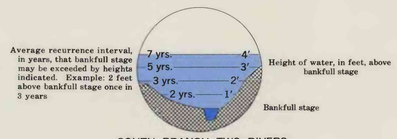
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE MINNESOTA DEPARTMENT OF CONSERVATION
DIVISION OF WATERS

HYDROLOGIC INVESTIGATIONS
ATLAS HA-237 (SHEET 3 OF 4)

SURFACE WATER

EXPLANATION



SOUTH BRANCH TWO RIVERS
at Pelan–1034

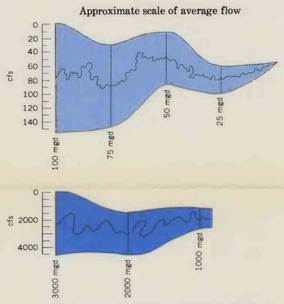
Name of stream-gaging station and elevation, in feet above mean sea level at bankfull stage

(J) Letter key to table
4 Average number of months of no flow
3.5 Maximum continuous period of no flow, in months
▲ Stream-gaging station

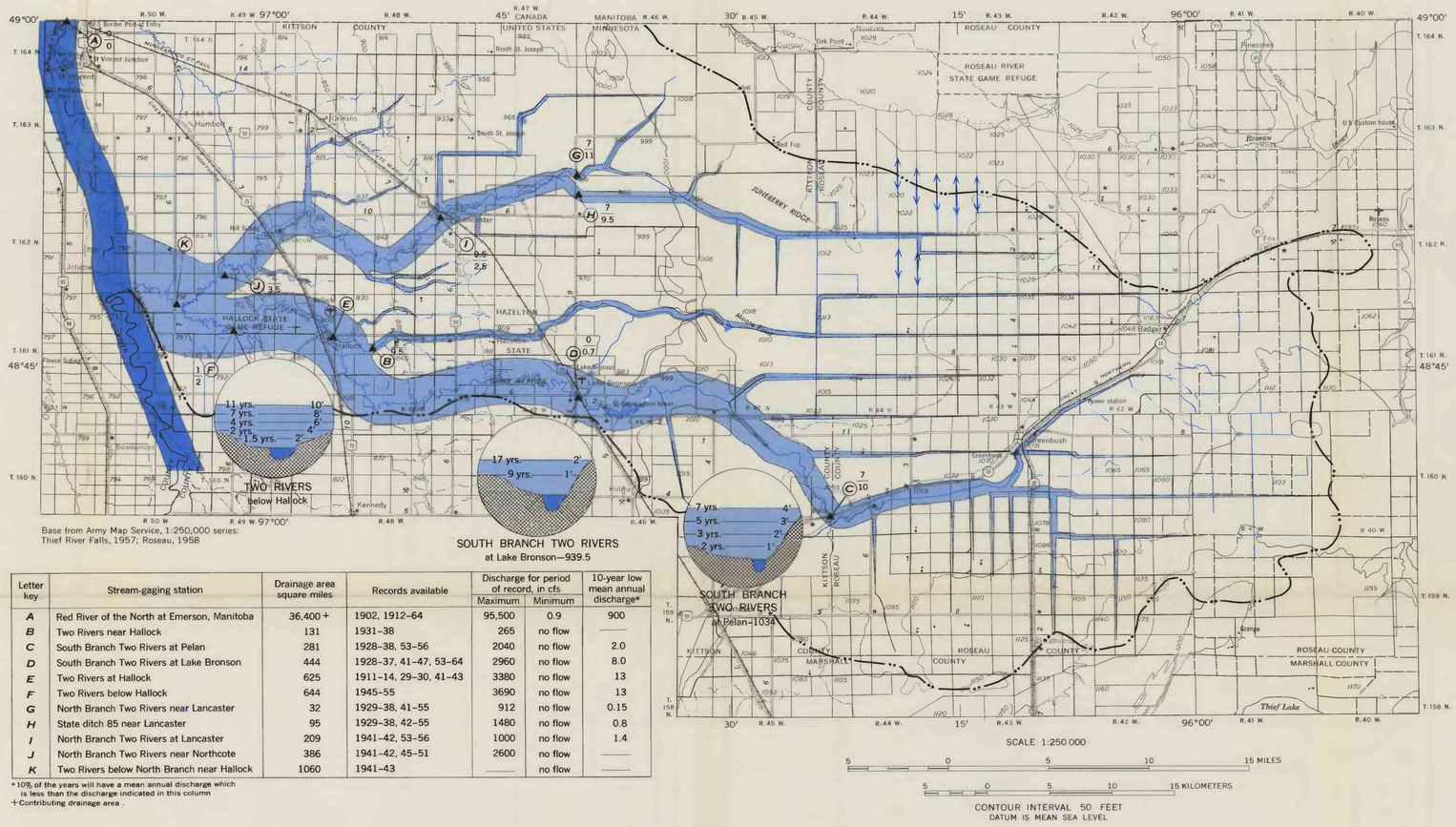
Watershed boundary

Arrows indicate drainage ditches where flood water can flow across the drainage divides

Approximate scale of average flow

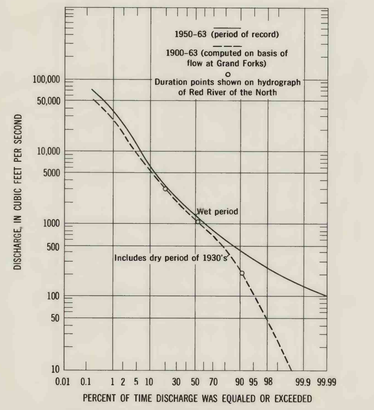


Width of color pattern along stream indicates approximate average flow in millions of gallons per day (mgd) or in cubic feet per second (cfs)

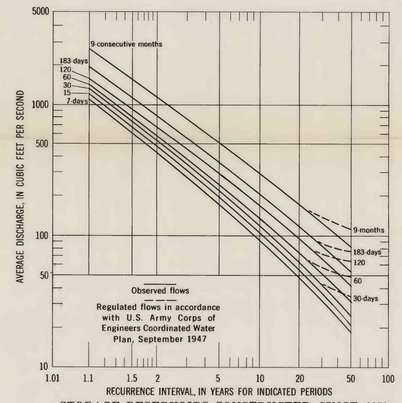


Letter key	Stream-gaging station	Drainage area square miles	Records available	Discharge for period of record, in cfs		10-year low mean annual discharge*
				Maximum	Minimum	
A	Red River of the North at Emerson, Manitoba	36,400+	1902, 1912–64	95,500	0.9	900
B	Two Rivers near Hallock	131	1931–38	265	no flow	——
C	South Branch Two Rivers at Pelan	281	1928–38, 53–56	2040	no flow	2.0
D	South Branch Two Rivers at Lake Bronson	444	1928–37, 41–47, 53–64	2960	no flow	8.0
E	Two Rivers at Hallock	625	1911–14, 29–30, 41–43	3380	no flow	13
F	Two Rivers below Hallock	644	1945–55	3690	no flow	13
G	North Branch Two Rivers near Lancaster	32	1929–38, 41–55	912	no flow	0.15
H	State ditch 85 near Lancaster	95	1929–38, 42–55	1480	no flow	0.8
I	North Branch Two Rivers at Lancaster	209	1941–42, 53–56	1000	no flow	1.4
J	North Branch Two Rivers near Northcote	386	1941–42, 45–51	2600	no flow	——
K	Two Rivers below North Branch near Hallock	1060	1941–43	——	no flow	——

* 10% of the years will have a mean annual discharge which is less than the discharge indicated in this column
+ Contributing drainage area .

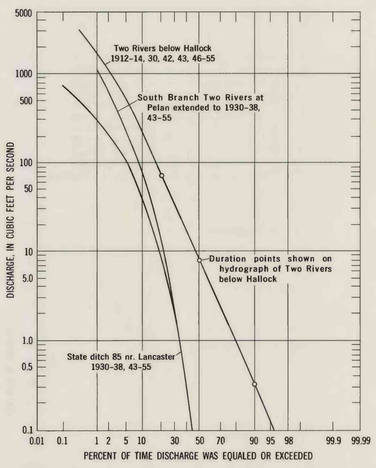


FLOW DURATION CURVES FOR RED RIVER OF THE NORTH AT DRAYTON, NORTH DAKOTA INDICATE SMALL FLOWS WERE AVAILABLE EVEN DURING DROUGHT OF 1930'S

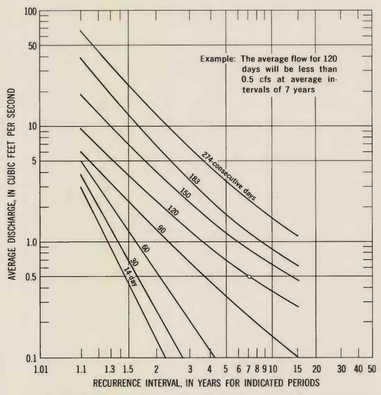


STORAGE RESERVOIRS CONSTRUCTED SINCE 1950 INCREASE DEPENDABILITY OF LOW FLOWS FOR THE RED RIVER OF THE NORTH AT DRAYTON, NORTH DAKOTA.—*Curves are applicable for the portion of the river that is adjacent to the Two Rivers watershed. Dashed lines express the frequency of a given low flow that will probably occur with the system of reservoirs now in operation (Erskine, 1962)*

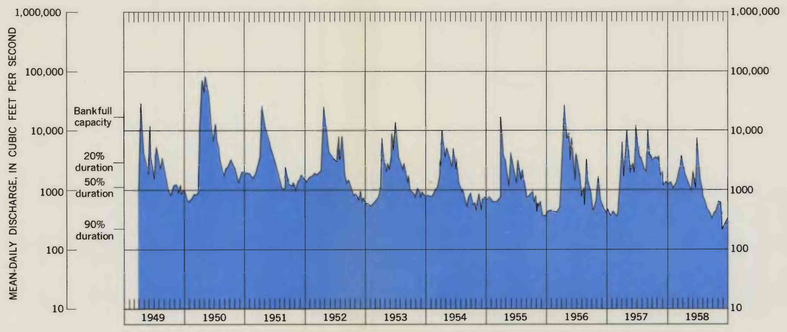
FREQUENT OCCURRENCE OF OVERBANK FLOW AND LONG PERIODS OF NO FLOW ARE CHARACTERISTIC OF THE STREAMS TRIBUTARY TO THE RED RIVER OF THE NORTH.—*In the upper reaches of these streams surface-water runoff is collected through a system of drainage ditches. The drainage pattern has been altered by the ditches and may be changed in future years by construction or improvement of drainage ditches. During periods of extreme flooding, overland flow occurs across drainage divides*



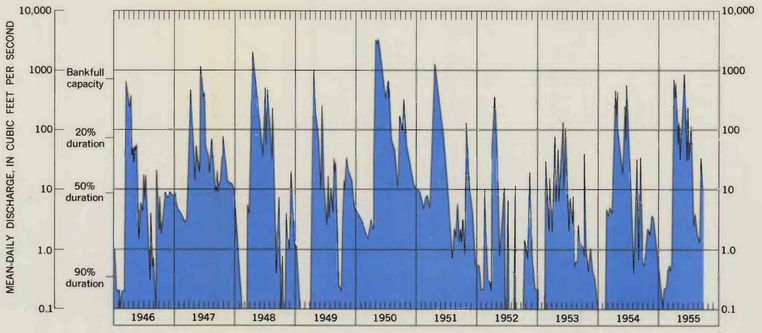
FLOW DURATION CURVES FOR STREAMS TRIBUTARY TO RED RIVER OF THE NORTH SHOW LONG PERIODS OF NO FLOW IN UPPER REACHES INDICATING VERY LITTLE GROUND WATER DISCHARGE.—*Most flow in these streams is due to snowmelt and storm runoff*



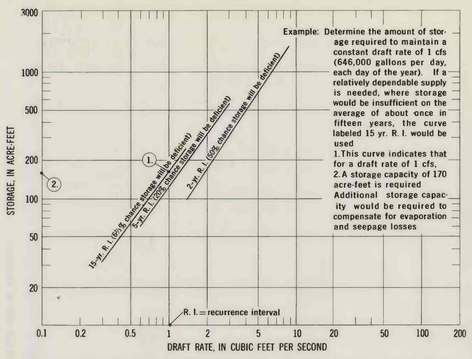
LOW FLOW FREQUENCY CURVES INDICATE MINIMUM AVERAGE DISCHARGES FOR GIVEN PERIODS OF TWO RIVERS BELOW HALLOCK.—*Only 3 of the 14 years of record available had below normal precipitation. Low flow for periods of 150-consecutive days or less consist largely of ground water discharge*



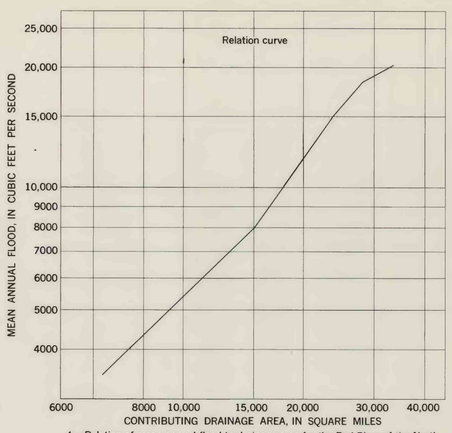
SEASONAL VARIATIONS IN DISCHARGE ARE SHOWN FOR RED RIVER OF THE NORTH AT DRAYTON, NORTH DAKOTA.—*High flows are normally confined to the months of April through July, with the highest flow most likely to occur in April as a result of snowmelt. Low flows occur during fall and winter months and are regulated to some extent by storage reservoirs*



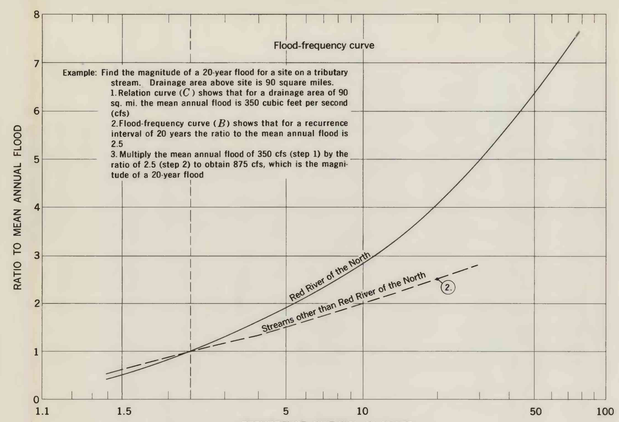
WIDE VARIATIONS IN DISCHARGE AND NUMEROUS PERIODS OF NO FLOW ARE SHOWN FOR TWO RIVERS BELOW HALLOCK.—*The percent of time discharge was equaled or exceeded is shown by duration points and may be compared with other streams on figure showing flow-duration curves for streams tributary to Red River of the North*



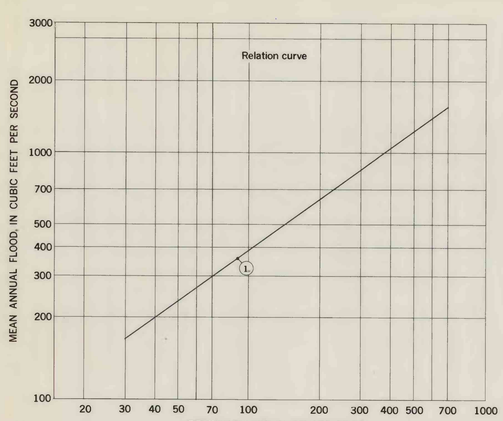
STORAGE-DRAFT-FREQUENCY RELATIONS SHOW THAT ONLY SMALL SURFACE-WATER SUPPLIES MAY BE DEVELOPED FROM TWO RIVERS BETWEEN HALLOCK AND THE CONFLUENCE WITH THE NORTH BRANCH.—*The curves indicate the amount of storage needed for various draft rates neglecting evaporation and seepage losses. Evaporation losses from open water may be expected to average about 25 inches per year in the watershed. The curves were developed on the basis of 14 years of available streamflow records of which all but 3 of the years had above normal precipitation. Lake Bronson, the largest existing reservoir has a usable storage capacity of 3,700 acre-feet, of which a large part has been reserved for recreational use*



A.—Relation of mean annual flood to drainage area for the Red River of the North

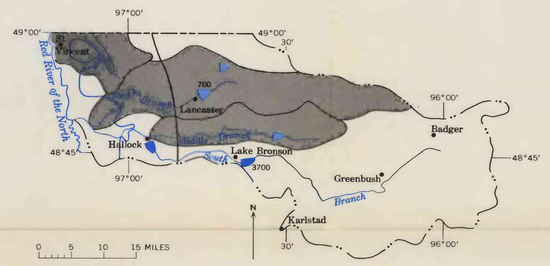


B.—Flood-frequency curves for Red River of the North and other streams in the Two Rivers watershed



C.—Relation of mean annual flood to drainage area for streams tributary to the Red River of the North in the Two Rivers watershed

FLOOD FREQUENCY AND RELATION CURVES SHOW THE MAGNITUDE OF A FLOOD FOR A SELECTED FREQUENCY.
Modified from Prior and Hess, (1961) and McCabe and Crosby, (1959)



RESERVOIRS AND WATERSHED MANAGEMENT ARE PROPOSED AS MEANS OF REDUCING FLOOD DAMAGES IN THE LAKE PLAIN

AVAILABILITY AND MANAGEMENT OF SURFACE-WATER RESOURCES

River	Lake Plain		Till Plain	
	Problems	Considerations	Problems	Considerations
Red River of the North	Floods, which are normally caused by snowmelt Long duration of floods adjacent to the river is the major cause of flood damage Because of the flat topography and small stream channels, suitable sites of sufficient storage for control of large floods are not available Flows of less than 50 cfs may be expected during periods of extreme drought	Flood control dams and retention reservoirs on tributary streams may alleviate future flood damage Low flows are supplemented by water released from storage reservoirs on large tributary streams outside the Two Rivers watershed Storage reservoirs constructed on tributary streams outside the Two Rivers watershed since 1950 and proposed return flows from the Garrison Diversion Project will increase minimum flows	Not applicable	Not applicable
Two Rivers	Floods may occur during any month of the growing season. Floods from snowmelt occur on an average of every other year. Flood problem areas are near the channel of the Middle Branch and North Branch of Two Rivers in the eastern part of the Lake Plain Flooding at times is caused by back water from the Red River of the North Flood damages are much greater in the Lake Plain than in the Till Plain largely because of greater crop loss Because of the flat topography and small stream channels, suitable sites of sufficient storage for control of large floods are not available No flow may be expected for continuous periods of a month or more on the Middle and North Branches of Two Rivers	Floods reduce average yields of crops by direct damage and delayed seeding. Plans are proposed by the U.S. Soil Conservation Service for alleviation of flood damages by improvement of drainage along streams and land treatment measures No regulation of flow on Middle Branch and North Branch of Two Rivers. Low flow on the South Branch Two Rivers is supplemented by water released from Lake Bronson reservoir for the municipal supply of Hallock	Flood problem is aggravated by flood waters overflowing from Roseau River and entering the watershed through drainage ditches Periods of no flow during late summer, fall, and winter	Flooding would be reduced by proposed flood control measures on the Roseau River which drains the watershed east of the Two Rivers unit Storage reservoirs to supplement small municipal supplies are available within the banks of the Two Rivers in the western part of the Till Plain
Joe River	Floods may occur throughout the area during the spring snowmelt period or any month of the growing season Floods reduce yields of crops by direct damage and by causing a delay in seeding	Plans are proposed by the U.S. Soil Conservation Service for alleviation of flood damages by improvement of drainage and land treatment measures. However, floods that recur statistically at intervals of once or more in 10 years would result in damage	Not applicable	Not applicable

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WATER RESOURCES OF THE TWO RIVERS WATERSHED, NORTHWESTERN MINNESOTA

By
R. W. Maclay, T. C. Winter, and G. M. Pike

1967