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## Ice Jam Mitigation

Ice Engineering Research Division  
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## Outline

- Objectives
- Classification
- Advance Measures
- Early Warning
- Emergency Measures
- Permanent Measures
- Assessing Effectiveness

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## Mitigation Objectives

- Reduce ice jam flood damages,  $B/C > 1$
- Reliable performance
- Low environmental impact



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## Middlesex Blames Montpelier For Flooding

By ERICA HOUSEKEEPER  
Times Argus Staff

MIDDLESEX — Residents are blaming Montpelier officials for failing to notify them of potential flooding that stemmed from ice-breaking procedures on the Winooski River in the capital Friday.

Home on Three Mile Bridge Road were flooded by flood waters on Friday night after Montpelier officials began to break up ice on the river to create a channel of water near the Interstate 88 interchange.

The channel prevented ice from backing up in Montpelier and to Berlin.

"It was not an attempt to damage someone else's property," Montpelier City Manager Bill Fromm said this morning.

Montpelier Police Chief Douglas Hoyt said that flooding was imminent. "My response is, whose ice is it? Berlin's? East Montpelier's? Who notified us? We have a plan, and we followed it."

But Middlesex homeowners contend that the flooding could have been prevented if their town officials had received proper notice from Montpelier officials.

After the flooding occurred, the Middlesex Volunteer Fire Department notified residents, who also brought their concerns to a regularly scheduled Middlesex select board meeting tonight at 7.

"It's a situation where Montpelier's actions have led into us," said Gary Wells-Darling, who



Jeffrey Darling surveys the damage around his home on the Three Mile Bridge Road in Middlesex. Rising waters in the nearby Winooski River flooded the home and left massive ice chunks and debris in the yard.

Jeffrey, have flood insurance for their home. They do not have insurance. "This is not the first time this has happened," the wife, Shelly, and their three children are staying with their parents in Berlin.

**“Residents are blaming Montpelier officials for failing to notify them of potential flooding stemming from ice-breaking procedures on the Winooski River in the capital Friday.”** <sup>5</sup>

## Classification

- Process
  - freezeup
  - breakup
- Lead Time
  - advance
  - early warning
  - emergency
  - permanent

## Freezeup Control

Control production and transport of frazil ice

Displace jam initiation location

## Breakup Control

Control timing of ice breakup

Displace jam location

- Freezeup
  - gradual production and accumulation
  - reduce production
  - collect ice in safe place



- Breakup
  - dynamic breakup and arrest
    - reduce ice volume
    - arrest run in safe place
    - allow run to pass



## ***Goals of Advance Measures***

Flood protection  
Reduce ice supply  
Control breakup  
sequence  
Increase  
conveyance

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## ***Advance Measures***

- non-structural intervention
- two weeks to six months lead time
- can be inexpensive
- effective?

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## ***Advance Measures - Breakup***

- Ice weakening
  - weaken ice to pass ice run
  - mechanical & thermal methods
  - 2-6 weeks before breakup
  - watch downstream
  - very low cost
  - effective?

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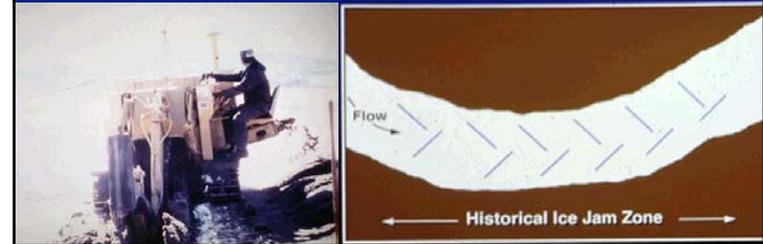
## ***Mechanical Weakening***

- Immediate strength reduction
- Ice cutting
  - 4WD trencher
  - amphibious ice saw
- Ice breaking
  - amphibious excavator
  - vessels

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## ***Ice Cutting***

- Beaurivage River, Quebec
  - 4WD trencher
  - diagonal slot pattern, center 2/3
  - ice moves through cut area



## ***Ice Breaking***

- Aroostook River, ME
  - 18-ton amphibious excavator
  - breaks open channel
  - ice moves into dam pool



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## ***Ice Breaking***

- Icebreakers
  - can clear channels in jams
- hovercraft
  - effective for sheet ice



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## ***Thermal Weakening***

- Accelerate natural ice deterioration
- Dependent on meteorological conditions
- Hole drilling
- Dusting

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## ***Hole Drilling***

- Oconto River, WI
  - 10 ft grid, central 2/3 of channel
  - holes expand to weaken sheet
  - ice moves into Lake Michigan



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## ***Aerial Dusting***

- Yukon River, AK
  - sand increases solar absorption
  - 25 years, high productivity
  - difficult to assess effectiveness



## ***Dusting - Hydroseeder***

- Winooski & White Rivers, VT
  - mulched leaves
  - road access, hose extension



## ***Early Warning***

- Ice motion detectors
- Trained observers
- Provides critical information
- Two weeks to six months lead time
- Inexpensive and invaluable

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## ***Ice Motion Detectors***

- Trip wires in ice
  - alarms inform emergency managers
  - select locations to give days/hours warning
- Other:
  - stream gage, satellite, cellular phone

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## ***Trained Observers***

- Part of emergency response team
- Track pre-event ice conditions
- Check U/S & D/S during event
- Helpful for after-action assessment, permanent measures

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## ***Goals of Emergency Measures***

**Flood protection**  
**Increase conveyance**  
**Remove ice**

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## ***Emergency Measures***

- Jam in place
- Cost & effectiveness depend on timing
  - try to minimize damages
  - time is critical
- Excavation
- Blasting
- Flood Fighting
- Do nothing

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## ***Excavation - Stage Rising***

- immediate flood threat
- pre-positioned equipment
  - excavator, clam-shell, bulldozer
  - clear channel D/S of toe
  - dislodge key pieces at toe
- can be inexpensive (& nerve wracking)

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## ***Excavation - Stage Falling***

- second flood threat possible
- bulldozer clears channel
  - from D/S, through toe
- dislodge key pieces
  - blasting, clam-shell
- expensive to excavate ice pieces
- access difficult

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## ***Excavation - Examples***

- Gorham, NH
- Morrisonville, NY

[Click here to view remainder of presentation](#)

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