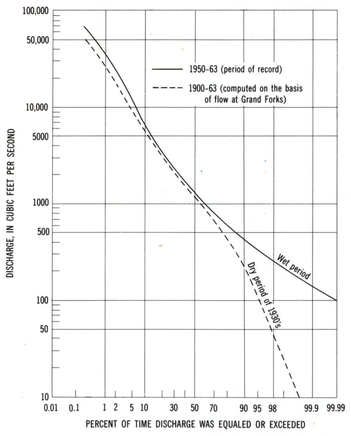
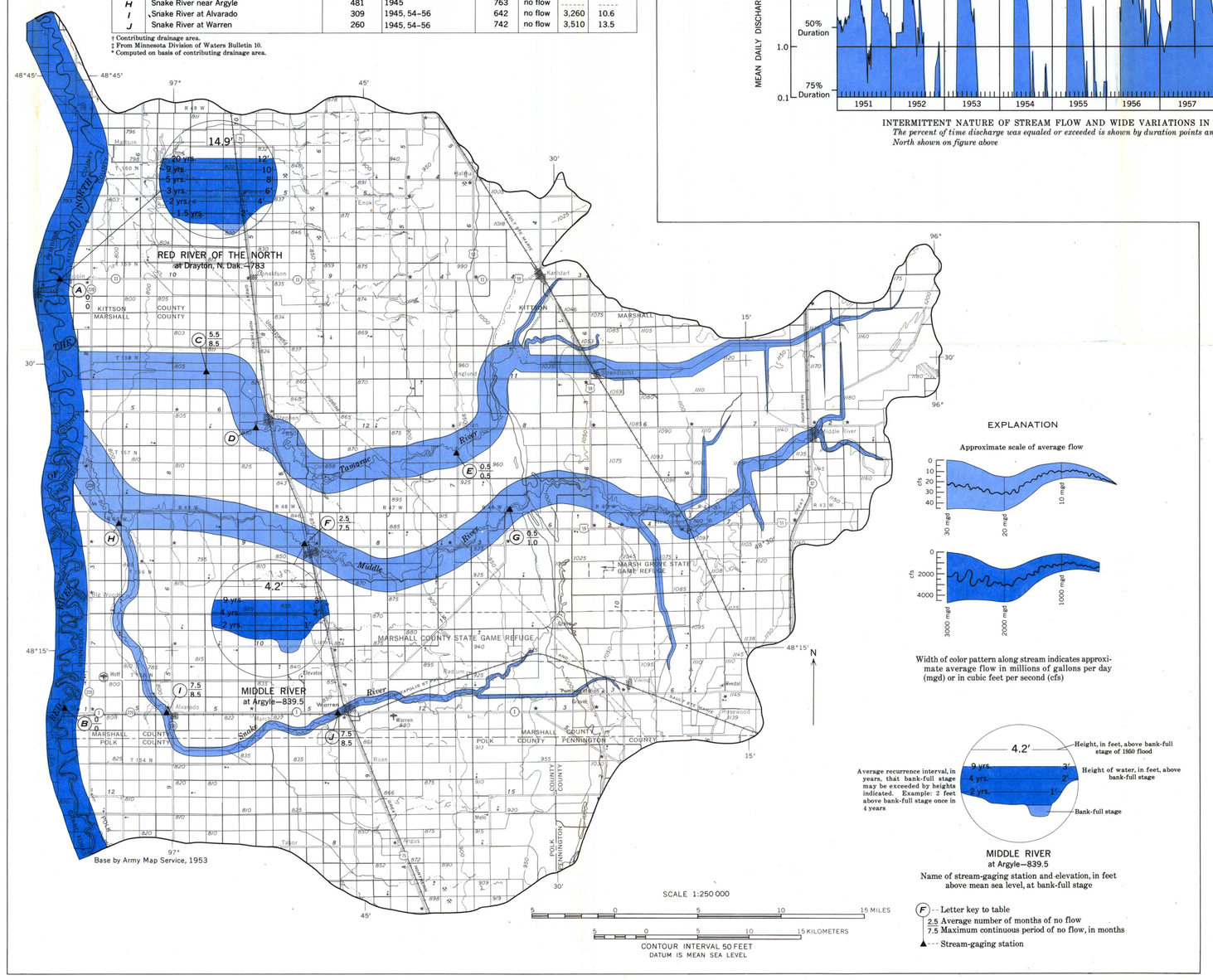
SURFACE WATER

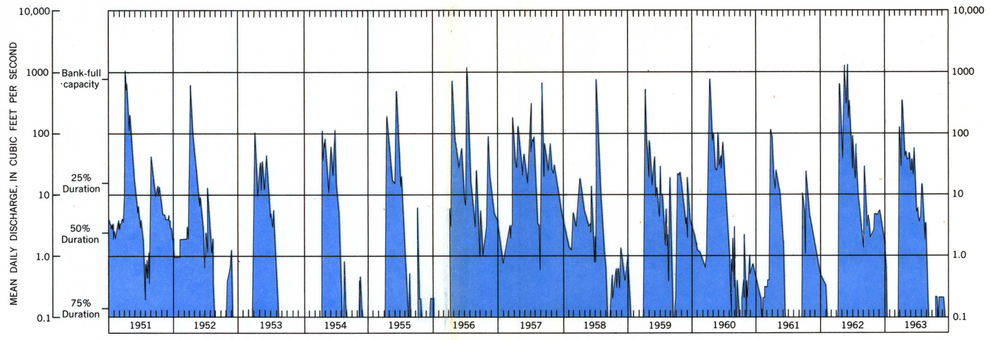


SMALL FLOWS WERE AVAILABLE EVEN DURING DROUTH OF THE 1930'S. — *As indicated by flow duration curves for Red River of the North at Drayton, North Dakota*

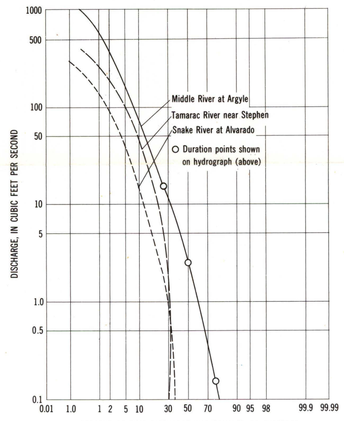
Letter key.	Stream-gaging station	Drainage area square miles	Records available	Discharge for period of record, in cfs		Maximum discharge (Flood of 1950)	
				Maximum	Minimum	cfs	cfs per square mile
A	Red River of the North at Drayton, N. Dak.	27,600†	1936–37, 41–63	86,500	7.7	86,500	3.13*
B	Red River of the North at Oslo	24,100†	1936–37, 41–43, 45–60	63,000	---	63,000	2.61*
C	Tamarac River near Stephen	320	1945, 54–55	827	no flow	6,620	20.7
D	Tamarac River at Stephen	254	1945	765	no flow	2,730	10.8
E	Tamarac River near Strandquist	177‡	1954–56	1,160	no flow	-----	-----
F	Middle River at Argyle	265	1945, 51–63	1,620	no flow	2,790	10.5
G	Middle River near Strandquist	---	1954–56	1,330	no flow	-----	-----
H	Snake River near Argyle	481	1945	763	no flow	-----	-----
I	Snake River at Alvarado	309	1945, 54–56	642	no flow	3,260	10.6
J	Snake River at Warren	260	1945, 54–56	742	no flow	3,510	13.5

† Contributing drainage area.
‡ From Minnesota Division of Waters Bulletin 10.
* Computed on basis of contributing drainage area.

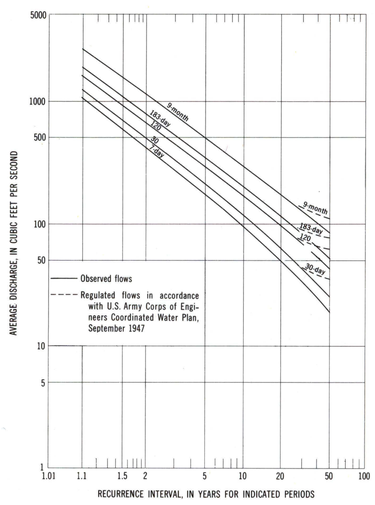




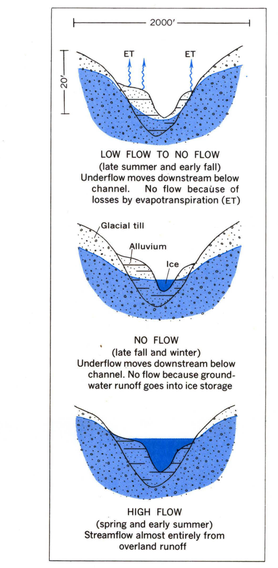
INTERMITTENT NATURE OF STREAM FLOW AND WIDE VARIATIONS IN DISCHARGE ARE SHOWN FOR MIDDLE RIVER AT ARGYLE.— *The percent of time discharge was equaled or exceeded is shown by duration points and may be compared with other streams tributary to the Red River of the North shown on figure above*



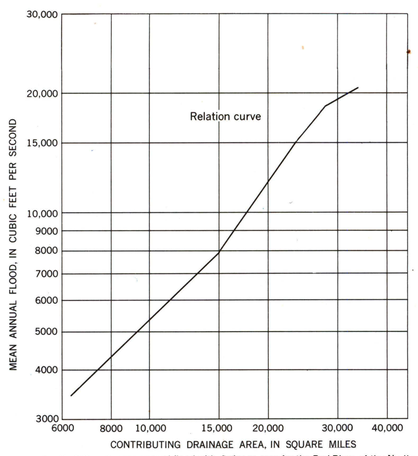
STREAMS TRIBUTARY TO THE RED RIVER OF THE NORTH HAVE NO FLOW IN LOWER REACHES FOR A LARGE PERCENTAGE OF TIME



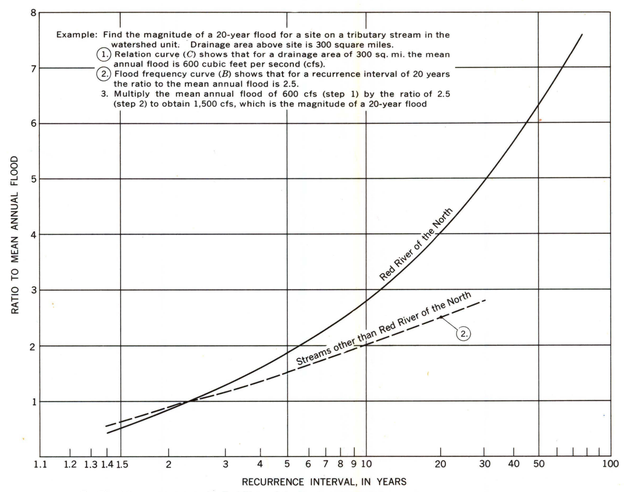
STORAGE RESERVOIRS CONSTRUCTED SINCE 1950 INCREASE DEPENDABILITY OF LOW FLOWS FOR RED RIVER OF THE NORTH AT DRAYTON, NORTH DAKOTA.—*Modified from Erskine, 1962*



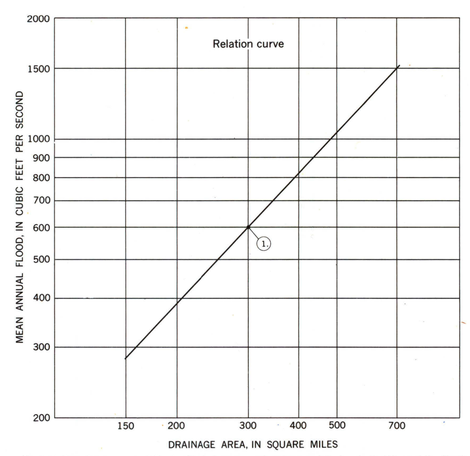
DIAGRAMMATIC CROSS SECTION OF TAMARAC RIVER CHANNEL SOUTH OF FLORIAN CHURCH.—*Illustrates that seasonal climatic fluctuations affect the position of the water table and stream flow*



A.—Variation of mean annual flood with drainage area for the Red River of the North



B.—Flood-frequency curves for Red River of the North and other streams in the Middle River Watershed Unit

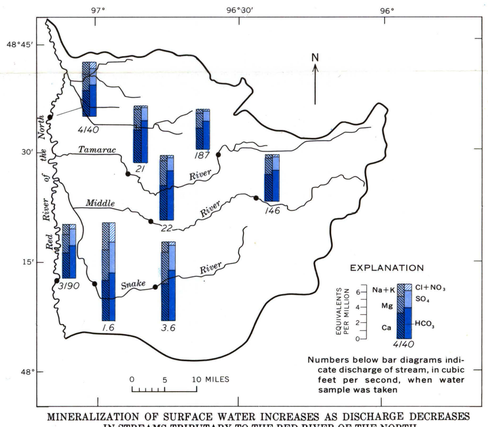


C.—Variation of mean annual flood with drainage area for streams tributary to Red River of the North in the Middle River Watershed Unit

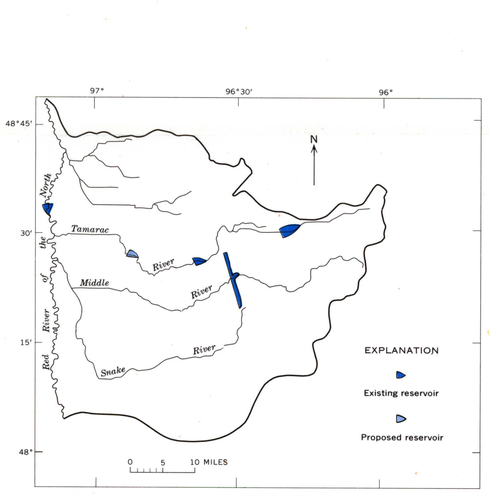
THE MAGNITUDE OF A FLOOD FOR A SELECTED FREQUENCY OF ANY STREAM IN THE MIDDLE RIVER WATERSHED CAN BE DETERMINED FROM FLOOD FREQUENCY AND RELATION CURVES.— *Modified from Prior and Hess, 1961*

AVAILABILITY AND MANAGEMENT OF SURFACE-WATER RESOURCES

River	Lake Plain area		Shoreline area		Glacial Till Upland area		Remarks
	Problems	Considerations	Problems	Considerations	Problems	Considerations	
Red River of the North	Floods which are normally caused by snowmelt Small flows may be expected during periods of extreme drouth.	Sites for flood control reservoirs available only on tributary streams Small flows may be supplemented by storage behind small dams on Red River of the North or by storage in large reservoirs on tributary streams.	Not present		Not present		Storage reservoirs constructed in the upstream watershed since 1950 and proposed return flows from the Garrison Unit will increase minimum flows.
Snake River	Floods caused by snowmelt in spring, or summer thunderstorms. No flow may occur for continuous periods longer than 8 months.	Spring flooding aggravated by snow-blocked channels. Flat topography contributes to slow drainage. Limited amounts of water may be stored behind small dams in river channel.	Floods caused by snowmelt in spring and summer thunderstorms. No flow may be expected for several months most years.	Poorly defined channels in some areas. Drainage ditches increase the average annual runoff and may increase the height of flood crests at times.	Not present to any extent		Lack of runoff will limit development of surface-water resources.
Middle River	Floods caused by snowmelt in spring, or summer thunderstorms. No flow may occur for continuous periods longer than 7 months.	Spring flooding aggravated by snow-blocked channels. Flat topography contributes to slow drainage. Small amounts of water may be stored behind low dams in river channel.	Floods caused by snowmelt in spring, or summer thunderstorms. No flow may occur for continuous periods longer than 1 month.	Channel gradients are steeper resulting in less serious flood problems than in the Lake Plain or Till Upland. Storage reservoirs have been proposed in this area. (See figure showing existing and proposed reservoirs). Suitable storage could result in dependable community supplies and reduced flooding.	Floods caused by snowmelt in spring, or summer thunderstorms. Periods of no flow may be expected to occur during fall or winter months.	Poorly defined channels in some areas. Drainage ditches increase the average annual runoff and may increase the height of flood crests at times.	High water losses in stream channels may be expected between points in Lake Plain area and any storage reservoirs located upstream in the Shoreline or Till Upland areas.
Tamarac River	Floods caused by snowmelt in spring, or summer thunderstorms. No flow may occur for continuous periods longer than 8 months.	Spring flooding aggravated by snow-blocked channels. Flat topography causes slow drainage. Small amounts of water may be stored behind low dams in river channels.	Floods caused by snowmelt in spring, or summer thunderstorms. No flow may occur for continuous periods longer than 15 days	Channel gradients are steeper resulting in less serious flood problems than in the Lake Plain or Till Upland. Storage reservoirs have been proposed in this area. (See figure showing existing and proposed reservoirs). Suitable storage could result in dependable community supplies and reduced flooding.	Floods caused by snowmelt in spring, or summer thunderstorms. Periods of no flow may be expected to occur during fall or winter months.	Poorly defined channels at some places. Drainage ditches increase the average annual runoff and may increase the height of flood crests at times.	



MINERALIZATION OF SURFACE WATER INCREASES AS DISCHARGE DECREASES IN STREAMS TRIBUTARY TO THE RED RIVER OF THE NORTH



EXISTING AND PROPOSED RESERVOIRS IN THE MIDDLE RIVER WATERSHED

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1965—W65018

WATER RESOURCES OF THE MIDDLE RIVER WATERSHED, NORTHWESTERN MINNESOTA

By

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

1965

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