

# Urban Flooding

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# Introduction

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- Urban Flooding Background
  - ◆ Stormwater management practices
  - ◆ Overland, infiltration and sewer backup flooding
  - ◆ Impacts
- Homeowner Urban Flood Mitigation
- Hazard Perceptions
- Conclusion

# Stormwater Management

- Storm Sewer Era: 1880-1970

- ◆ 2-10 year design standard – up to 25 years
- ◆ Use of combined sewers
- ◆ Most common method of stormwater management in Canada



# Stormwater Management

- Stormwater Management Era: 1970-1990
  - ◆ Major system: overland system
    - ☞ Stormwater management ponds, overland flow routes
    - ☞ Usually major system (conveyance routes) designed to handle 100 year events
  - ◆ Minor system: underground system
    - ☞ 2-10 year design standards for minor system
    - ☞ 5 year standard common

# Stormwater Management

- Best Management Practice Era: 1990-
- Considering stormwater quality along with quantity
  - ◆ Environmental considerations
  - ◆ Source controls
  - ◆ Reduce rapid flows, increase infiltration
  - ◆ Porous pavements, green roofs, pervious & green areas, vegetation, etc.

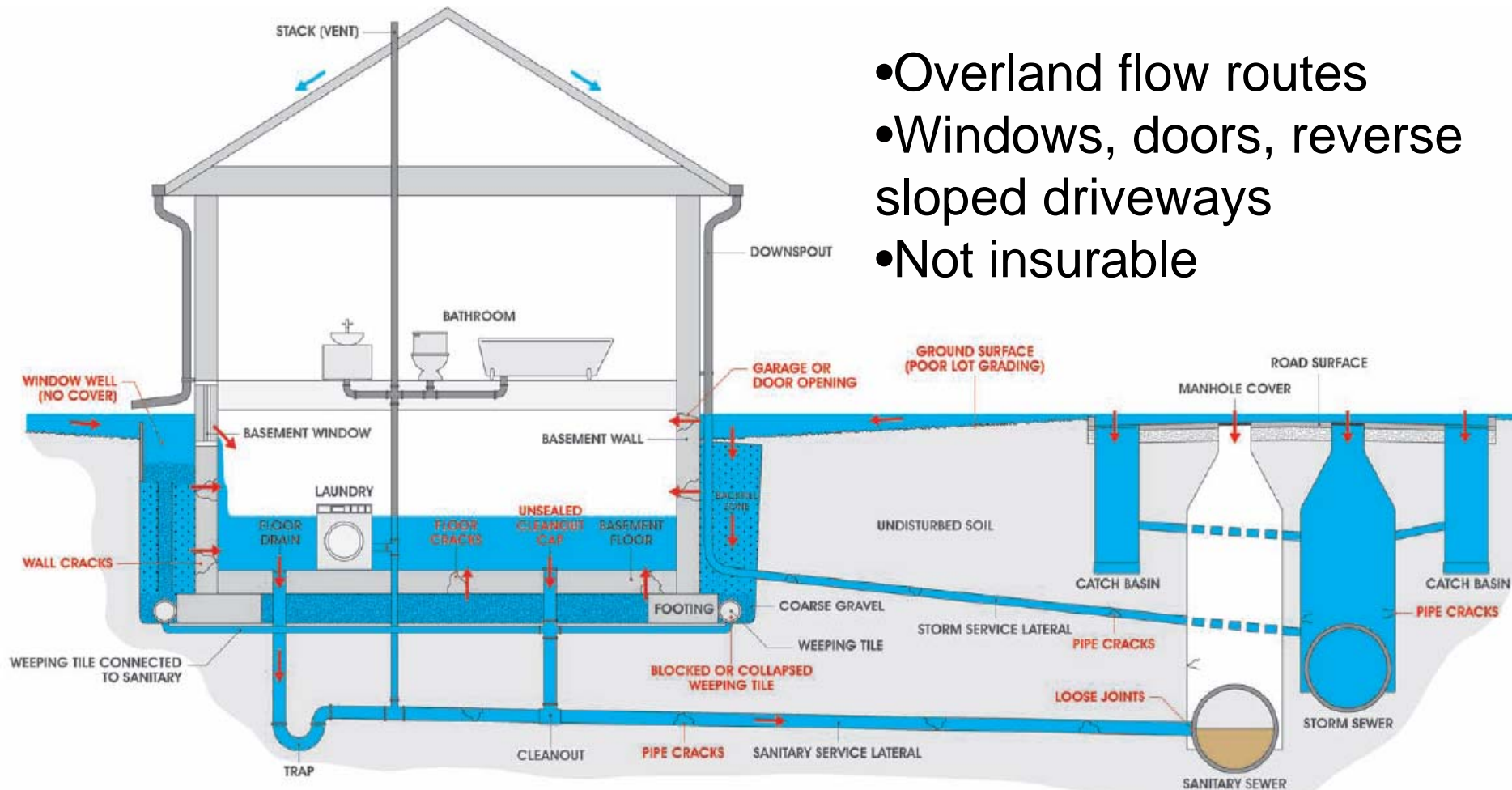
# Types of Urban Flooding

- Overland flows caused by extreme rain
  - ◆ Caused directly by intense rain
    - ☞ e.g., when rain exceeds 100 year capacity of major systems and/or where major systems are poorly defined
  - ◆ Occur outside of formally defined floodplain
    - ☞ Generally, have not been identified in riverine flood maps



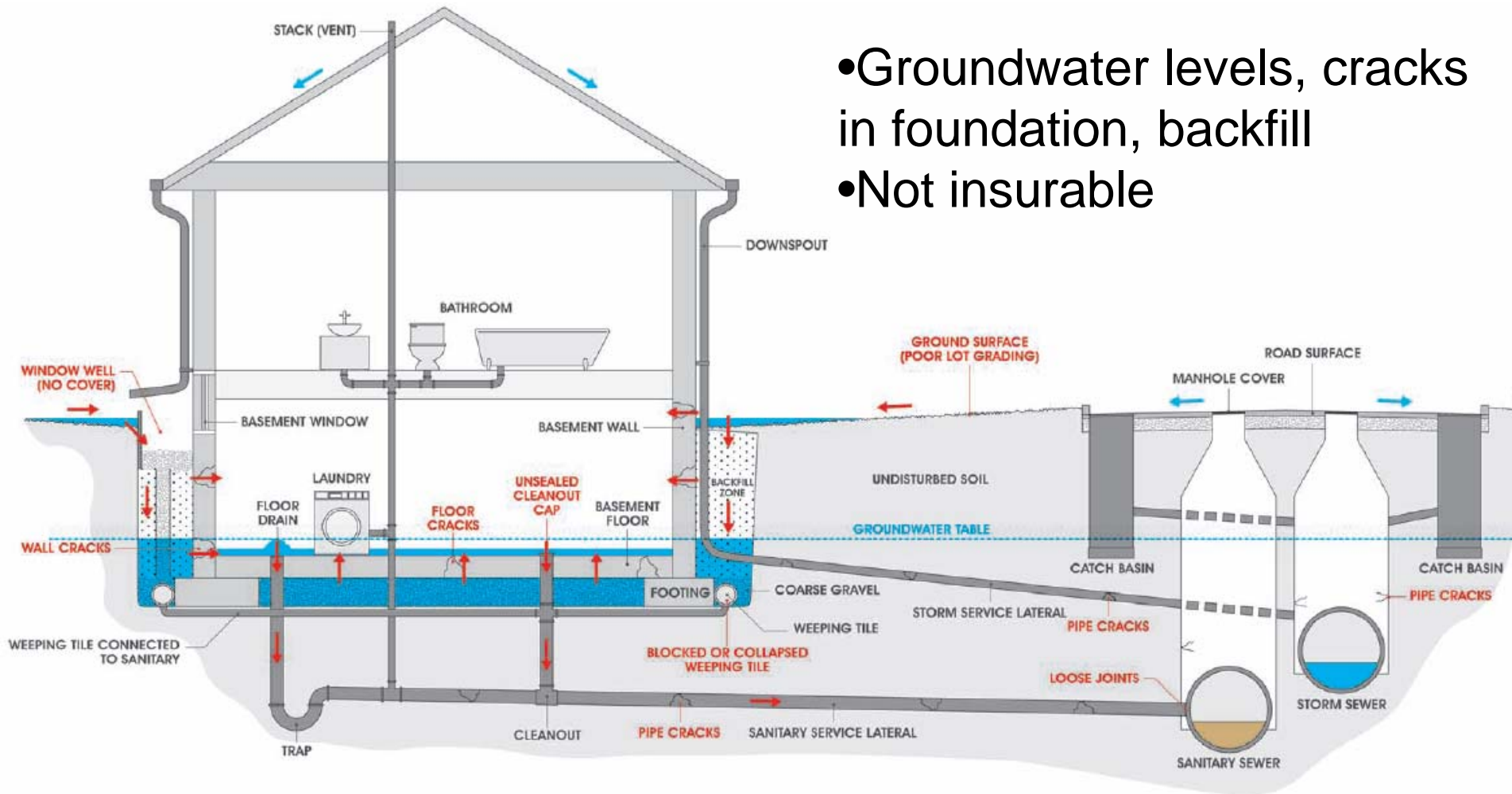
# Overland Flooding

- Overland flow routes
- Windows, doors, reverse sloped driveways
- Not insurable



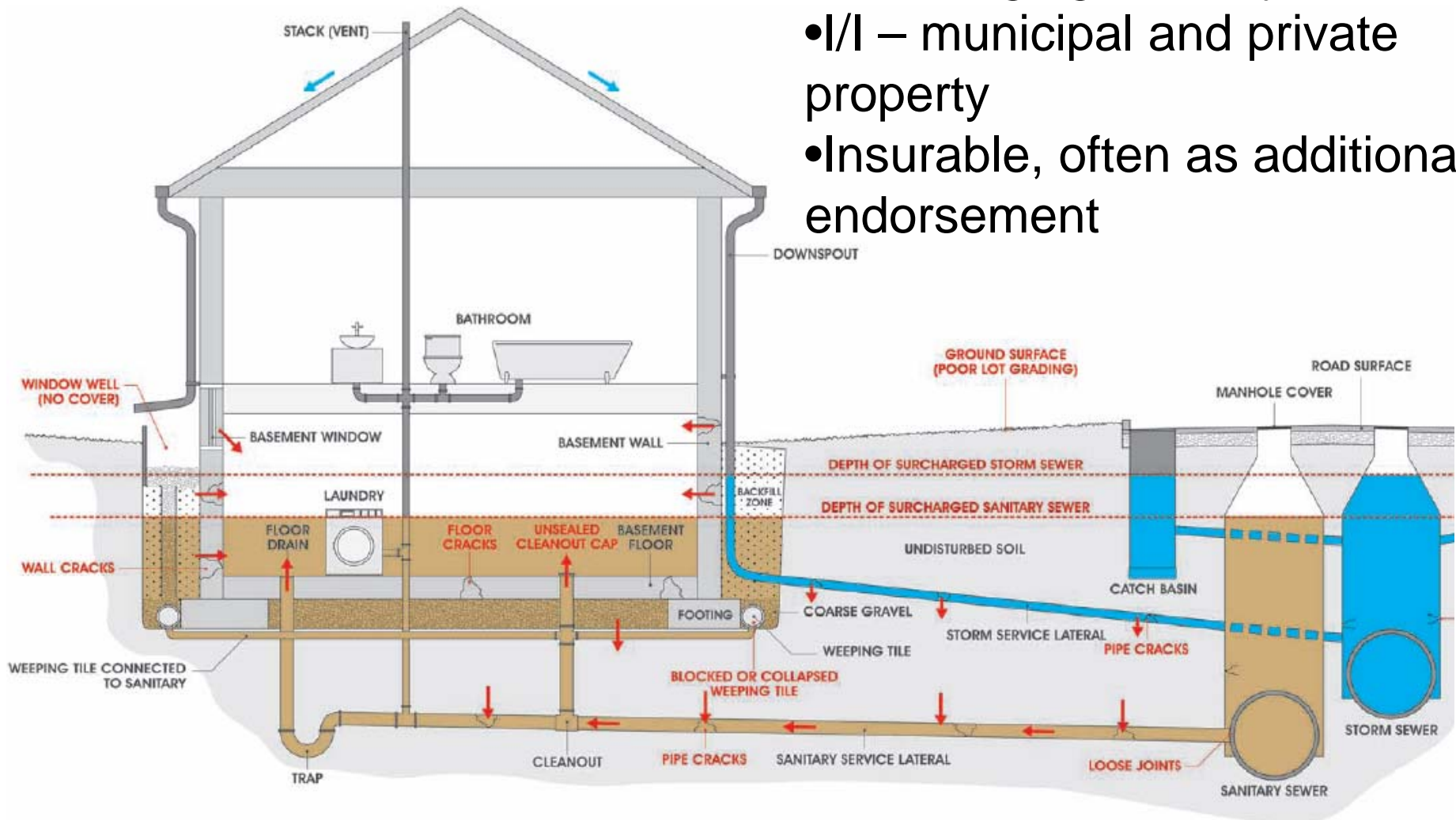
# Infiltration Flooding

- Groundwater levels, cracks in foundation, backfill
- Not insurable



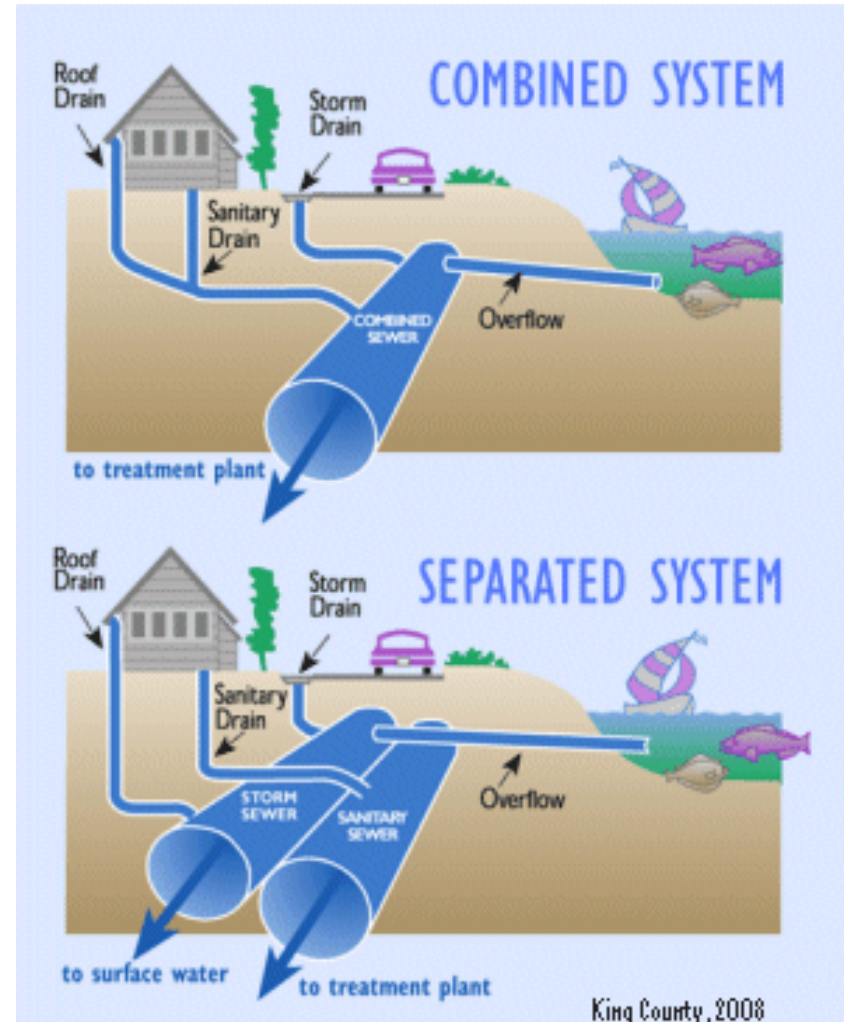
# Sewer Backup

- Surcharging sanitary sewer
- I/I – municipal and private property
- Insurable, often as additional endorsement



# Urban Flood Impacts

- Environmental impacts
  - ◆ Combined Sewer Overflows (CSOs)
  - ◆ Stormwater surface flows
    - ☞ Carry contaminants (oil, animal waste, etc.) from city surfaces to receiving surface water (lakes, streams, etc.)



# Payouts

- GTA 2005
  - ◆ \$500 M total, \$247 M in sewer backup payouts
- Calgary, 2005
  - ◆ \$300 M, \$144 M for sewer backup
- Edmonton, 2004
  - ◆ \$166 M total, \$143 M for sewer backup



# N. Ontario Damages

Location	Date	Rainfall	Notes
Kenora	1996	144 mm	Several million \$ in insurance payouts
Sudbury	Apr., 1997		\$21 M in insurance payouts – <b>Only N. Ontario flood identified by IBC as significant payout event</b> (based on 1983-2007)
NW Ontario/49 <sup>th</sup> Parallel storm	June, 2002	200-400 mm	\$31 M in infrastructure damage, \$4 M in ODRAP payouts, exceeded Timmins Storm severity; exceeded Fort Francis, Kenora 1-day rainfall records
Lake of the Woods/Kenora	Sept. 2003	79 mm in 3 hrs in Lake of the Woods; 92 mm in Kenora	
Thunder Bay	June, 2008	70-80 mm	\$2 M in infrastructure damages

# Litigation

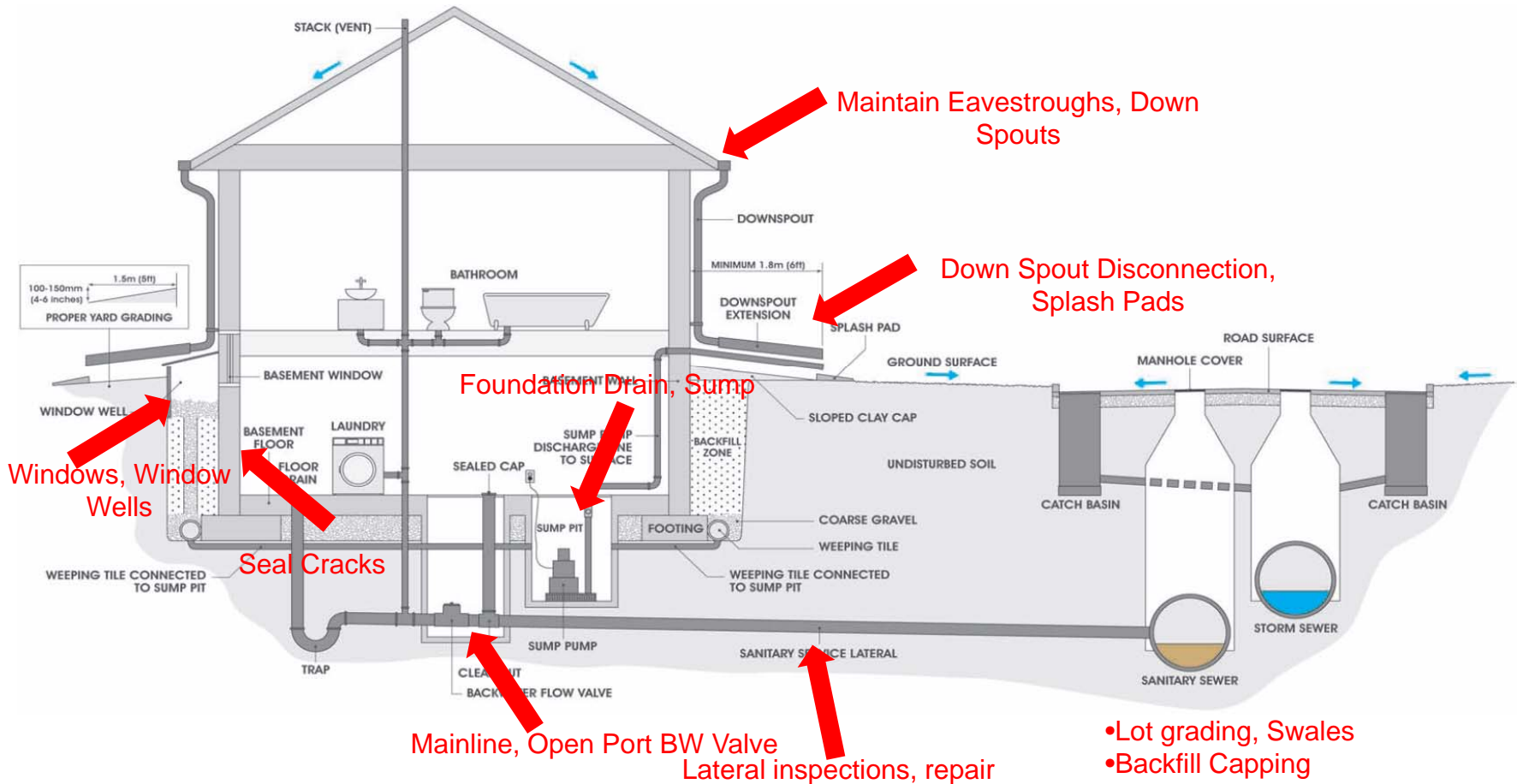
- Thunder Bay – 200 homes serviced by combined sewers flooded in 1991
  - ◆ Municipality liable to plaintiffs for negligence and nuisance – related to failure to take reasonable measures to enforce 1985 bylaw (identified as a problem in 1965)
  - ◆ Judge rejected municipality's argument that the flooding was inevitable cause of sewer system design
- Port Alberni, Stratford, St. John's, Kenora

# Climate Change

- Study in City of Greater Sudbury based on PIEVC protocol (road infrastructure)
  - ◆ Slight increase in rainfall, more precipitation in the form of rain
  - ◆ More frequent severe rainstorms
  - ◆ Decreasing snowfall, fewer minor storms (less than 20cm) and more large storms (more than 20cm)
  - ◆ Increasing occurrence of “rain on snow” events
- MTO study climate change impacts on highway drainage infrastructure standards (inc. Kenora/Rainy River)
  - ◆ 50 year system will be able to handle only 20 year event by 2050s
  - ◆ Recommended 16% increase in pipe diameter for all of Ontario to maintain current service levels

# Homeowner Urban Flood Mitigation

# Example Homeowner Level Measures



# Encouraging Homeowner Action

- Education
  - ◆ Public meetings associated with EAs
  - ◆ Meetings focussed on affected neighbourhoods
  - ◆ Meetings focussed on plumbing measures
  - ◆ Mass media, brochures, handbooks, websites, etc.
  - ◆ Insurance providers
- Subsidy programs



# Subsidy Programs

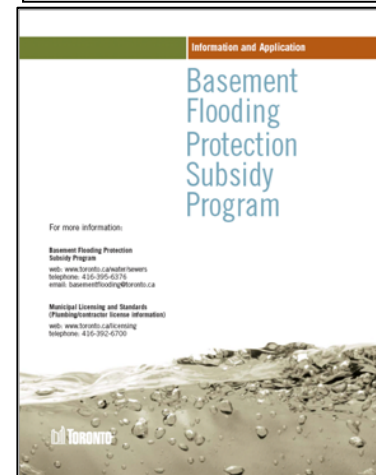
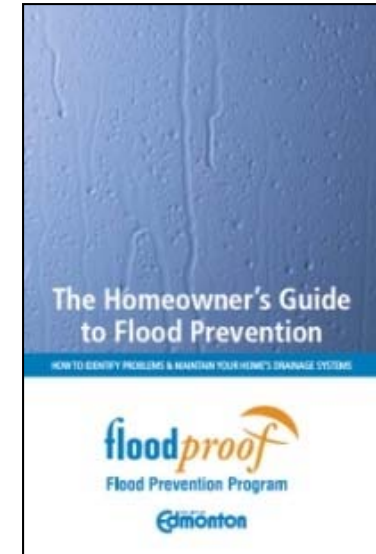
- Toronto
- Edmonton
- London
- Ottawa
- Halton Region
- St. Catharines
- Welland
- Niagara Falls
- Hamilton
- Saskatoon
- Durham Region (loan)

80% up to \$2,800 for BW valve and sump-pump in **Toronto**

\$975 for BW valve, \$1,400 for sump in **Edmonton**

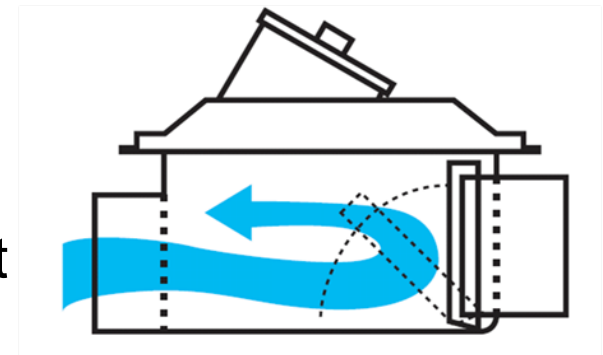
\$2,000 for sump, BW valve, lateral repair, DS disconnection – additional \$1,500 for repair of lateral if affected by City trees in **Hamilton**

\$3,000 in **St. Catharines, Welland**



# Standards and Bylaws

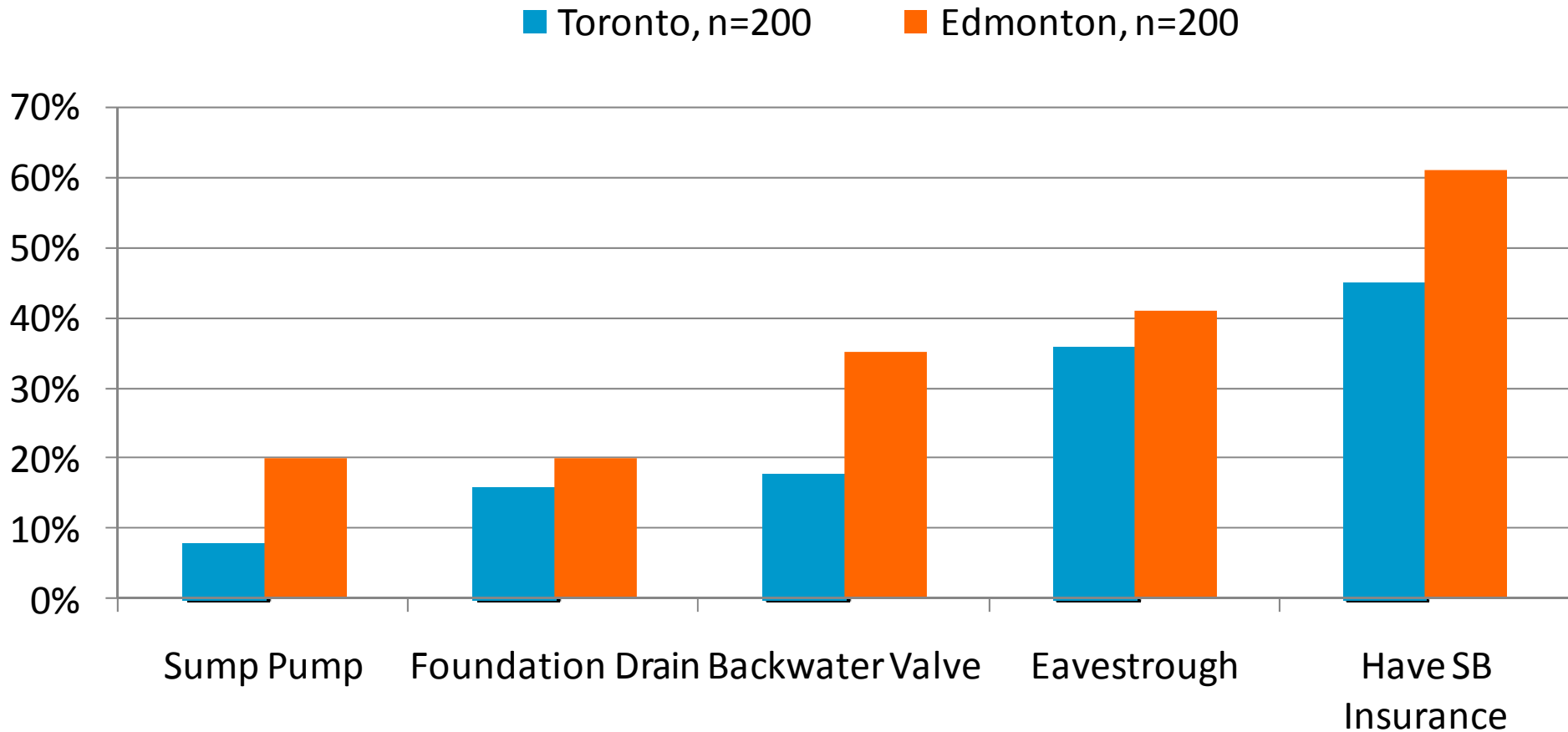
- Lot grading
- Contribution of freshwater to sanitary system
  - ◆ Eavestrough
  - ◆ Foundation drains – sanitary sewer (e.g., Durham Region since 1983, Peterborough since 1991, Sault Ste. Marie since 1968)
- Reverse sloped driveways
- Backwater valves in all new development
  - ◆ Edmonton (since 1989)
  - ◆ Winnipeg (since 1979)



# Hazard Perceptions

- Frequent hazard denial, denigration
  - ◆ “It won’t happen here”
  - ◆ Perception of 1 in 100 year storm, “gambler’s fallacy”
- Infrequent adoption of risk reducing adjustments
- Reliance on governments to reduce risk
  - ◆ Transfer of blame

# Edmonton/Toronto – Sewer Backup

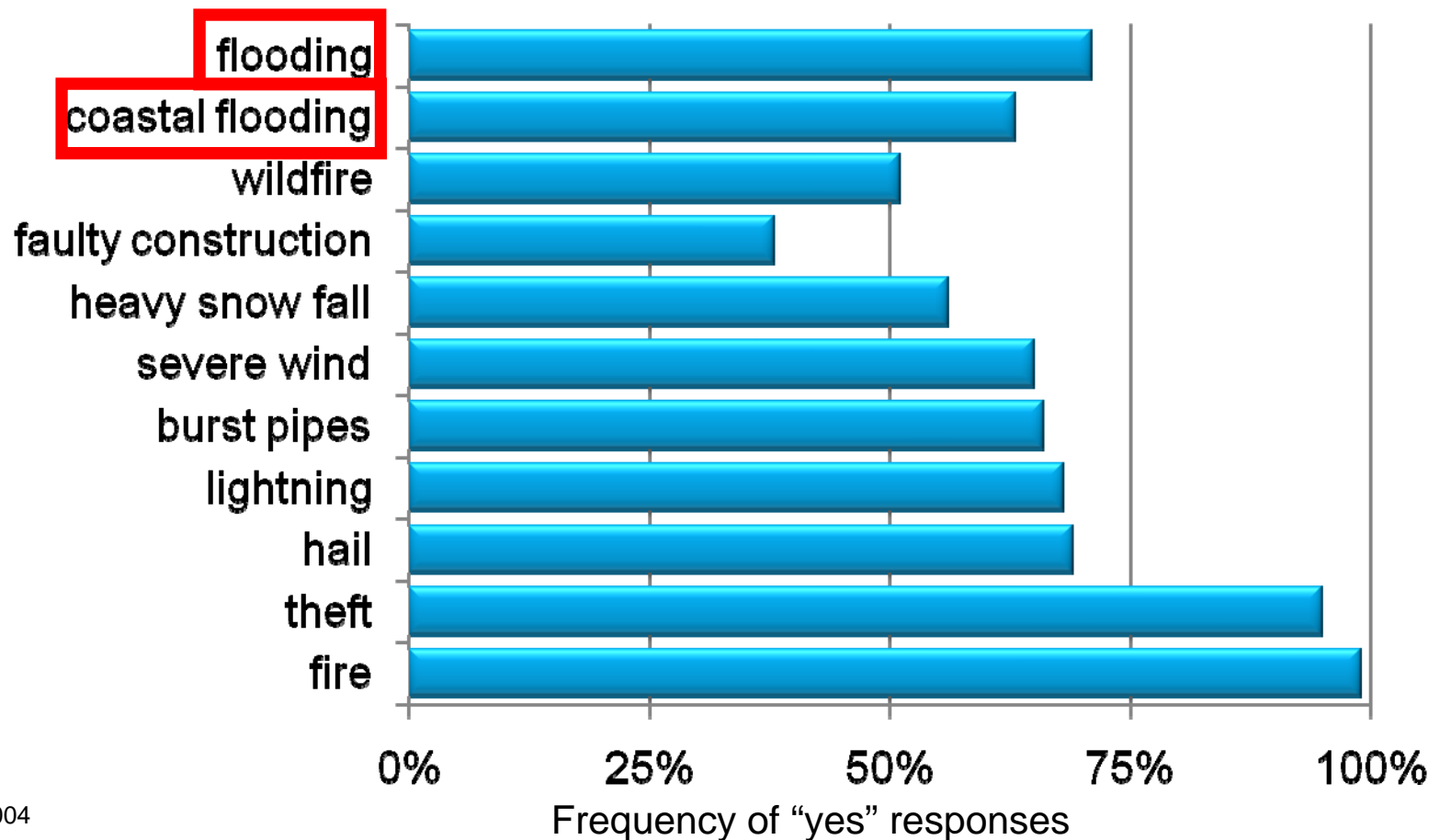


# Incentive Programs

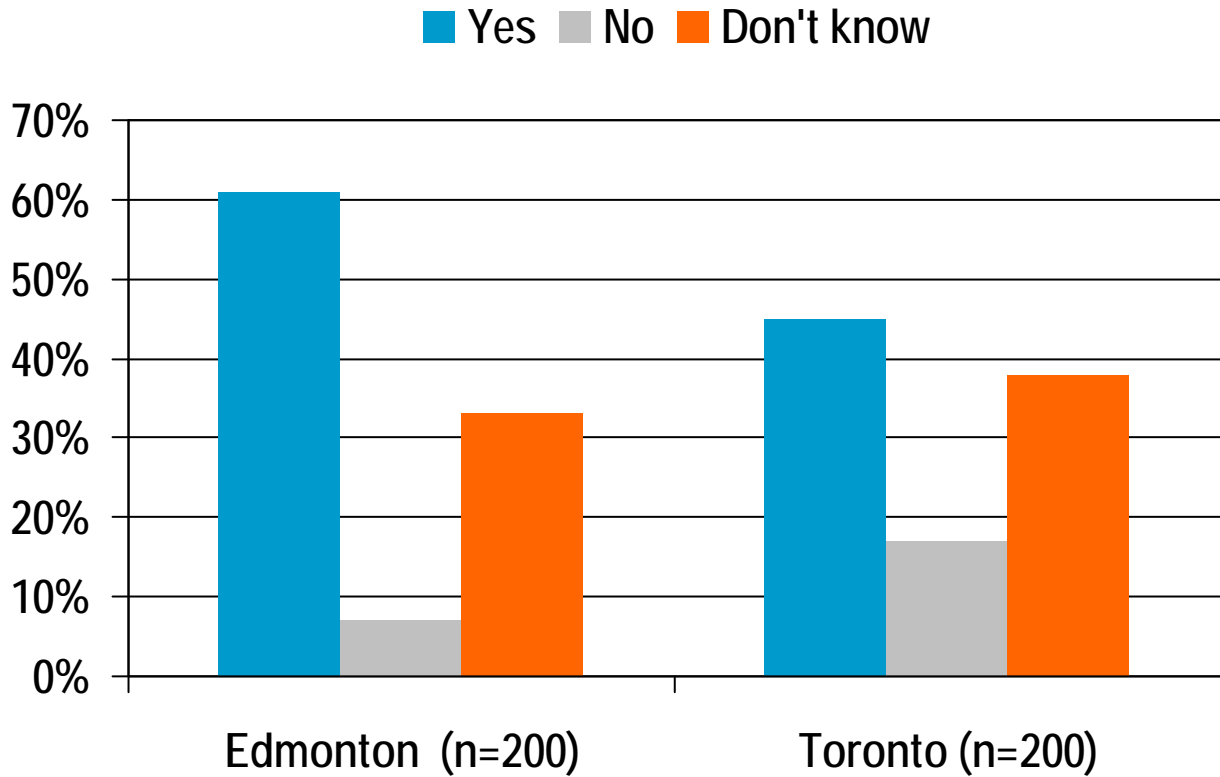
- Potential low uptake of incentive programs
  - ◆ Notifications by mail after flood complaints
  - ◆ Toronto:
    - ☞ In 2005, 5000 applications mailed, 2000 returned, 1000 approved for funding
  - ◆ Edmonton:
    - ☞ Notified by mailings in 2004
      - Half of those who received mailings applied
      - $\frac{3}{4}$  of those who applied received funding

# Perceptions of Insurance Coverage

Which of the following does a standard home insurance policy cover?



# Insurance



Do you have insurance coverage for sewer backup damages?  
(Respondents who have experienced sewer backup in the past)

# Identifying Affected Homes

- 9,500 claims in Edmonton in 2004
  - ◆ City estimated 4,000 flooded basements
  - ◆ Identified as an issue in Hamilton
- Low level of insurance claims in Edmonton-Toronto
  - ◆ E.g. only about a third claimed for last SB event
- Issues with identifying who has been affected
  - ◆ Implications for information on where there are flooding issues

# Concluding Remarks

- Homeowner level actions an important part of overall flood mitigation strategies – challenge is to affect behaviour
- Increasing risk
- Who's been affected?
- Insurability?
  - ◆ Initial reaction by many insurers is restricting, limiting coverage
  - ◆ Some are more progressive

# Thank you

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