UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FLOW CHARACTERISTICS OF THE LOWER WISCONSIN RIVER

Open-File Report 75-582

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FLOW CHARACTERISTICS OF THE LOWER WISCONSIN RIVER

By J. H. Green

Open-File Report 75-582

Madison, Wisconsin

November 1975

CONTENTS

ILLUSTRATIONS

The flow of water throughout the year and the stream gradient are necessary considerations in evaluating the recreational potential of the lower Wisconsin River. This flow is regulated in part by the dam at Prairie du Sac and influenced considerably by the 47 storage reservoirs and power dams above Lake Wisconsin. The river's gradient and flow characteristics can be illustrated by a river profile and graphs of flow durations, 7-day low flows, and flood-flow recurrence (Hindall and Borman, 1974). Sufficient streamflow data to develop meaningful graphs were available for the gaging site at Muscoda, about the midpoint of the river reach being studied.

The uniform, low gradient of the river below the Prairie du Sac dam (fig. 1) allows easy, recreational canoeing. In this reach, the river gradient is only about 1.5 ft/mi and is at grade with the Mississippi River. Being at grade, the Wisconsin is neither eroding downward nor building up its valley. Sediments commonly removed from the outside of meander loops generally move slowly downstream as migrating sand bars and eventually are deposited along the insides of other meander loops. Canoeists have no difficulty with the slow-moving water, but occasionally may become grounded on the slightly submerged sand bars.

The flow-duration curve (fig. 2) shows the percentage of time that the discharge equaled or exceeded a given rate between 1939 and 1968. For about 98 percent of the time, the discharge of the Wisconsin River at Muscoda ranged between about 3,000 ft^3/s and 30,000 ft^3/s. The flow was more than 30,000 ft^3/s only 1 percent of the time and less than 3,000 ft^3/s only 1 percent of the time. Average flow of the river for the 1913-74 period, 8,613 ft^3/s, was equaled or exceeded about 35 percent of the time.

The 7-day low flow is the lowest average discharge during 7 consecutive days of any year. Figure 3 shows the recurrence interval of these 7-day low flows based on a data period from 1939 to 1968 (Hindall and Borman, 1974). Based on the assumptions that 1939-68 is a representative sample of time and that regulation patterns of upstream reservoirs have not and will not change, an extreme low flow of only 2,000 ft^3/s for 7 consecutive days can be expected in the future on the average of just once in 50 years. More common are 7-day low flows of about 3,000 ft^3/s, which may recur an average of about once per 5 years.

Flood-frequency curves show the average recurrence interval of a given discharge and the percentage chance of that discharge being exceeded in any year assuming the period of record is a representative time sample and no change in regulation patterns. The range of flood flows on the lower Wisconsin River are not great--the 50-year flood is only about twice as high as the average annual flood. Figure 4 shows that the 50-year flood will have a discharge of about 70,000 ft^3/s compared

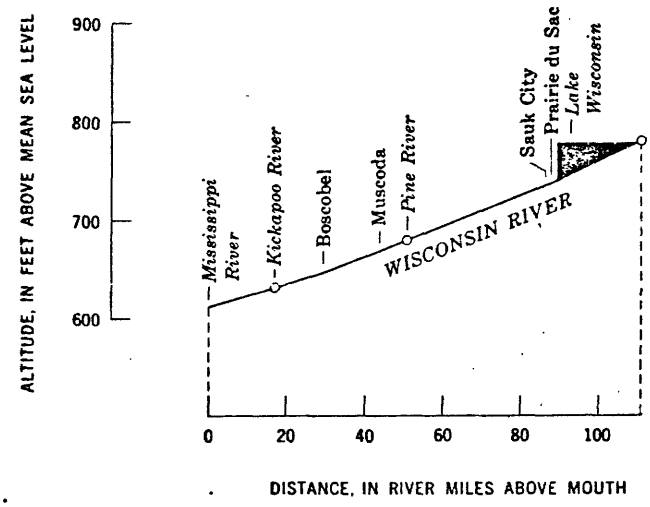

Figure 1. Profile of the Wisconsin River between the Mississippi River and Lake Wisconsin.

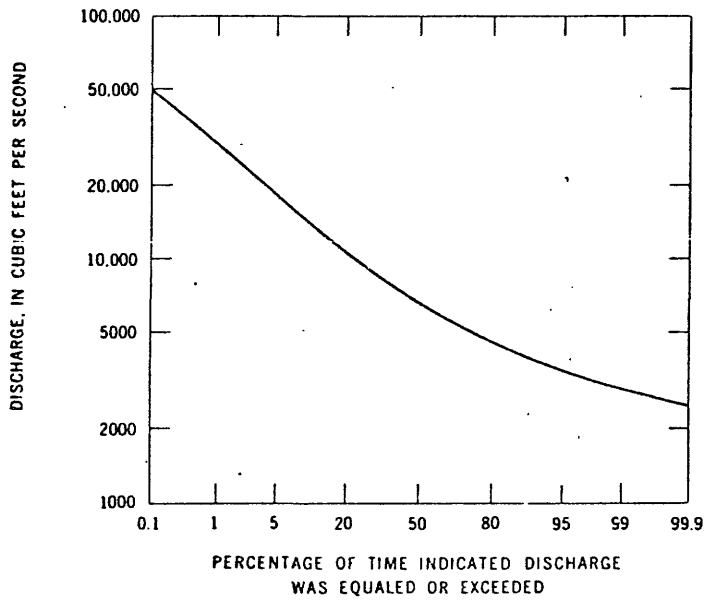

Figure 2. Flow duration of the Wisconsin River at Muscoda.

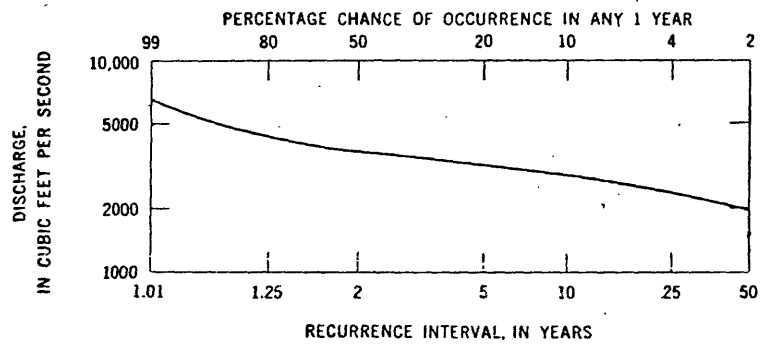

Figure 3. 7-day low flow of the Wisconsin River at Muscoda.

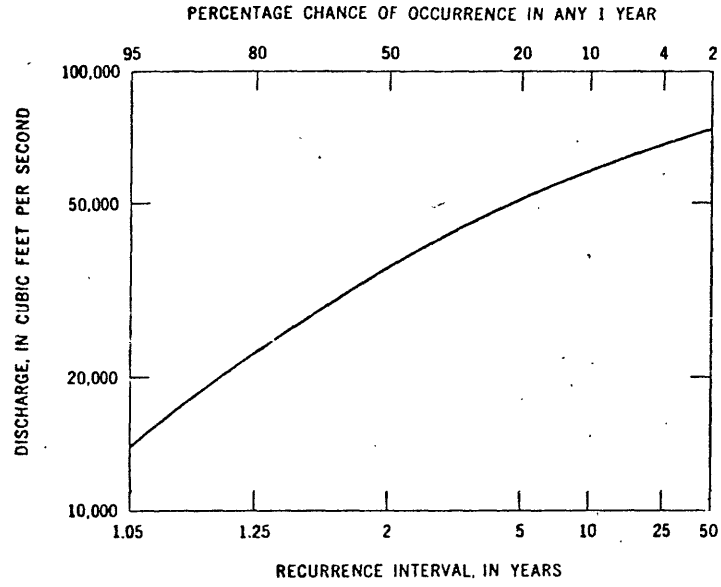

Figure 4. Flood-flow recurrence of the Wisconsin River at Muscoda.

to a 2-year or average flood of about 35,000 ft^3/s and a 1.05-year flood of about 14,000 ft^3/s. This narrow range of flood discharge can be attributed to floodwater storage behind the many dams farther upstream and by the dam at Prairie du Sac.

Figure 5 compares water profiles for the predicted 100-year flood, the highest flood of record, and low water. All three profiles show 14 to 16 ft difference between low water and the predicted 100-year flood. At each location the 100-year flood is only 2 to 3 ft above the record flood of September 1938. The flood-profile segments are for places where major damage might result from a 100-year flood. This 100-year flood is estimated to be about 94,000 ft^3/s at the Muscoda gage.

The suitability of the Wisconsin River for canoeing may be judged from monthly flow durations. Figure 6 shows the percentage of daily flows in each month that the riverflow equaled or exceeded a given amount (based on daily records of the Wisconsin River at Muscoda between 1913 and 1974). During the period of record, the average daily discharge for each of the 12 months always was greater than 2,000 ft^3/s. At a flow of 2,000 ft^3/s, the river could be traversed by a canoe if the canoeist can "read the river" and use the deep-water channel. As discharge increases, sand bars become less of a problem for the canoeist.

Because of Wisconsin's cold winters, the river generally is not suitable for canoeing in December, January, and February. During these months, the river may be partly to totally frozen over, with most of the water flowing under the ice.

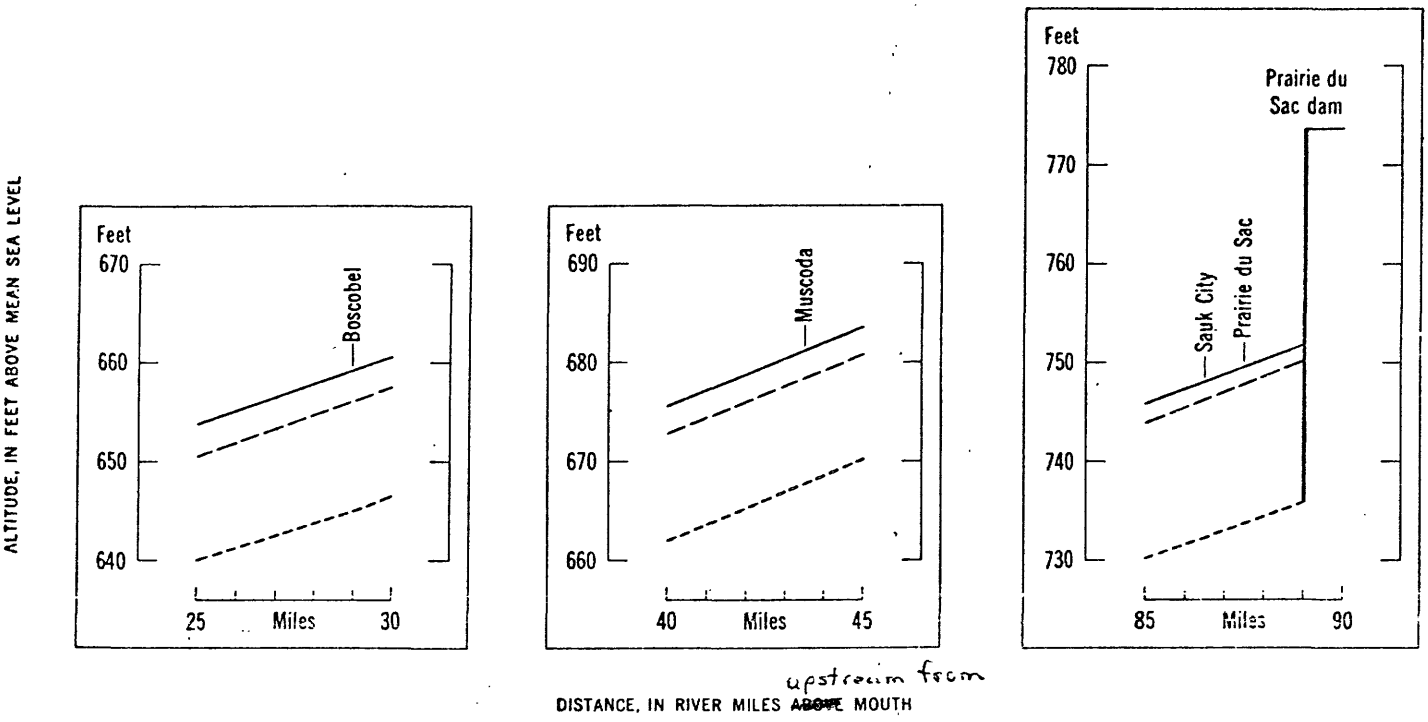

Figure 5. Profiles of the 100-year flood, the highest flood of record (Sep. 1938), and low water.

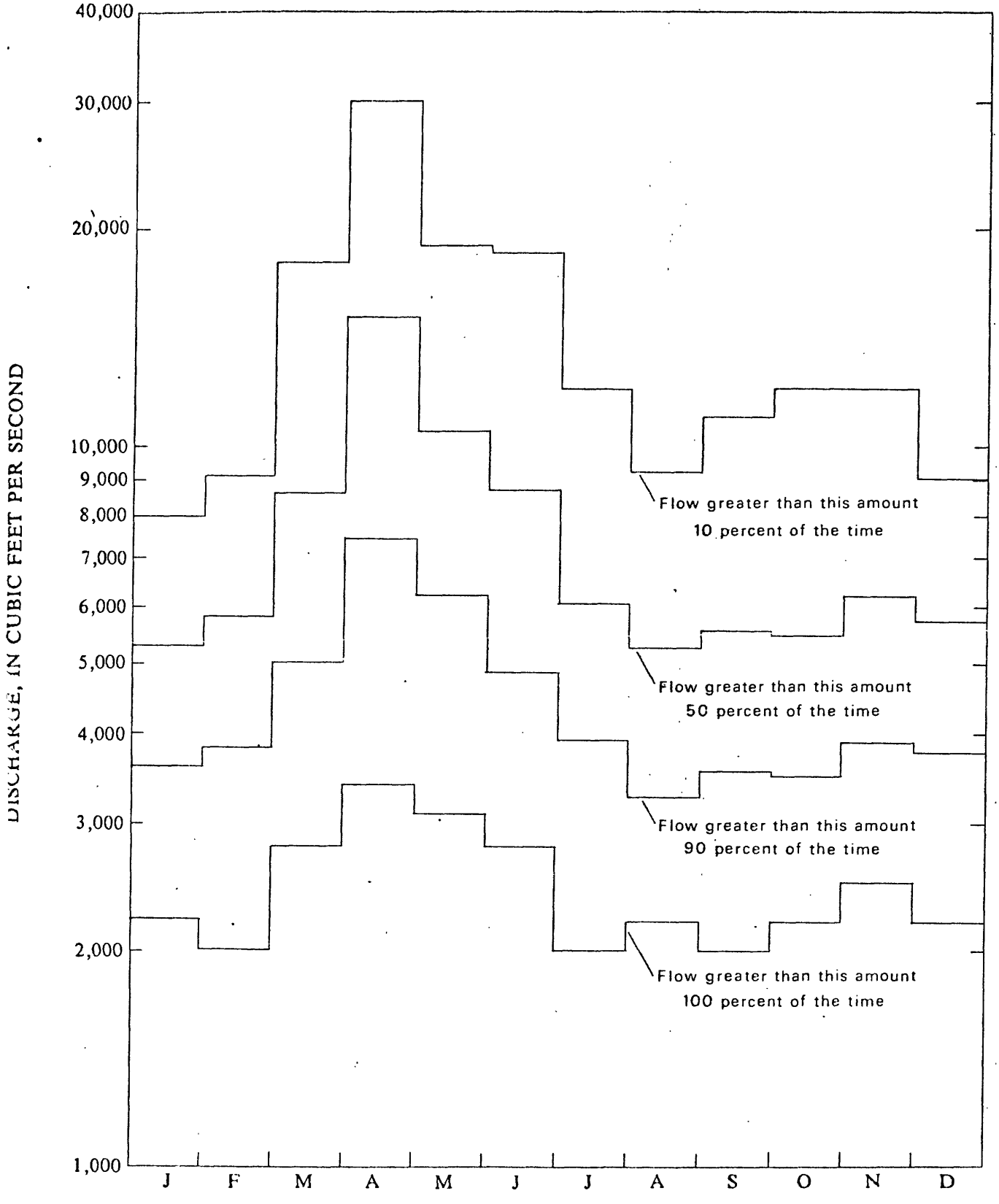

Figure 6. Monthly flow durations of the Wisconsin River at Muscoda.

REFERENCE

Hindall, S. M., and Borman, R. G., 1974, Water resources of Wisconsin-lower Wisconsin River basin: U.S. Geol. Survey Hydrol. Inv. Atlas HA-479.