What makes Alberta flooding distinct?

Flooding is a natural event which occurs when normally dry lands are covered by water. It is a result of very complex meteorological, topographical, and hydrological interactions. In Alberta, those interactions are influenced by our unique topography.

Rocky Mountains Make Alberta's Flooding Different

Unlike the other prairie provinces, Saskatchewan and Manitoba, which are covered almost entirely by flat plains, Alberta's landscape includes the Rocky Mountains and Foothills. The presence of these regions significantly influences the climate and hydrology of Alberta, which results in a very different flood regime.

Major Alberta Floods Are Rainstorm-Driven

While flooding in most parts of the prairies is commonly caused by the gradual melting of the plains' snowpack, Alberta's large-scale flooding is driven by heavy rain or rain-on-snow events.

During rainstorm flooding, water levels in rivers and lakes increase much quicker, meaning there is much less time to respond. In snowmelt events, however, water levels increase more slowly as melt water is added to the prairie potholes/depressions, lakes and streams.

For example, a rainstorm in the headwaters of the Bow River basin will impact upstream communities, such as Lake Louise, sooner than communities farther downstream, such as Calgary. In terms of forecast lead times, communities in or near the mountains and foothills may have hours notice whereas communities on the eastern side of Alberta may have days notice.

A unique example on the prairies is the Red River flowing into Manitoba. Floodwaters which are driven by snowmelt coming from the United States gives forecast lead times of one week or more.

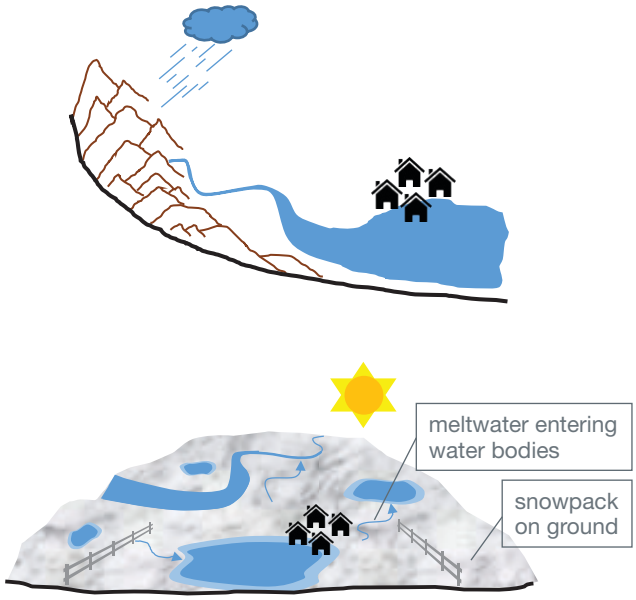

Figure 1: (top) rain-driven flood in or close to the mountains and foothills (bottom) snowmelt flooding in the prairies

Weather Patterns Are Difficult to Forecast

The mountain and foothill areas provide sites for the development of flood-producing rainstorms. Flood forecasting in Alberta heavily depends on the rainfall forecasts; however, weather patterns over the eastern slopes of the Rockies can be chaotic and change very rapidly, and it is difficult for weather models to accurately predict the amount, timing, and location of rainstorms. As a result, there is much shorter lead time and larger uncertainty associated with flood forecasting in these parts of Alberta. For example, shortly before the 2013 flood, one major weather model under predicted the rainfall while another model projected that the focal point of the rainfall would be in a different river basin.

Rainstorm Formation

Two flood-producing weather conditions are of particular importance in Alberta:

1. severe rainstorms resulting from large-scale, low-pressure weather systems; and
2. summer thunderstorms due to local convective weather systems.

Severe rainstorms over the eastern slopes of the Rocky Mountains can trigger major floods like the floods of June 2013, 2005 and 1995. A low-pressure system originating in the northern Pacific Ocean or Gulf of Alaska moves eastward across the continent, carrying moisture from the Pacific. In some cases, the system is large enough to bring moisture into Alberta from the Gulf of Mexico. In the case of southern Alberta, these systems can then get pushed up against the eastern slopes of the Rocky Mountains where they may stall for a couple of days. This results in heavy rainfall over a large area along the foothills.

Early and accurate prediction of floods due to this weather system is very difficult because it takes only a couple of days for it to form and then potentially bring heavy precipitation to Alberta. Moreover, the exact storm path can change radically, which shortens the forecast lead time.

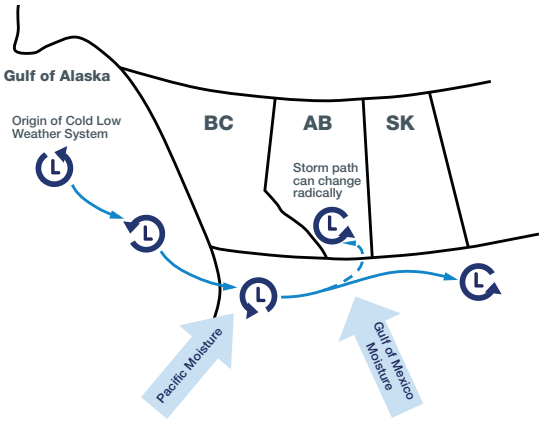

Figure 2: Progression of the "Cold Low" weather system

Summer thunderstorms form when moist warm air masses rapidly rise up through the atmosphere, which typically occurs during warm days. This forces moisture out of the clouds which can result in heavy rainfall.

Summer thunderstorms can form over a very short time span, therefore, the timing and location of flooding from these storms is difficult to predict. They typically move eastward across the province, do not last long, and usually dissipate by the end of the day.

Because these systems produce relatively large amounts of rainfall over a concentrated area, they will not typically result in flooding of major rivers, but may cause urban flooding or flooding of low-lying areas as excess runoff tries to make its way to streams and rivers.

Alberta is the headwaters

Many rivers meandering through the prairies originate in the Rocky Mountains. The proximity of major centres and communities such as Calgary and High River means that there is a much shorter response time after a rainstorm hits the ground.

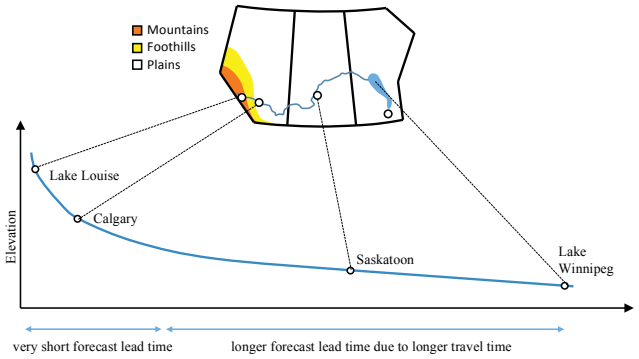

Figure 3: Profile of Saskatchewan River, from headwaters of the Bow River to Lake Winnipeg

Additionally, due to the steeper slopes associated with the mountain and foothill areas, less water infiltrates into the soil, more water runs off, and water moves faster downstream. The combination of these factors can result in rapid flooding, particularly in communities within or in proximity to foothill areas. For instance, in a matter of hours, floods can hit the Town of Canmore when it rains in the headwater areas of Cougar Creek.

Moreover, river basin sizes in the mountain and foothill areas of Alberta are comparatively small, which combined with the uncertainty of the location of flood-producing precipitation, results in higher degrees of uncertainty in flood forecasting. For example, a 100km shift in the storm's path is the difference between a flood in the Bow River basin or a flood in the Red Deer River basin.

To address these difficulties, the River Forecast Centre continuously monitors weather conditions and updates its forecast as the event progresses and more current information is available.

Download the Alberta Rivers app for current information about snow, river flows, lake levels, precipitation, and ice conditions across the province, plus important advisories sent straight to your cell phone.