The Unique Hydrology of the Souris River Basin: A Prairie Pothole Region

Hydrology is the scientific study of how water moves and is distributed across land.

The effects of rainfall and snowmelt on river flows and reservoir levels are part of the unique hydrology that characterizes the Souris River basin.

The Souris River basin is part of the Prairie Pothole Region, which stretches across Alberta, Saskatchewan, and Manitoba in Canada, and extends into North and South Dakota, Iowa, Minnesota, and Montana in the United States. What makes this region unique is the presence of shallow wetlands, or potholes, that were left behind during the last glacial period in North America. This pothole topography can be found across the majority of the Souris River basin.

Kettles and Kames

Shallow potholes, called kettles, are sometimes surrounded by irregularly-shaped earth mounds called kames. Kettles often contain sediment or vegetation, and can be dry during summer months. During the spring snowmelt, they can fill with water and form small kettle lakes. Kettle lakes are often isolated from streams and rivers, and the water in these kettle lakes usually reduces over time through natural processes.

This topography, coupled with the basin's relatively flat landscape, make it difficult to predict the volume of water reaching the Souris River.

Fill-and-Spill Hydrology

Under normal conditions, much of the watershed does not contribute to the Souris River directly because the kettle lakes can store water and keep it from reaching the river. However, with large amounts of precipitation from snow or rain, the small kettle lakes can fill and expand outwards until they begin to spill into one another, and eventually into the Souris River. This is what happened in June 2011 when kettles, saturated from snowmelt and record-setting rainfall, contributed to the runoff and resulted in significant flooding.

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Runoff and Streamflow

Snowmelt and rain affect the flow in the Souris River much more than water from underground sources. When precipitation, either as melted snow or rain, reaches the ground surface it may seep into the dry soil, puddle on wet ground, or run off of ice-covered or very wet surfaces. Understanding the rate at which water enters the soil (infiltration) and the relative wetness or dryness of a watershed (antecedent moisture) helps hydrologists estimate how much of the rainwater and snowmelt could become streamflow. Since these conditions can change often, rainfall and snow depth are measured at various sites throughout the Souris River basin. Hydrologists estimate the precipitation by recording rainfall and snowfall data, and by using radar and satellite images.

A Semi-arid Climate

The Souris River flows through a semi-arid zone of continental climate. The average annual precipitation across the area is low—only 250-500 mm or 10-20 inches. Cold winters lock up snowfall until the spring melt, which provides most of the stream flow. Surface runoff gathers in low spots. It begins to flow across fields and down ditches into creeks. Eventually the runoff flows into the Souris River.

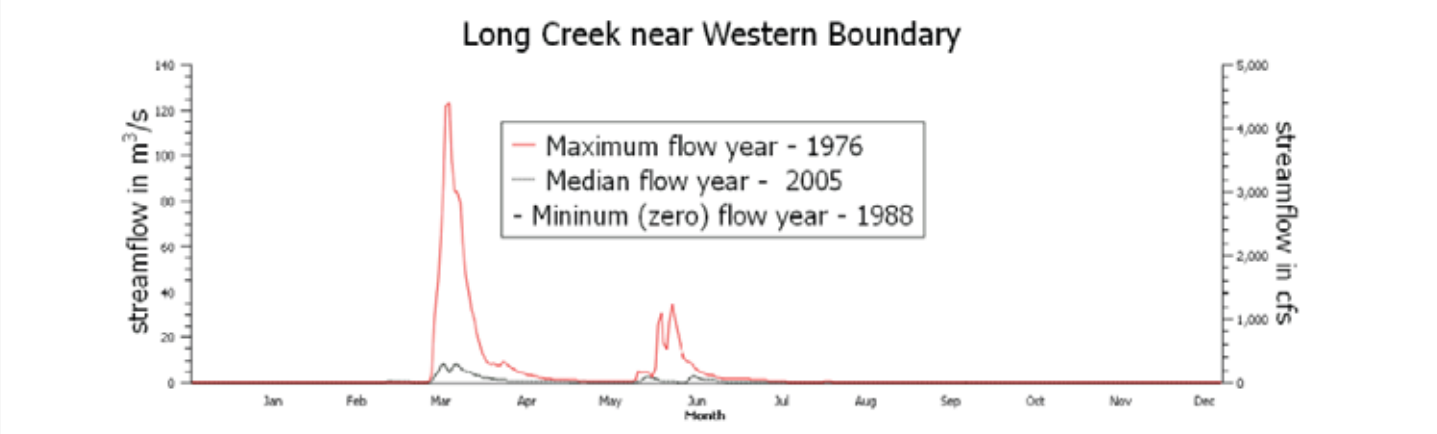
The annual potential rate of evaporation is triple the average precipitation.

Because the basin is quite flat, much of the water is retained in sloughs and ponds. The flatness of the basin also governs the travel time for runoff, which is usually very slow, taking many weeks for floods to move the length of the river. Hot, dry summers quickly evaporate the surface water as well as water stored within reservoirs. With these conditions, limited water makes its way to the Souris River.

The runoff from the Souris basin is less than 1% of the precipitation it receives.

Highly Variable Flows

When the kettle lakes are empty and the basin is dry, precipitation does not have a significant effect on river flows. However, when kettle lakes are full and the basin is wet, precipitation has a greater impact on river flows. The graph below shows the high variability in daily and annual flows over three years in Long Creek, above Boundary Reservoir in the Province of Saskatchewan. Under certain conditions, the flow can change from a trickle to a torrent in a few days. The flow in 1976 was ten times the median flow of 2005, while no water flowed in Long Creek across the western boundary in 1988.



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