Landslide Risk and Climate Change in the Interior Plains

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The **Prairie Adaptation Research Collaborative** is a facilitative, interdisciplinary research network established to understand the **potential impacts of climate change** on the Canadian Prairie Provinces and conduct research necessary to develop appropriate **adaptation strategies**.
Slumgullion earth flow, San Juan Mountains, Colorado
Front Ranges
Alberta Rockies
Arm River valley, Saskatchewan
Swift Current Creek valley, Saskatchewan
<table>
<thead>
<tr>
<th>Pollen zone</th>
<th>years BP</th>
<th>Paleoclimate relative to present</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>0</td>
<td>present climate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cooler</td>
</tr>
<tr>
<td>III</td>
<td>3200</td>
<td>moister</td>
</tr>
<tr>
<td>II</td>
<td>4500</td>
<td>drier and warmer</td>
</tr>
<tr>
<td>II</td>
<td>5100</td>
<td>much drier and warmer</td>
</tr>
<tr>
<td>I</td>
<td>7700</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>9120</td>
<td>drier and warmer</td>
</tr>
</tbody>
</table>
Departures From Median Precipitation

June - July Precipitation
Medicine Hat, Alberta, 1754-2001

August - July Precipitation,
Havre, Montana, 1727-2001
<table>
<thead>
<tr>
<th>Epoch</th>
<th>Formation</th>
<th>Thickness (m)</th>
<th>Hydraulic Conductivity (m/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oligocene</td>
<td>Cypress Hills</td>
<td>15 - 76</td>
<td>$10^0$</td>
</tr>
<tr>
<td>Paleocene</td>
<td>Ravenscrag</td>
<td>70 +</td>
<td>$10^{-4}$</td>
</tr>
<tr>
<td>Upper Cretaceous</td>
<td>Frenchman</td>
<td>3 - 45 +</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>Upper Cretaceous</td>
<td>Battle</td>
<td>6 - 9</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>Upper Cretaceous</td>
<td>Whitemud</td>
<td>10 - 14</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>Upper Cretaceous</td>
<td>Eastend</td>
<td>21 - 37</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>Upper Cretaceous</td>
<td>Bearpaw</td>
<td>285 - 305</td>
<td>$10^{-5}$</td>
</tr>
</tbody>
</table>
Police Point Landslide
The Eureka River landslide and dam, Peace River Lowlands, Alberta
B.G.N. Miller and D.M. Cruden

The Eureka River landslide of June 1990, at 50 Mm$^3$, is one of the largest historical landslides on the Interior Plains of Canada. It is one of seven large translational landslides to have occurred in the Peace River Lowlands within the last 65 years. Each landslide occurred in Quaternary sediments deposited within a preglacial valley. Each landslide formed a dam. The landslide dam was over 20 m high, forming a lake exceeding 8 km in length.
The 1939 Montagneuse River landslide, Alberta
D.M. Cruden, Z-Y. Lu, and S. Thomson

The 1939 landslide on the west wall of the Montagneuse River valley, 1300 m long, 1400 m wide, and 80 m thick with a volume of $76 \times 10^6$ m$^3$, is the largest historic rapid landslide on the Interior Plains of Canada. It lasted about a minute, dammed the river, and formed a reservoir 1.5 km long. The Montagneuse River was pushed eastward. The main scarp has been substantially modified by earth flows and slides. Landslides in the Montagneuse River valley coincide with the Shaftesbury buried preglacial channel of the Peace River. The surfaces of rupture of five historic landslides in the Peace River Lowland follow clays deposited in preglacial channels, confirming that these deposits may be hazardous when eroded.
The Lesueur landslide occurred on 3 September 1963 on the outside of a meander of the North Saskatchewan River in northeast Edmonton. The displaced volume was 0.76 Mm$^3$ of Pleistocene deposits and underlying Upper Cretaceous mudstones. The trigger of the landslide is believed to be accelerated erosion of the slope toe caused by dumping of mine waste on the inside of the meander. Surveys in 1964, 1971, 1992, 1995, 1997, and 1998 have documented continued slope movements.
North Saskatchewan River, Edmonton
Explanation of significant differences between budget and actual:

1. **Unexpected landslides** at various locations resulting from wet summer conditions.
2. Increased costs on various tendered construction contracts.
3. Carry-over of various construction projects to 2001-02 fiscal year.
4. Increased winter gravel crushing and haul.
5. Positions transferred.
Aridity Index (P/PET), 1961-90
Aridity (P/PET), 2050, CGCM2
Extreme precipitation events are likely to become more frequent.
Extreme rainfalls in southern Saskatchewan

Buffalo Gap, May 30, 1961
• one-hour: 258 mm

Parkmanm, August 3-4, 1985
• six-hour: 267 mm
• 12-hour: 362 mm
• 24-hour: 381 mm

Vanguard, July 3, 2000
• eight-hour: 334-387 mm

Note: all data from bucket surveys