



# Best Practices to Repair Potholes in Canada





# The Problem...





# Public Expectation

- High expectations for condition of the road network
- Associate potholes with poor infrastructure
- Safety hazard and vehicle damage
- Winter/spring, more attention paid by the media with “calls” to improve road conditions



## Press Search on City Name and “Pothole”

- **Potholes in Montréal wreaking havoc on the roads**
- **It makes no sense, Montréal driver fuming over potholes**
- **A city of potholes - crews have filled 134,000 in Toronto**
- **Toronto pothole repairs hit 5-year high, 55 crews filling potholes**
- **Winnipeg mechanic said he's shipping loads of broken springs to the scrap yard weekly from trucks who have hit potholes**
- **Saskatoon fills 100,000 potholes so far this year**
- **A pothole so large that it took out a Cadillac in Calgary**
- **Pothole swallows truck's tire in Edmonton**



## Agency Perspective

- **Good understanding of the cause of potholes**
- **Design and construction issues**
- **Uncontrollable freeze/thaw cycles**
- **Lack of resources for preventive maintenance**
- **Lack of resources for timely rehabilitation**
- **Primary focus is to fill potholes as quickly as possible to improve safety and limit liability**



# Causes of Potholes



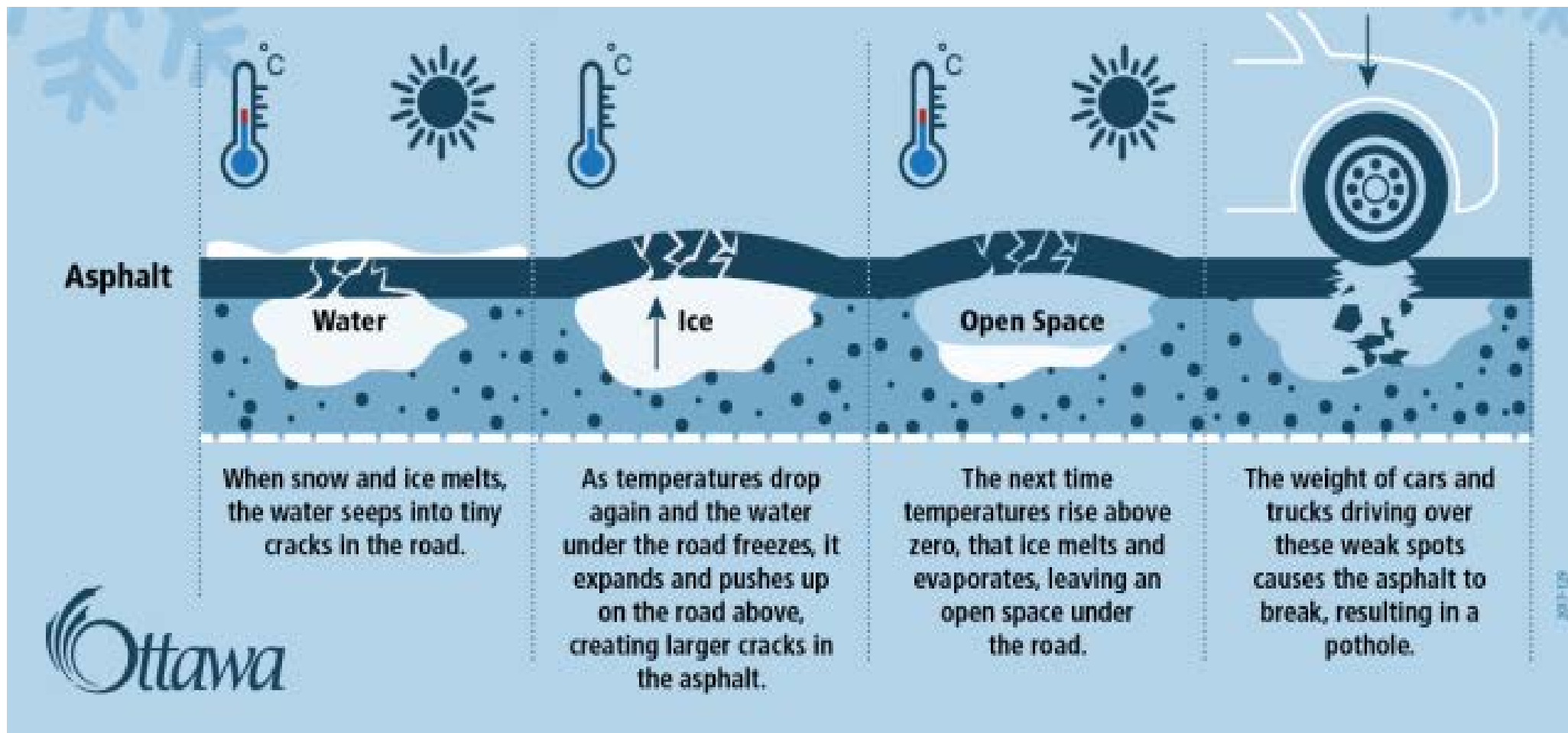


# Contaminants





# How Potholes are Formed







# Not Always Related to Freezing Conditions



Location - Hawaii



# Survey Summary

- **22 Canadian and 7 International responses**
- **Causes of potholes in Summer**
  - Canada
    - Pavement age
    - Lack of maintenance
    - Drainage issues
  - International
    - Construction workmanship (poor compaction)
    - Lack of maintenance
    - Pavement age and drainage issue



# Survey Summary

- **Causes of potholes in Winter**
  - Canada
    - Freeze/thaw cycles
    - Pavement age
    - Recurring potholes (repair technique)
  - International
    - Construction workmanship (poor compaction)
    - Freeze/thaw cycles
    - Lack of maintenance



# Has Climate Change Impacted the Frequency and Severity of Potholes?

<b>Respondents</b>	<b>Yes</b>	<b>No</b>
Canadian Municipalities	9	1
Canadian Provinces/Territories	9	2
International (European)	2	5
<b>Overall</b>	<b>20</b>	<b>8</b>



## What Materials do you use for Pothole Repair?

- 39 products, 28 good to very good performance, 11 poor
- Popout, bleeding, poor compaction, lack of bonding, soft when temperature increases
- 24 use hot mix asphalt, 22 good to very good
- 6 used spray patching, all rated good to very good
- Some have tried: stone mastic, warm mix, reheated recycled asphalt, infrared
- Performance generally good to very good



# Specialized Equipment

- Hot boxes, infrared heat, spray patching systems
- Systems generally work well
- Challenges include:
  - Excessive downtime for cleaning and maintenance
  - Need for year round dry aggregate
  - Availability of indoor storage facilities
  - Need for preparation and cleaning of repair area
  - Need for adequate compaction





# Pothole Repair Techniques

- **Most agencies have standard operating procedures**
- **Compliance rated as fair to good**
- **Quality of repairs indicated mostly as fair**
- **Few had any quality verification system**
- **Recipe for success:**
  - Account for time of year, pavement condition and traffic when selecting material (best use hot mix asphalt)
  - Clean debris and water from pothole
  - Use tack coat to improve fill material bond to pavement
  - Ensure proper fill height and compaction





# Definitions from Canadian PPP Agreements

Concession/Agency	Pothole Size	Time to Repair
Fredericton/Moncton Highway, New Brunswick	150 mm in width and/or depth of 75 mm	48 hours of discovery
Sea to Sky Highway, British Columbia	Depth is 25 to 50 mm	3 months
407 ETR, Ontario	0.4 m <sup>2</sup> (20 x 20 cm or 10 x 40 cm)	3 days
Southwest Stoney Trail / Northeast Anthony Henday, Alberta	Localized deficiencies which are > 0.1 m <sup>2</sup>	24 hours
South Frazer Perimeter Road, British Columbia	Depth is 25 to 50 mm	3 months
Hwy 427 PPP/Rt Hon Herb Gray Parkway, Ontario	No Pothole deeper than 75 mm and greater than 0.04 m <sup>2</sup> No more than three (3) Potholes greater than 0.04 m <sup>2</sup> in an area of 20 m <sup>2</sup> No more than ten (10) Potholes per lane km	5 QF Points for each Pothole deeper than 75 mm and greater than 0.04 m <sup>2</sup> 1 QF Point for each four (4)-hour segment until the Pothole is repaired
Chief Peguis Trail – Winnipeg, Manitoba	Localized deficiencies which are > 0.1 m <sup>2</sup>	36 hours
Regina Bypass, Saskatchewan	No definition	24 hours
A-30 Montréal, Québec	Dimension greater than 100 mm	24 hours
North Commuter Parkway – Saskatoon, Saskatchewan	Pothole on roadway and other localized deficiencies >0.1 m <sup>2</sup>	24 hours
Disraeli Bridge – Winnipeg, Manitoba	Localized deficiencies which are > 0.1 m <sup>2</sup>	24 hours
Champlain Bridge, Montréal	Greater than 100 mm deep and/or greater than 100 mm laterally	7 days

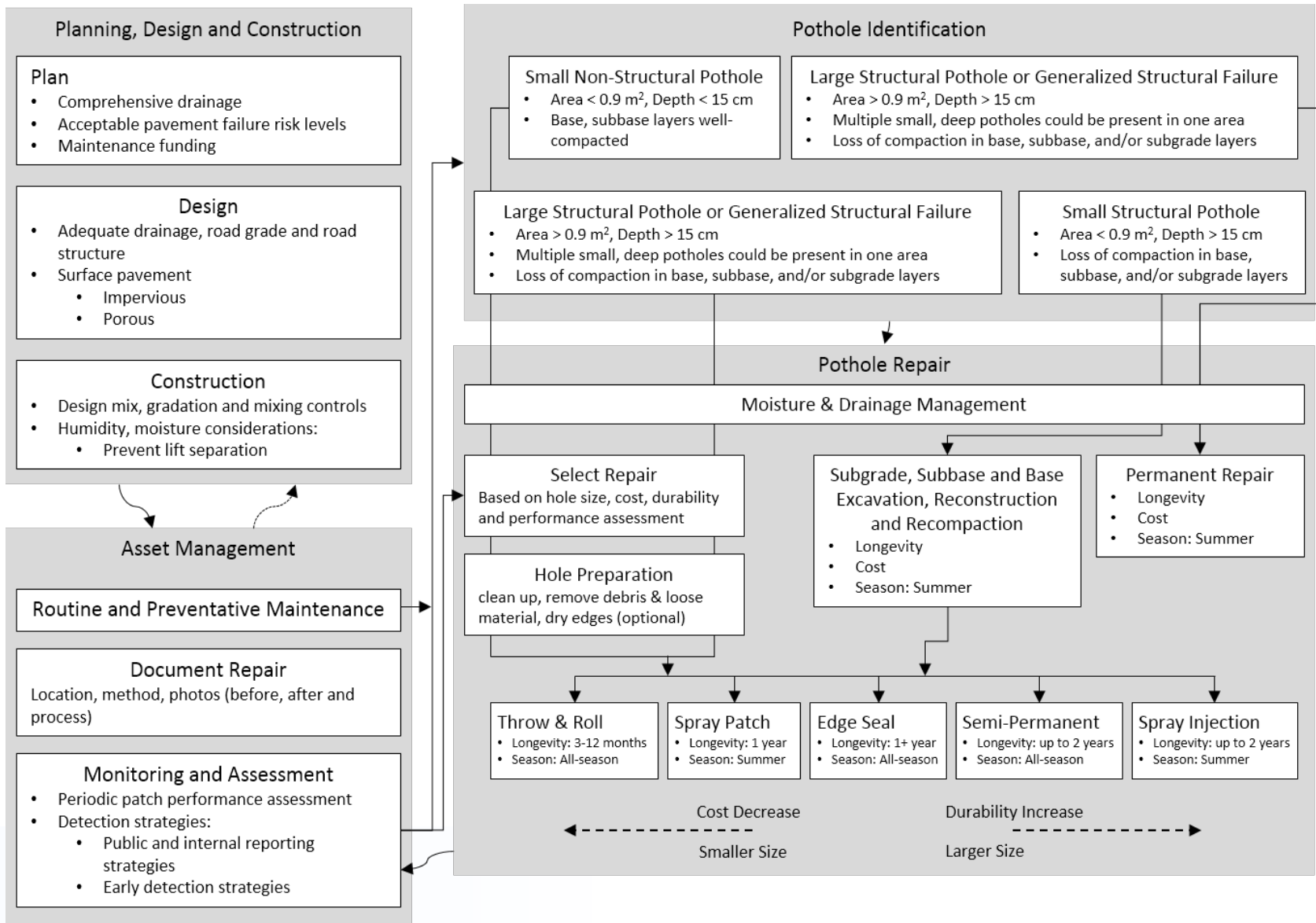


# Expected Service Life of Pothole Repairs

Material	Expected Service Life
Cold applied asphalt	
Regular	< 1 year
Premium	3 years
Water setting	1-3 years
Hot mix asphalt	>3 years
Thermal patching	2 years
Spray patching	3 years
Resin-based mixtures	>3 years
Concrete and hydraulically bound mixtures	>3 years



# Selection of Best Method for Repairs





# Prevention and a Better Cure

- **Focus on pothole prevention**
  - Prevention is better than a cure
  - Do it once and get it right
  - Effectively communicate to the public what is being done and how it is being done
- **Importance of competence through skills training**
- **Key recommendation – minimize long-term damage from the repair of utility cuts**



## European Union Study (2013)

- Adequate bonding and compaction is critical
- Established laboratory testing for material durability
- Uniformly applied tack coat, edge seals and compaction in lifts
- Most materials have only one aggregate fraction (results in high voids)
- Of 14 common materials tested, only 1 was water and freeze/thaw resistant
- Only 1 material had indirect tensile strength close to hot mix asphalt



# Patching Material

- Most popular used in Canada is cold mix
- Some agencies own their own asphalt plants and use hot mix asphalt year round
- Little use of recycled asphalt pavement (RAP)
- Tack coat, usually emulsified asphalt, can be hot asphalt cement





# Cold Mix Aggregate Gradations

Sieve Size (mm)	Ontario	Saskatchewan	Coarse Mix	Intermediate Mix	Fine Mix
25			100		
16.0	100				
13.2	98-100	100	95-100	100	100
9.5	85-100	78-88			
6.7			55-75	90-100	90-100
4.75	50-85	58-75			
2.36	35-65	38-57	15-40	12-40	35-60
1.18	25-50	26-42			
600 μm	15-40				
300 μm	7-25	11-30			
150 μm	2-13	3-12	0-5	0-5	2-10
75 μm	0-7	2-6			0-5
AC (%)	3.7-5.5		4-7.5	4-8	5.5-8

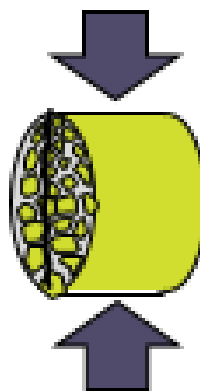


# Typical North American Laboratory Testing

- Gradation and asphalt cement content
- Marshall stability
- Indirect tensile strength
- Cohesiveness
- Wheel track rutting



TSR,  
Tensile  
Strength  
Ratio:







## New Developments

- **55 percent of agencies evaluating new materials and methods**
- **Majority of highway agencies outsource maintenance**
- **Standards for pothole repairs**
- **If repair fails, contractor required to repeat treatment**
- **Drives contractors to find longer lasting repairs**



# Summary

- **Public engaged through the use of mobile applications, social media, websites and 311 call systems**
- **Many agencies track pothole repair locations, typically this is of limited benefit given the large number of repair locations**
- **Numerous methods are used to determine the number of potholes filled**
- **Need to focus on prevention through:**
  - Sustainable funding for maintenance and rehabilitation
  - Pavement preservation
  - Improved materials and construction



## Summary

- **Canadian agencies repair millions of potholes every year**
- **Repair of potholes is one of the most challenging operations**
- **Road users are very cognizant of potholes**
- **Freeze/thaw cycles and their impact on water on/in the pavement have a significant impact on pothole formation**
- **Most agencies have documented means and methods for pothole repair but do not always follow them**
- **Very few agencies test the quality of pothole materials**
- **Very few agencies monitor the performance of pothole repair materials and methods**



# Summary

- **Most agencies use cold mix asphalt for the repair and the performance is relatively poor**
- **Agencies who use hot mix asphalt indicate better performance than with cold mix asphalt**
- **Few have tried spray patching and indicate that it works well but equipment care and maintenance can be a problem**
- **Many potholes are caused by construction defects**
- **Key to quality is to follow installation best practices**
- **The timing and type of pavement maintenance and rehabilitation treatments can significantly reduce the number of potholes**



# Recommendations

- 1. Develop a communication strategy to identify and report potholes and to engage the public**
- 2. Each agency should establish a pothole repair methodology**
- 3. Explore opportunities to share policy and technical information for pothole repairs**
- 4. A process and procedures should be developed to evaluate the field performance of pothole repair products and procedures**



## Recommendations

- 5. Review maintenance procedures to address deficiencies that may be the underlying cause of potholes**
- 6. Optimize pavement maintenance, preservation and rehabilitation treatments reduce pothole occurrence**
- 7. Review design standards to determine if materials and specifications are taking advantage of current technology**
- 8. Assess resources for pavement maintenance such as ditching, crack sealing, surface sealing, patch repairs, utility cut repairs, etc.**



## Recommendations

- 9. Review specifications and materials to identify deficiencies related to pothole generation**
- 10. Complete field review of pavement maintenance and rehabilitation treatment performance**
- 11. Training for construction administration and field inspectors on the importance of high-quality materials and construction**
- 12. Methods and/or specifications for patching should be reviewed to improve performance**