Managing River Ice Risk in Alberta

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Summer and breakup flood level frequency analyses for the Athabasca River at Fort McMurray

Most Severe Event on Record

1875

Gerard and Karpuk (1979)
"...The winter of 1874-75 was a bitter one, with deep snow and never a thaw until April. On the 2nd or 3rd of that month, however, a further heavy fall of snow was followed by a sudden rise in temperature. The change of weather and the weight of melting snow caused the ice for the 85 mile stretch of rapids above the fort [Fort McMurray] to breakup, and it came down the Athabasca with terrific force. On striking the turn of the stream at the post it blocked the river and drove the ice 2 miles up the Clearwater [a major tributary] in piles 40 to 50 feet high. In less than an hour the water rose 57 feet, flooding the whole flat and mowing down trees, some 3 ft in diameter, like grass..."
Ice Jam Flood Mitigation: Considerations

- Type of river ice jam
- Size of the river (Flow and Velocity)
- Location and type of floodplain development
- Ecology
- Risks of mitigation activity
- Effectiveness of proposed mitigation
- Time for mitigation activity: hours to years
- Cost of mitigation
Ice Jam Flood Mitigation in Alberta

• Freeze up, winter and break up river ice jams
• Large rivers with high velocities in northern Alberta
  – Peace River flow is influenced by hydro electric operations
  – Athabasca River flow is unregulated

• Residential and industrial development
• Ecological considerations:
  – fish
  – other aquatic life
Ice Jam Flood Mitigation in Alberta

- Ice Weakening
  - Ice cover or jam blasting
  - Ice cover dusting
  - Excavation
  - Warm water

- Structural controls

- Regulatory controls
- Monitoring and Forecasting
- River flow control

S. Beltaos
Ice Jam Flood Mitigation in Alberta

Regulatory and Planning:
- Structural controls
- Regulatory controls

Operational Response:
- Monitoring and Forecasting
- River flow control
Reduce risks: 
*before* a potential river ice event

- Identify the hazard
- Appropriate floodplain development
- Be aware of hazardous activities in the floodplain area
  - Water Approvals
  - Compliance “Sweeps”
Managing Risk: Aerial Observation

- Development of river ice processes
  - Location of freeze up front
    - Potential for severe freeze up jams to develop
    - Timing for flow regulation
  - Monitor changing river basin & ice conditions
    - Potential basin runoff
    - Development of open water leads
    - Development of upstream ice jams
Managing Risk: monitoring and forecasting river ice events

- Manual Observations
  - Ground
  - Aerial

- Remote Monitoring
  - Gauging stations
  - Satellite images

- Models
  - Long lead outlook
  - Forecast models
Managing Risk: Aerial Observation

Real time monitoring of river ice runs for emergency response groups
Managing Risk: Knowledge necessary for Mitigation

Peace River Freeze Up Jam

Issue: High freeze up water levels cause residential groundwater seepage

Considerations

• Operation of inter-provincial hydro electric facility

• Risk of freeze up jam is increased by weather which cannot be accurately forecast 3+ days in advance.
Managing Risk: Knowledge necessary for Mitigation

- Peace River Freeze Up Jam
  - Control flows during freeze up
    - Flow volume and flow fluctuations
  - Develop mitigation plan should severe freeze up occur
    - Lower flows if feasible

reservoir storage
Managing Risk: Knowledge necessary for Mitigation

Develop mitigation plan should severe freeze up occur

- Lower flows if feasible
- Increase flows
  » promotes frazil ice redistribution
  » More efficient channel hydraulics
  » More effective use of reservoir storage
  » Limited returns?
Managing Risk:
Knowledge necessary for Mitigation

Develop mitigation plan for severe river ice break up conditions develop

*Lower flows if feasible*

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**Graph: Distance on Peace River (km) and equivalent distance on Smoky River to Confluence**

- Peace River April 20 water level
- Water Level on Smoky River April 20
- Water Level Smoky River April 17
- TPR Dyke
Committee on River Ice and the Environment (CRIPE)
Thank you!

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