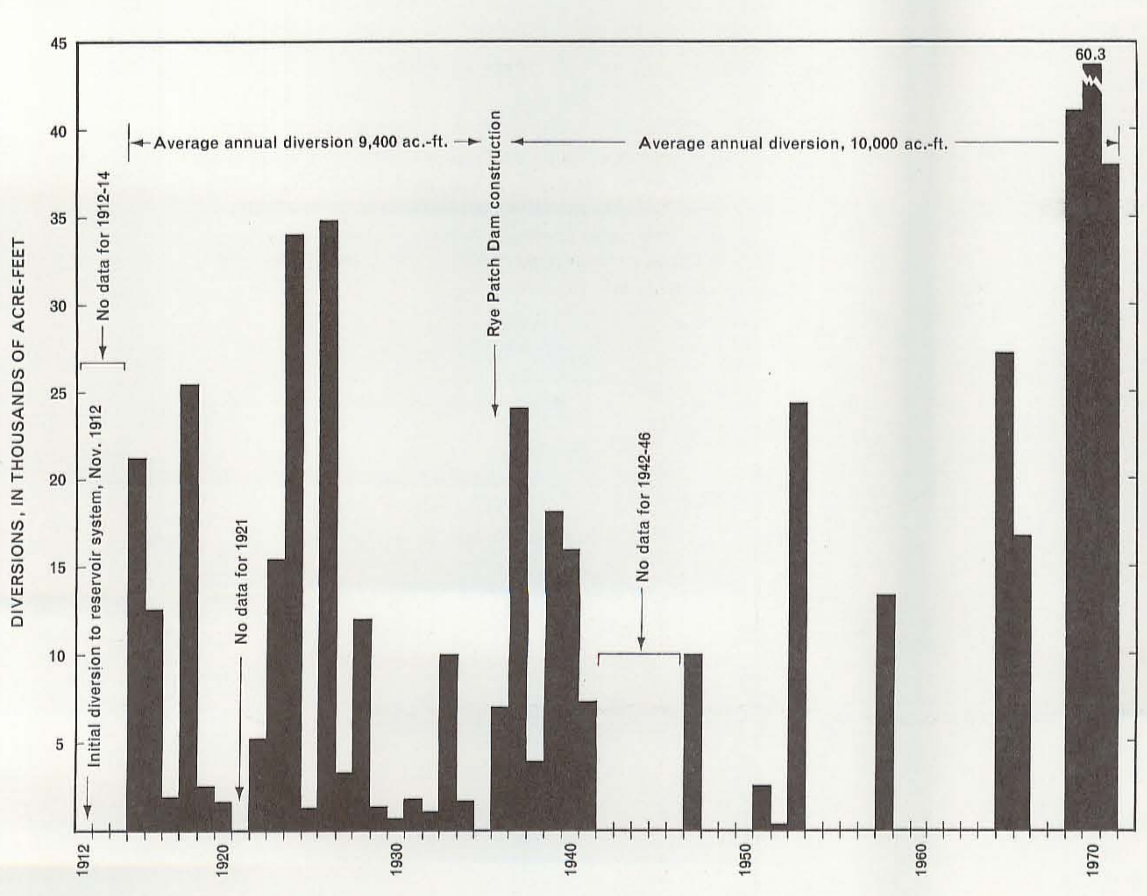


Figure 3.—Annual diversions of water from the Humboldt River to the Pitt-Taylor Reservoirs


Table 1.--*Summary of water-quality data for Rye Patch Reservoir*

[At gaging station 1,000 feet below Rye Patch Dam]

| Constituent | Concentration range (in milligrams per liter unless otherwise specified) |
|---|---|
| Water year 1970 (9 samples) | |
| Discharge when sample collected | 13-694 cfs |
| Temperature | 36-71°F<br>2.2-21.5°C |
| Silica | 33-36 |
| Calcium | 38-45 |
| Magnesium | 15-16 |
| Sodium | 125-135 |
| Potassium | 16-18 |
| Bicarbonate | 296-312 |
| Carbonate | 0-8 |
| Sulfate | 72-87 |
| Chloride | 86-106 |
| Fluoride | 0.8-1.1 |
| Nitrate | 0.0-0.2 |
| Boron | 260-580 µg/l |
| Dissolved solids | 562-604 |
| Hardness | 161-174 |
| Specific conductance | 893-950 micromhos |
| pH | 7.7-8.5 |
| Total phosphorus (as $PO_4$) | 0.27-0.65 |
| Aldrin, DDD, DDT, dieldrin, endrin, heptachlor, heptachlor epoxide, lindane, 2,4-D, 2,4,5-T, chlordane | 0.00 µg/l |
| Silvex | 0.01-0.06 µg/l |
| Period of record | |
| Specific conductance, (1951-58, 1959-61, 1962-69): | |
| Maximum daily | 4,010 micromhos on Sept. 2, 1954 |
| Minimum daily | 384 micromhos on June 24, 1956 |
| Water temperature: | |
| Maximum (1951-54, 1956-58, 1959-61, 1962-68) | 78°F(25.5°C) on Sept. 21, 1958 |
| Minimum (1951-54, 1956-58, 1959-61, 1962-67, 1968-69) | 33°F(0.5°C) on many winter days |

## BATHYMETRY

A continuously recording, electronic fathometer was used to measure water depth on the 43 traverses of Rye Patch Reservoir, 21 traverses of Upper Pitt-Taylor Reservoir, and 16 traverses of Lower Pitt-Taylor Reservoir, in June 1971. The results of the surveys are summarized in figures 5, 6, 7, 8, and 9. Dimensions of the reservoirs at reference stages used in figures 5, 6, 7, 8, and 9 are summarized in table 2.

Table 2.--*Dimensions of the reservoirs when full*[1]

| Dimension | Rye Patch Reservoir | Pitt-Taylor Reservoirs Upper | Pitt-Taylor Reservoirs Lower |
|---|---|---|---|
| Stage, in feet above mean sea level | 4,134 | 4,158 | 4,147 |
| Staff gage, in feet | -- | 60.0 | 47.4 |
| Maximum depth, in feet | 61.5 | 17.5 | 26 |
| Area, in acres | 11,400 | 2,070 | 2,570 |
| Volume, in acre-feet | 171,000 | 24,200 | 22,200 |
| Limit of drawdown when down-system reservoir is at maximum stage: | - no limit - | | |
| Stage, in feet above mean sea level | | 4,147 | 4,134 |
| Maximum depth, in feet | | 6.5 | 13 |
| Area, in acres | | 1,360 | 360 |
| Volume, in acre-feet | | 4,800 | 1,600 |

1. Pershing County Water Conservation District and the State Engineer may consider the Pitt-Taylor Reservoirs to be full at stages other than those listed in this table.

## SEDIMENTATION

The extent of sedimentation within Rye Patch Reservoir has been estimated by two methods: (1) the computed reduction in reservoir storage since the reservoir was formed, and (2) by estimating the amount of sediment fill on the reservoir bottom.

In 1936, the Bureau of Reclamation (1961, p. 261) computed that the reservoir, at a stage of 4,134 feet, had a storage capacity of 190,000 acre-feet. The results of the bathymetric survey of 1971 indicated a capacity of 171,000 acre-feet, or 19,000 acre-feet less. The difference in estimates may be the result of sedimentation, small errors in storage estimates, or both.

Comparing the bathymetric data of 1971 to an unpublished Bureau of Reclamation topographic map of the reservoir site compiled in 1934, sedimentation of from 1 to 5 feet along the axis of the reservoir is indicated. Figure 6 shows supplemental (dashed) contours that represent the configuration of the reservoir bottom in 1934 as compared to 1971 findings (the solid-line contours). The sedimentation, based on this comparison, is estimated to be on the order of 16,000 acre-feet. Sources of sediment would be the inflow of the Humboldt River and the collapse of vertical banks of the reservoir at high stage, as observed during the bathymetric study. This collapse has apparently enlarged the water-surface area of the reservoir from about 11,100 acres, when the reservoir was formed, to its 1971 area of 11,400 acres at a 4,134-foot stage.

From the two methods of estimating sedimentation within Rye Patch Reservoir, it is concluded that between 15,000 and 20,000 acre-feet of sediment has been deposited during the period 1936-71, or between about 30 and 40 million tons, assuming the unit weight of the deposits to be about 90 pounds per cubic foot. According to P. A. Glancy, hydrologist, U.S. Geological Survey (oral commun.), the 36-year sediment yield of the upstream 16,000-square-mile basin, in order to supply this amount to the reservoir from the Humboldt River, assuming a trap efficiency of nearly 100 percent, would be only about 50 to 70 tons per square mile per year. No estimates of sedimentation in the Pitt-Taylor Reservoirs have been made.

Other bathymetric surveys have been completed or are planned, as follows:

| *Lake or Reservoir* | *Publication* |
|---|---|
| Pyramid Lake | USGS HA-379 |
| Walker Lake | USGS HA-415 |
| | Nev. DWR |
| Lahontan Reservoir | Info. Ser. 9 |
| Big and Little Washoe Lakes | Info. Ser. 10 |
| Big and Little Soda Lakes | Info. Ser. 11 |
| Topaz Lake | Info. Ser. 12 |
| Rye Patch Reservoir and Upper and Lower Pitt-Taylor Reservoirs | Info. Ser. 13 |
| Marlette and Spooner Lakes | Info. Ser. 14 |
| Weber Reservoir | Info. Ser. 15 |
| Wildhorse Reservoir | Info. Ser. 16 |

## REFERENCES

*Everett, D. E., and Rush, F. E., 1965, Water-resources appraisal of Lovelock Valley, Pershing County, Nevada: Nevada Dept. Conserv. and Nat. Resources, Water-Resources Reconn. Ser. Rept. 32, 40 p.*

*U.S. Bureau of Reclamation, 1961, Reclamation project data: U.S. Bur. Reclamation pub., 890 p.*

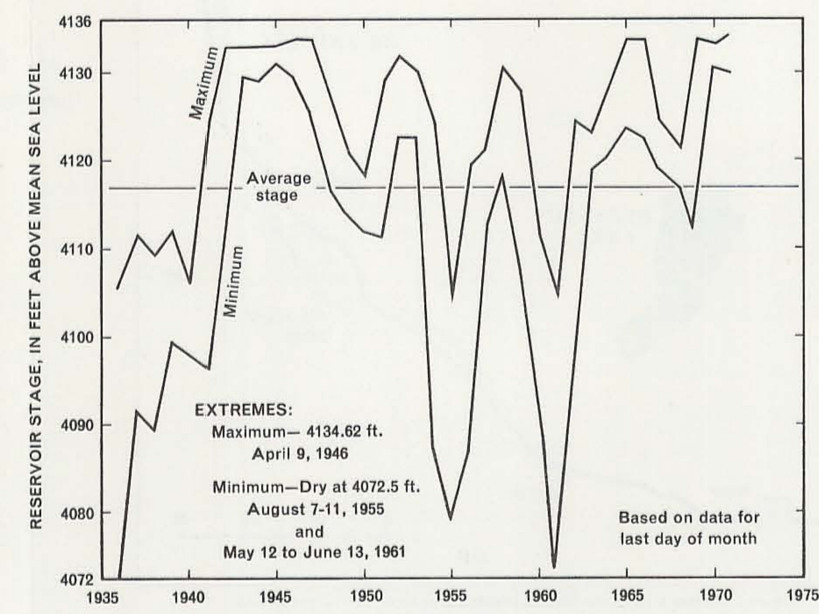


Figure 4.—Annual variation in stage of Rye Patch Reservoir

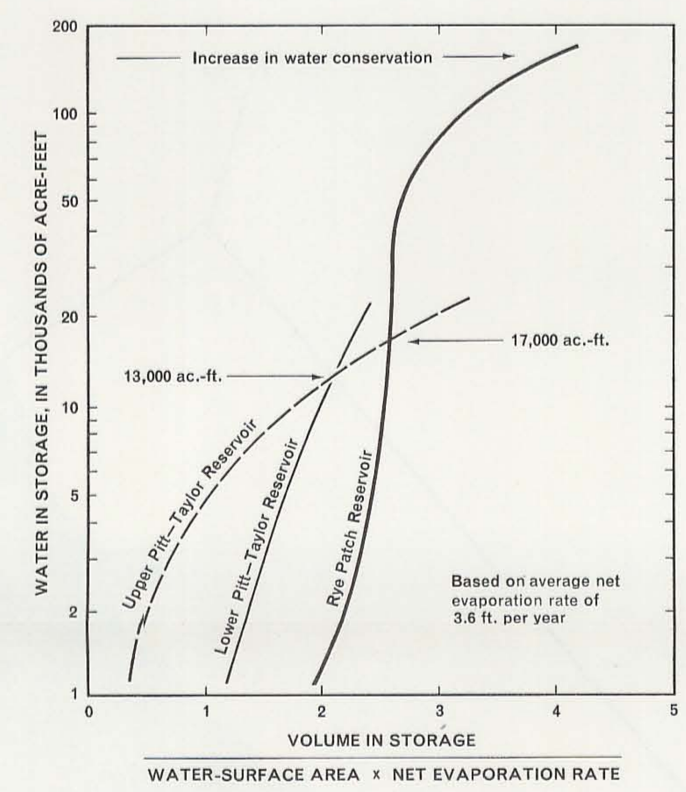


Figure 5.—Storage efficiency of the reservoirs

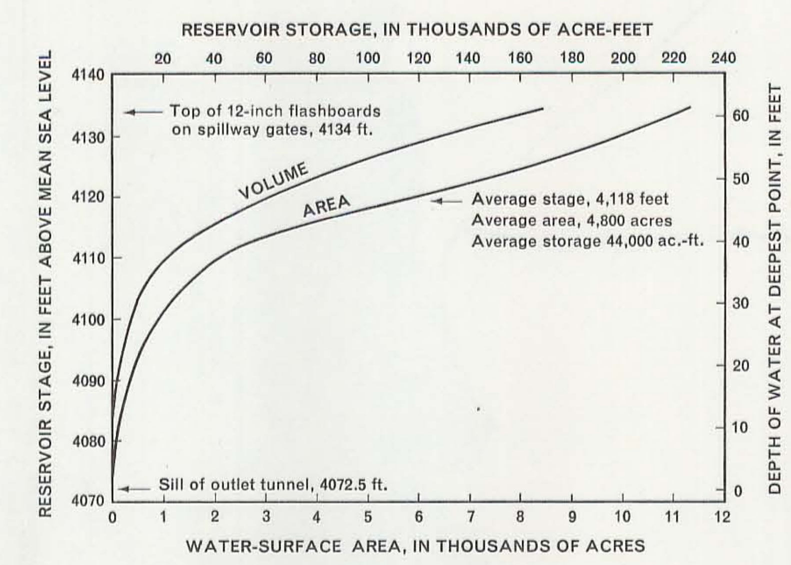


Figure 7.—Stage-area-volume relations for Rye Patch Reservoir, June 1971

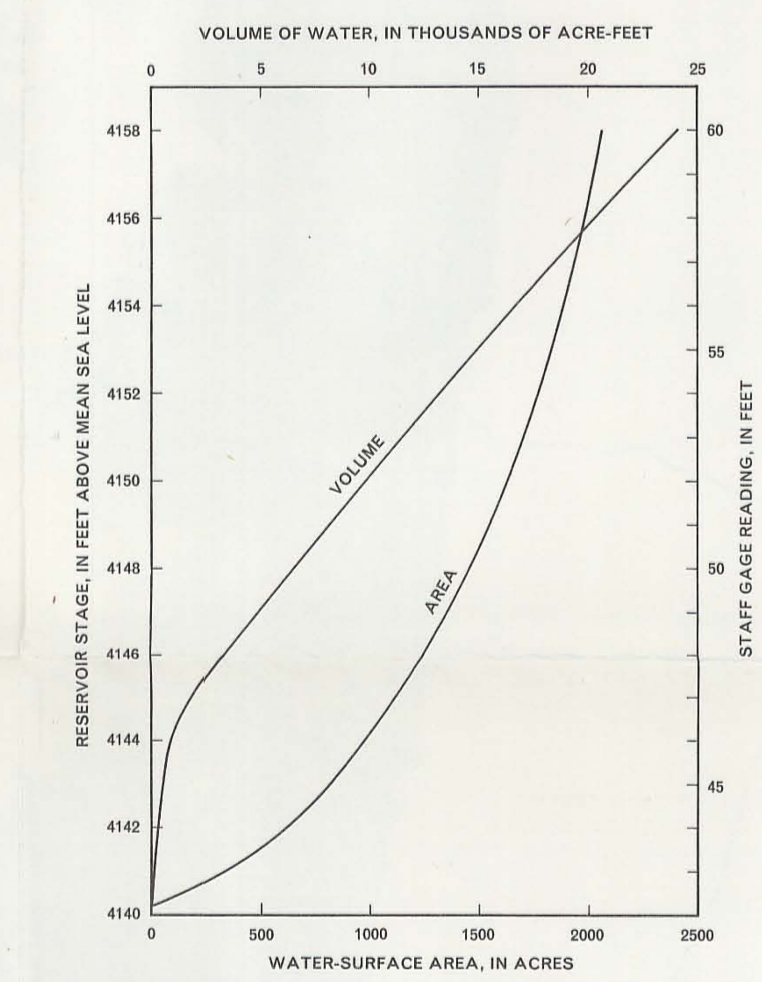


Figure 8.—Stage-area-volume relation for Upper Pitt-Taylor Reservoir

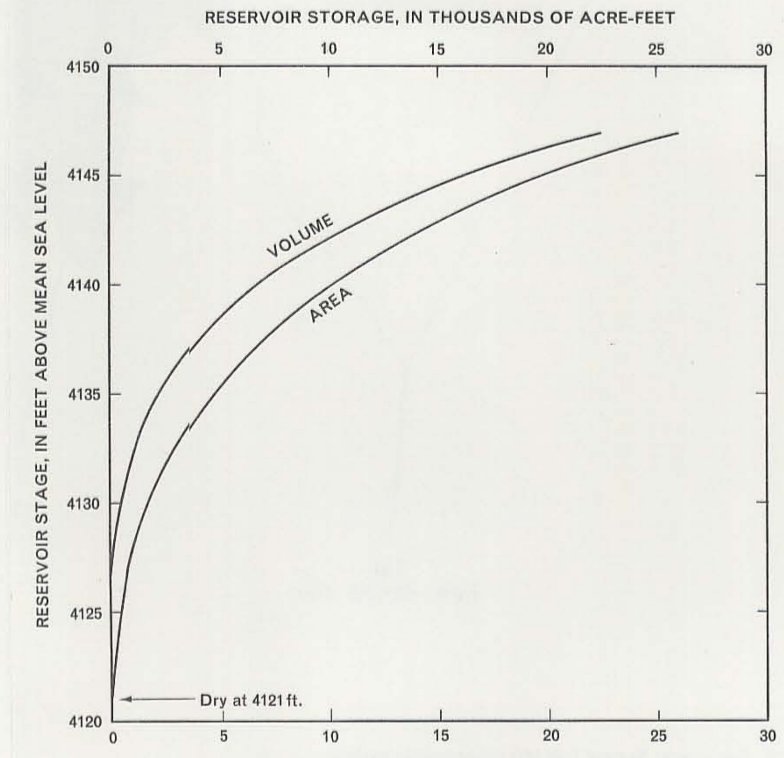


Figure 9.—Stage-area-volume relation for Lower Pitt–Taylor Reservoir

ELMO J. DeRICCO
*Director*

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
201 South Fall Street, Carson City, Nevada 89701

ROLAND D. WESTERGARD
*State Engineer*

In reply refer to
No.

Address All Communications to the State Engineer, Division of Water Resources

Bathymetric reconnaissance of Rye Patch Reservoir and the Pitt-Taylor Reservoirs, Pershing County, Nevada, by F. E. Rush and B. L. Rice: Nevada Water Resources-Information Series Report 13, 1972.

## Explanation of Figure 5

Figure 5 shows the water-storage efficiency of Rye Patch and the two Pitt-Taylor Reservoirs, based on a comparison of (1) amount of water in storage at various stages and (2) the corresponding average annual evaporation loss that would occur at various stages. In figure 5, the ratio of water in storage to evaporation loss (that is, water-surface area x net evaporation rate) is scaled across the bottom of the graph and water in storage along the left side of the graph. Moving to the right along the bottom scale corresponds to an increase in efficiency of the reservoir (or a decrease in evaporation in relation to storage). For example, a scale value of 3 means that the storage volume is 3 times the net volume of average annual evaporation. Moving up the left scale corresponds to an increase in reservoir stage and storage volume.

Figure 5 shows, for example, that with a storage volume of less than 13,000 acre-feet, Lower Pitt-Taylor Reservoir is more efficient than Upper Pitt-Taylor Reservoir. With 5,000 acre-feet of water stored in each, the ratio of water in storage to evaporation loss is 1.7 for the lower reservoir and 1.0 for the upper reservoir. This means that if the reservoirs were held at a stage wherein 5,000 acre-feet of water were maintained in each reservoir for a long-term period, the average annual evaporation loss from the upper reservoir would equal the stored volume of 5,000 acre-feet, but for the lower reservoir would be about 3,000 acre-feet (that is, 5,000 ÷ 1.7). For Rye Patch Reservoir, the corresponding ratio of storage to evaporation loss is 2.4. The computed loss from Rye Patch Reservoir would be 2,100 acre-feet.

In general terms, Rye Patch Reservoir is more efficient than either of the Pitt-Taylor Reservoirs because the ratio of storage to evaporation loss for Rye Patch Reservoir is generally larger.