3.5.3 Overview Refresher

> *Without the cycling of water, ecosystems could not function and life could not exist. Water is the medium by which materials make their never-ending odyssey through the ecosystem.*
>
> Robert Leo Smith

Important Process

Flooding is one of many natural processes on Earth that serves a purpose and contributes to a healthy environment. Floodwaters carry nutrient-rich sediments out onto the land, renewing it annually. The Red River Valley is one of the most productive agricultural lands in the world, in part due to the frequent flooding of the Red River.

The fluctuation of the water levels in rivers, lakes and wetlands is an important component of those ecosystems. Many plants have evolved with the regular flooding cycle and require some flooding to survive. The area beside a river, the flood plain and the river itself, combine to form a complex and dynamic biological system found nowhere else. High water and low water are important cycles for this biological system. There are many benefits to the flooding cycle that are still not well understood.

> *The river moves from land to water to land, in and out of organisms, reminding us what native peoples have never forgotten: that you cannot separate the land from the water, or the people from the land.*
>
> Lynn Noel, *Voyages: Canada's Heritage Rivers*

History of Flooding

The Red River has a long history of flooding. Archeological sites at The Forks in downtown Winnipeg reveal many flood events in the last 8,000 years. One flood layer, from approximately 1,800 years ago, was six times greater than the flood of 1826 – our largest flood on record.

Through recorded history – the last 150 years – there have been many significant floods along the Red and its tributaries. The largest, in 1826, was considered a one-in-300-year flood (likely to occur on average once in 300 years). The area that would become downtown Winnipeg was under 3.5 metres of water. The second largest flood on record was in 1852; it was just slightly larger than the 1997 flood. Other major floods occurred in 1861, 1950, 1966 and 1979. The one many people remember is the Flood of the Century in 1997. The 1950 and 1997 floods are particularly significant because after both of those floods major projects were undertaken to protect communities from flooding.

Flooding the Plain

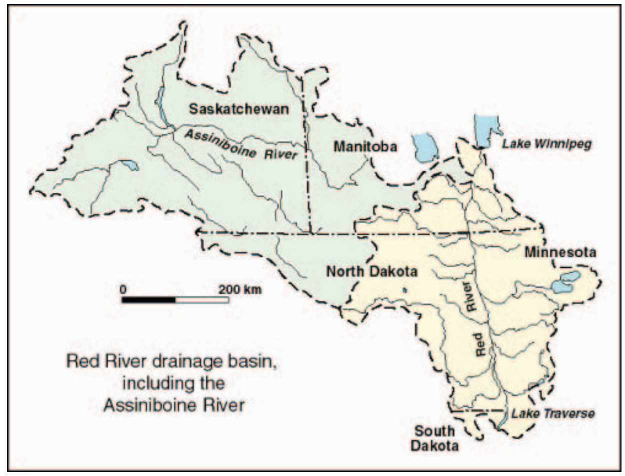
The Red River is a single-channeled, meandering river. It is 880km long by length of channel or 456km long in a straight line, from the confluence of the Bois de Sioux and Otter Tail rivers in southern North Dakota/Minnesota to Lake Winnipeg. The basin encompasses an area of about 279,500km^2, including the Assiniboine River (163,000 km^2) which joins the Red River at Winnipeg.

The Red River flows northward along the very flat Red River Valley. The valley is a vast plain oriented north-south 64km to 80km wide and about 530km long. Within Manitoba, the Manitoba Escarpment forms the western edge of the valley, but to the east the margin is much less distinct. In Manitoba, the river has an average valley gradient of 0.0001.

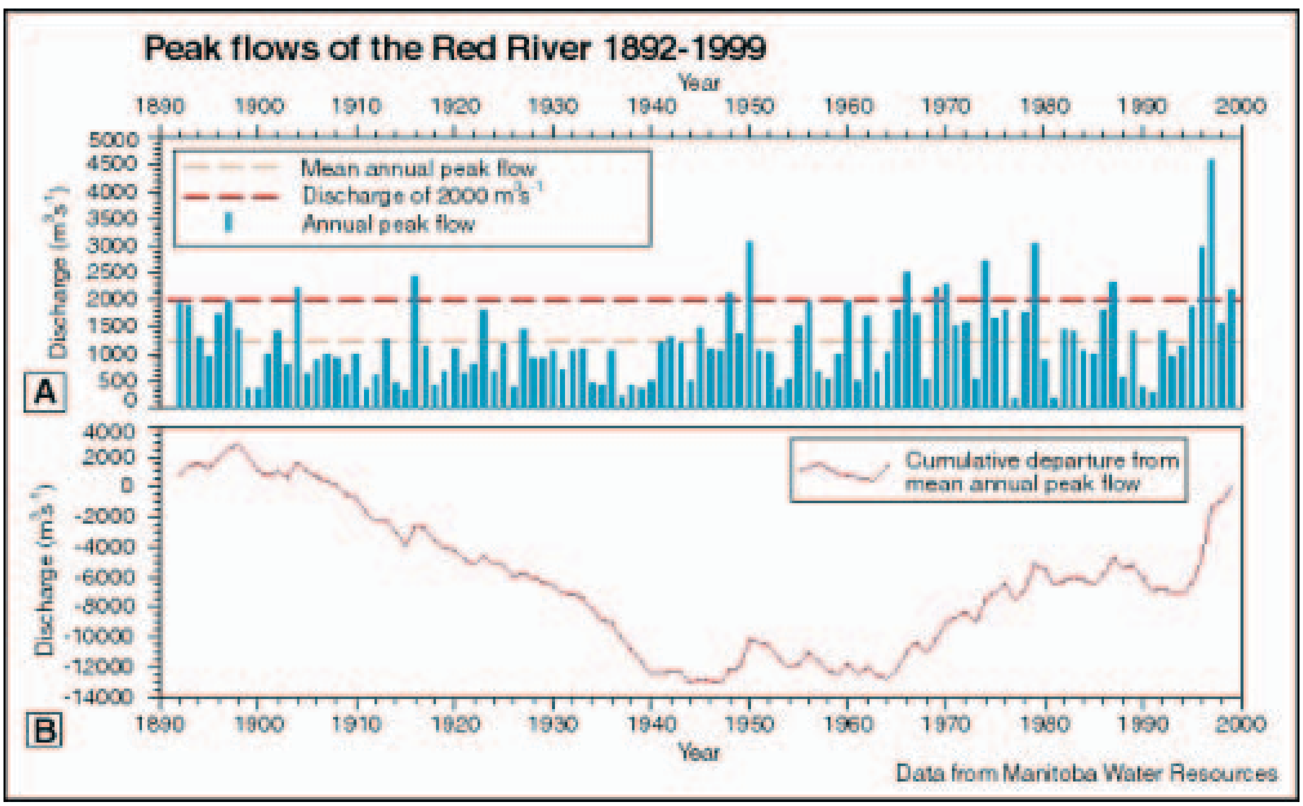
Despite the name, the Red River Valley predates the river. Along the central Red River Valley, the bedrock is buried beneath late Pleistocene glacial sediments that, in turn, were covered with a clay-rich deposit of sediments left by glacial Lake Agassiz. Lake Agassiz was a large glacial lake that at one stage occupied most of Manitoba, North Dakota, Minnesota, Saskatchewan and northwestern Ontario. Collectively, the deposits create the flat, gently northward-sloping plain.

The Red River is a very young river. It was established on the bed of glacial Lake Agassiz between 8,200 and 7,800 years ago, as the lake receded northward. The river eroded a shallow stream-cut valley, up to 15m deep and 2500m wide, into the surface of the plain. The river valley is shallow because of the flat topography and low gradient of the plain.

Twenty-five tributaries enter the Red River south of the border and 14 north of the border for a total of 39. Together the Red and Assiniboine rivers collect and drain water from a 279,500km² area.



Like all rivers, the size of the peak flow of the Red River varies considerably from one year to the next. Some years the peak flow is below the average while in others it exceeds it. Occasionally, the peak flow is far higher than average and there is an extreme flood, as occurred in 1997.



http://www.gsc.nrcan.gc.ca/floods/redriver/images/photo7.jpg

Five Flood Factors

Flooding along the Red River is caused by a combination of factors:

- wet ground conditions in the fall caused by a large amount of rain before freeze-up
- development of severe cold causing deep frost in late fall
- heavy snowfall, particularly during the latter part of the winter
- a late spring followed by sudden warming and quick snowmelt
- above normal precipitation during spring snowmelt

These factors cause flooding along the majority of rivers in Canada. When all five factors are present there is a risk of a severe flood.

The Flood of the Century in 1997 illustrates the five flood factors. The rainfall across the Red River Basin was above normal in the fall of 1996, as much as twice the norm in some areas of the United States. The winter began with saturated ground. It was a long, cold winter so no melting occurred before spring. Four blizzards brought large amounts of snow to the valley. In the United States where 70% of the Red River's water originates, the snowfall was the highest on record.

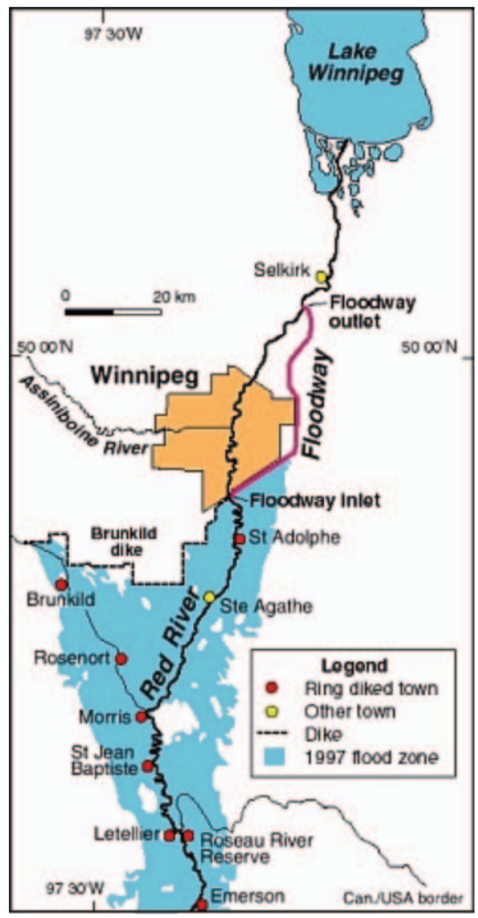
Red River in Flood

At the end of March and beginning of April, the weather warmed and the snow began to melt slowly so there was not too much runoff. Then a blizzard hit hard on April 5 and 6, dumping enough snow to raise the water in the river more than a metre.

Four of the five flood factors were present to create the Flood of the Century. The situation might have been even worse if the weather had warmed significantly during the spring melt, rushing even more water off the land into the rivers.

Slow Water Rising

The Red River Valley is one of the flattest regions in North America. From the headwaters it takes one week for the flood crest to reach Fargo, another week to reach Grand Forks, a week after that to cross over the border at Emerson and five days later it reaches Winnipeg. Because of the slow movement of the flood wave on the Red, major floods rise and fall slowly over a period of several weeks.



www.gsc.nrcan.gc.ca/floods/redriver/geological_e.php

Flooding of the Red River is not only slow, it spreads out well beyond what is normally thought of as the flood plain on to the flat land. This makes the Red River floods unique in comparison to floods along other Canadian rivers. During high flows, the river water spreads across the plain forming a long, broad flood zone. During the flood of 1997 an area of about 2,000km^2 and up to 40km wide was inundated in southern Manitoba between the border and the Floodway inlet at St. Norbert. The flood zones of most other rivers are comparatively narrow because the floodwaters remain confined within a distinct river valley.

Ice Jams

A very cold winter produces thick ice on the river, which takes longer to break up. Ice jams contribute to flooding when they back up the water behind the jam. Then when the ice jam breaks, the water rushes forward causing flooding downstream.

In 1996 an ice jam caused flooding in Selkirk. In 1997 thousands of holes were drilled in the ice around Selkirk to weaken the surface and prevent another ice jam.

Ice can also be a major destructive force. As they rush along with the water ice floes will rip through flooded buildings.

Accelerating the Process

Flooding is as much a natural process as the changing seasons. Like the change of seasons, flooding cannot be stopped but we can learn how to minimize the damage it causes us.

The first step in minimizing the damage is looking for how we contribute to flooding. In many ways we have increased the speed that water runs off the land and into the rivers. The result is less water infiltrating the ground and more water pushed into the rivers. Under natural conditions only about 25% of rainfall normally ends up as surface runoff in rivers; the rest soaks into the ground or returns to the atmosphere by evaporation and transpiration.

Many land use practices contribute to flooding:

- Natural water storage areas, such as ponds and wetlands, have been filled with earth to build towns and farm fields. In the past these wetlands would act as temporary water storage areas. They absorbed the water and helped it infiltrate the soil and groundwater system. As well, the water would be taken up by plants in the wetland and the standing water would have allowed evaporation.
- The land has been altered with elaborate drainage systems designed to remove water as quickly as possible from the land into the rivers. This prevents water from infiltrating the soil and the groundwater system or evaporating, instead sending it rushing into the rivers.
- Channelization, once a common practice, is still found across the valley. Straightening naturally meandering stream channels into water-shoots speeds water removal from the land, increases water velocity (and erosive power) and the amount of water entering the river in a short period of time. In some jurisdictions, natural stream courses and meanders are being rebuilt in channels.
- Natural vegetation along creeks and river banks slows the water flow and increases water infiltration to the soil and groundwater system. Vegetation also absorbs some of the water. Removing the natural vegetation speeds up runoff into the stream channels, increasing the volume of water.
- In cities extensive pavement prevents absorption of water and sends it rushing into storm sewer systems that empty directly into the river.

All these land use practices act like a big squeegee clearing the water off the flat plain into the river as fast as possible, much faster than would occur naturally. The result of our land use practice is more water entering the river than normal and at a much faster rate, contributing to flooding.