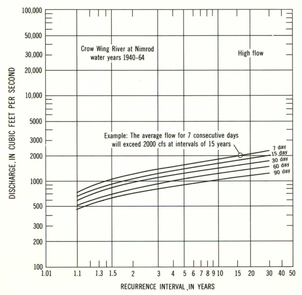
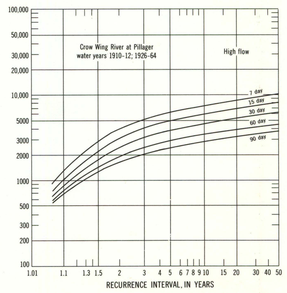
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS, SOILS, AND MINERALS

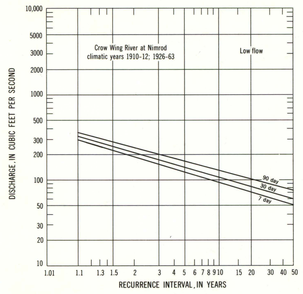
HYDROLOGIC INVESTIGATIONS
ATLAS HA-380 (SHEET 3 OF 4)

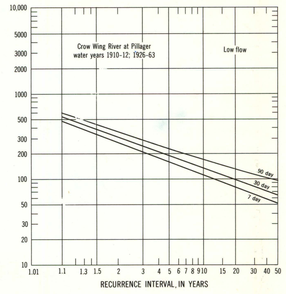
SURFACE WATER





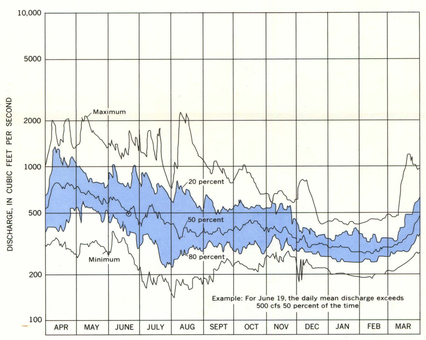
HIGH-FLOW FREQUENCY CURVES FOR THE CROW WING RIVER SHOW FLOOD FLOWS ARE SUSTAINED FOR RELATIVELY LONG PERIODS OF TIME.—*The natural storage in many lakes and marshes in the basin regulates the storm runoff so stages in the Crow Wing River usually rise and recede rather slowly.*



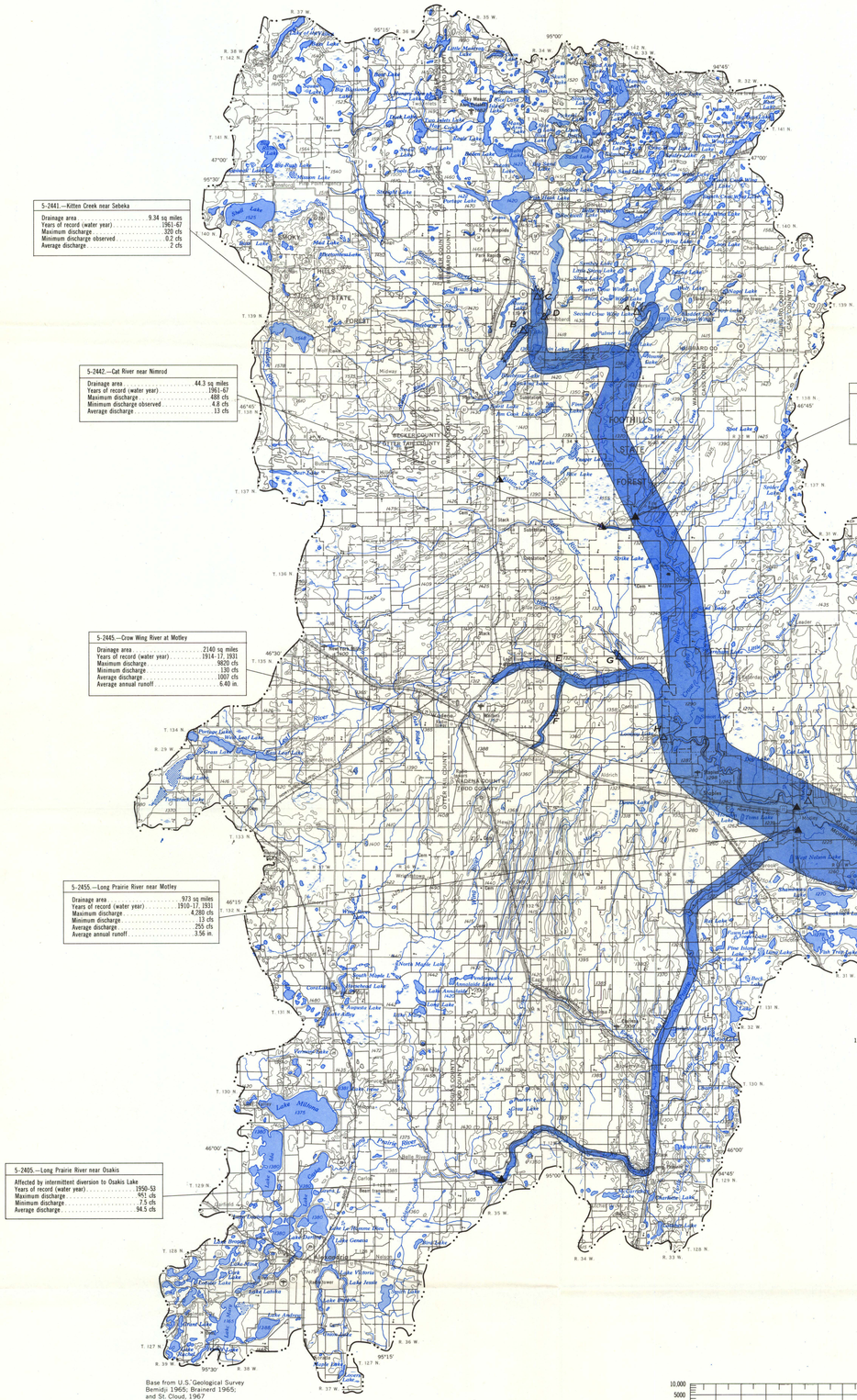


LOW-FLOW FREQUENCY CURVES FOR THE CROW WING RIVER SHOW SUSTAINED FLOWS THROUGHOUT THE RANGE OF RECURRENCE INTERVALS.—*Low flow is primarily discharge from ground-water sources so it is highly dependent on the storage capacity of adjacent outwash deposits.*

GEOLOGIC AND HYDROLOGIC CHARACTERISTICS OF THE WATERSHED ARE REFLECTED IN THE SHAPE OF THE FLOW-DURATION CURVES.—*The shape and relatively flat slope of the lower part of these curves is indicative of the perennial storage in the lakes and glacial deposits of the basin.*

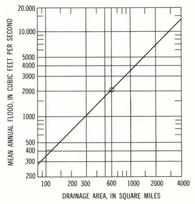


THE SEASONAL VARIATION OF FLOW IS SHOWN BY THE DAILY DURATION HYDROGRAPH FOR CROW WING RIVER AT NIMROD FOR 1943-61.—*Minimum discharges normally occur in January and February when the flow is sustained almost entirely by ground-water flow. In 20 of the 28 years from 1940-67, the minimum monthly flow per year for this station occurred during the winter. Instantaneous annual maximum flows have occurred any time from March through October but most periods of sustained high flow result from snowmelt in April.*

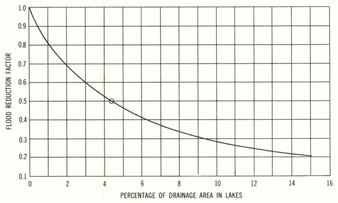


THE AVERAGE FLOW DIAGRAM SHOWS THE THEORETICAL MAXIMUM QUANTITY OF WATER AVAILABLE IN A STREAM

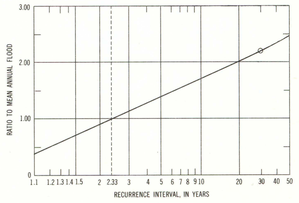
Flow diagram is for period 1931-64. Lack of suitable reservoir sites, and evaporation and seepage losses prevent complete utilization of the average stream-flow. Flow is diverted at times from the Long Prairie River to Lake Osakis and thence to the Sauk River basin. Point of diversion is just upstream from the gaging station on Long Prairie River near Osakis.



A.—RELATION CURVES BETWEEN MEAN ANNUAL FLOOD AND DRAINAGE AREA



B.—FLOOD REDUCTION CURVE



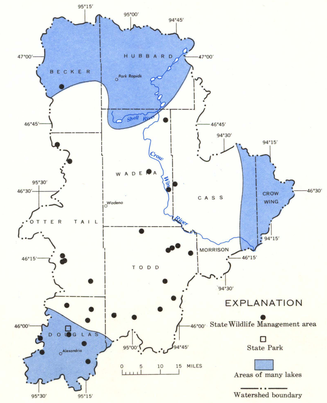
C.—FLOOD FREQUENCY CURVE FOR CROW WING RIVER BASIN

THE RECURRENCE INTERVAL OF A FLOOD OF SELECTED MAGNITUDE CAN BE DETERMINED BY USE OF RELATION CURVE *A* FLOOD REDUCTION CURVE *B*, AND FLOOD FREQUENCY CURVE *C*

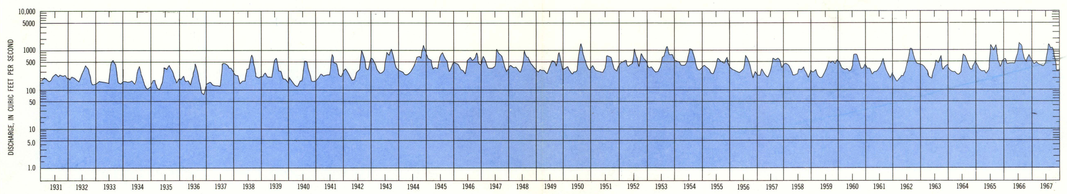
Example: Find the recurrence interval of a flood of 2310 cfs at a site having a 600 square mile drainage area of which 4.3 percent is lakes.

1. From curve in diagram *A*, the mean annual flood for 600 sq. mi. drainage area is 2,100 cfs.
2. From curve in diagram *B*, when 4.3 percent of the drainage area is lakes, the mean annual flood is reduced by a factor of 0.5. The adjusted mean annual flood becomes $0.5 \times 2{,}100$ cfs $= 1{,}050$ cfs.
3. The ratio of 2,310 cfs flood to the mean annual flood is $\frac{2310}{1050} = 2.2$.
4. Entering diagram *C* with ratio of 2.2, the frequency curve shows that the 2,310 cfs flood has a recurrence interval of 30 years. The magnitude of a flood of a specified recurrence interval at this same site can also be found by reversing this procedure. These curves do not apply to streams greatly affected by regulation at high flows. Curves are from report by Patterson and Gamble (1968).

Letter key	Miscellaneous discharge measurement site	Drainage area (sq mi)	Approximate average flow in cfs for period 1931-64
A	Crow Wing River near Hubbard.	218	75
B	Shell River above Straight River near Hubbard.	203	60
C	Straight River near Hubbard.	374	120
D	Long Lake outlet near Hubbard.	22	20
E	Leaf River near Verndale.	419	70
F	Wing River near Verndale.	166	25
G	Redeye River near Aldridge.	198	35
H	Partridge River near Aldridge.	97	6
J	Mosquito Creek at Motley.	43	5



THE NUMEROUS LAKES AND STREAMS IN THE WATERSHED PROVIDE EXCELLENT OUTDOOR RECREATIONAL OPPORTUNITIES.—*Game fish, such as walleye, northern pike, bass, and panfish, are found in many of the lakes and streams in the watershed. The Crow Wing and Shell Rivers are established canoe routes along which many access points and campsites are provided. They are family-type canoeing rivers for the current is not dangerous and there are no dams or portages along the route. State Wildlife Management Areas are primarily wetlands which are excellent wildlife habitats managed for maximum wildlife production.*



THE MONTHLY MEAN DISCHARGE HYDROGRAPH FOR CROW WING RIVER AT NIMROD SHOWS LITTLE VARIATION IN FLOW FROM YEAR TO YEAR
Winter records for 1931-39 water years are estimated on basis of streamflow records for Crow Wing River at Pillager.

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WATER RESOURCES OF THE CROW WING RIVER WATERSHED, CENTRAL MINNESOTA

By
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1972