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#### Abstract

Every year the City of Edmonton spends a few million dollars to fill a few hundred thousand potholes. Are potholes just a fact of life, or can we do something about them? It's time for a more sophisticated and creative discussion about potholes in Edmonton.

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# Table of Contents

Pothole Primer	2
How do potholes form?	2
How many potholes are there in Edmonton?	3
How much does Edmonton spend fixing potholes?	4
How does Edmonton compare to other Canadian cities?	6
How many kilometers of road does Edmonton need to maintain?	8
What are the traffic trends in Edmonton that affect potholes?	9
How does the weather in Edmonton affect potholes?	. 11
How often do we talk about potholes in Edmonton?	. 15
What other factors could be considered?	. 17
Sources	. 18
License	.18



### Pothole Primer

Here's the definition from Wikipedia:

A pothole (sometimes called a kettle and known in parts of the Western United States as a chuckhole) is a type of disruption in the surface of a roadway where a portion of the road material has broken away, leaving a hole.

An alternative definition, suggested in "Pothole primer: A public administrator's guide to understanding and managing the pothole problem" is:

Any pavement defect involving the surface, or the surface and base, to the extent that it will cause significant noticeable impact on vehicle tires and vehicle handling.

### How do potholes form?

Potholes develop when water and traffic are present at the same time. This infographic from the Missourian illustrates this process:

# **HOW DO POTHOLES FORM?**

Winter weather does more than close schools and disrupt lives: it also brings about ideal conditions for potholes to form.



Water seeps through cracks in the pavement into the soil



Water freezes and expands, causing surface to rise



The ice melts, leaving a gap beneath the road



Car tires collapse the surface into the gap, causing a pothole

Sources: MICHIGAN DEPT. OF TRANSPORTATION, MINNESOTA DEPT. OF TRANSPORTATION



# How many potholes are there in Edmonton?

The City of Edmonton generally cites an average of 400,000 potholes filled each year, and in 2012 estimated that roughly 97% of potholes would be filled. The true number of potholes is difficult to estimate.



This chart shows the number of potholes filled in Edmonton since 2000:

That totals more than 5.6 million potholes! Using an average of 400,000 potholes per year for the period 1990-1999, we can estimate that the City of Edmonton has filled nearly 10 million potholes over the last 20 years.



### How much does Edmonton spend fixing potholes?

A true accounting of the cost of the pothole problem would consider a number of factors, including:

- The cost to fill potholes each year
- The cost of any preventative maintenance undertaken
- The cost of any claims paid out
- The cost of repairs to vehicle damage caused due to potholes

Unfortunately, available data on these factors is limited. Estimates for the cost of fixing a pothole range from \$8.00 per pothole to \$25.00 per pothole.

The City of Edmonton does provide costing information for repairing, maintaining and reconstructing roads:

\$1.20/m²
\$4.50/m²
\$23.33/m <sup>2</sup>
\$79.70/m²
\$78.77/m <sup>2</sup>
\$209.00/m <sup>2</sup>



Here's a look at the annual amount budgeted by the City of Edmonton to fill potholes:



Since 1990, the City of Edmonton has budgeted an average of \$3.5 million per year just for filling potholes, for a total of about \$85 million. After reaching a peak in 1995, the budget for potholes dropped to less than \$3 million per year until the mid-2000s.



Here's a look at the same data, adjusted for inflation:

Looking at the raw budget numbers, it appears that Edmonton budgeted about the same for the period 1990-1999 as it did for the period 2000-2009. But taking inflation into account, the City actually budgeted about \$8 million less in the latter period.



### How does Edmonton compare to other Canadian cities?

Edmonton is one of the few cities that tracks the number of potholes it fills each year, and the only one that makes that data readily available through its Open Data Catalogue.

Using news articles and other publicly available information, we can get a sense of how Edmonton compares to other major cities in Canada:



Edmonton fills far more potholes each year than any of its counterparts.





Using this data we can estimate the amount budgeted per pothole:

While it is hard to make true comparisons across cities, due to differences in the accuracy of the data as well as the processes and methodologies that each follow, this does give some indication of where Edmonton lies in relation to other major cities in Canada.



### How many kilometers of road does Edmonton need to maintain?

The City of Edmonton currently maintains more than 4,600 kilometers of roads. Here's a look at the increases to our road network since 1994:



A measure known as the Pavement Quality Index (PQI) is used to distinguish between roads in poor condition and those in good condition. A score of 6.5 out of 10 is considered "industry standard" for quality.

In 1993, a study found that 29% of Edmonton's arterial and collector roads were in poor condition, while 19% of local roads were in poor condition. In 1995, the City attributed a PQI of 5.4 to arterial roads and 5.2 to collector roads. A report in 2007 warned that these values would drop to 5.2 and 4.4 respectively, unless funding levels increased.

From the approved 2012-2014 Capital Budget:

The Arterial Road Rehabilitation Program approved budget is only 39 per cent of the minimum \$40 million per year required funding levels. The level funding could result in an overall decrease in the Pavement Quality Index (PQI) for arterial roads. As a result of increased investment in 2009-2011, the average PQI for arterial roads is currently 6.1. The reduction in approved funding for this program could result in an overall decrease in the PQI from 6.1 down to 5.1 over the course of the 3-year budget program, resulting in PQI ratings equivalent to that of the mid 1990's. This would present as an increase in the number of potholes and the amount of operational maintenance required.



# What are the traffic trends in Edmonton that affect potholes?

As traffic is one of the two most important factors in the creation of potholes (the other being water) it may be useful to know more about traffic.



Here's a look at the number of registered motor vehicles in Edmonton, St. Albert, and Leduc:

Edmonton accounted for roughly 18.9% of all motorized vehicles registered in Alberta in 2012. That's a small decline from 2004 when the percentage was 19.3%.

One of the best sources of information on driving habits is the Canadian Vehicle Survey, last updated in 2009. Looking at that data, we can see that the number of kilometers traveled each year in Alberta has increased to nearly 50 billion.





Another factor to consider is the weight of vehicles. While the distance travelled by vehicles in all classes has gone up 15.3% in Alberta from 2000 to 2009, the largest increase has been in vehicles that weight more than 4.5 tonnes.





### How does the weather in Edmonton affect potholes?

Here's a look at the amount of precipitation recorded per year at the City Centre Airport:



**Difference in Extreme Temperatures by Year** 40.0 30.0 20.0 10.0 0.0 -10.0 -20.0 -24.4 -27.8 -27.6 -29.3 -28.3 -29.2 -29.5 -30.6 -32.1 -33.3 -30.0 -34.0 -35.4 -36.0 -36.5 -40.0 -50.0 1999 2000 2001 2002 2003 2004 2008 2009 2010 2011 2012 Max Temp (°C) Min Temp (°C)

Here's a look at the difference in extreme temperatures recorded per year:



It is commonly stated that freeze/thaw cycles contribute to the degradation of road surfaces. Here's a look at the number of days per winter (October through March) where a temperature increase from below zero to above zero was preceded by precipitation.



While there does not seem to be a correlation between the number of potholes (remember 2007 was the worst year on record) and the number of freeze/thaw days, there are other factors to consider. This data comes from the City Centre Airport, but temperature and precipitation are not uniform around the city. There could be large variations in precipitation that make potholes more likely to form in one part of the city versus another.





Here's a look at the total amount of precipitation per winter:

Here's a look at the number of winter days below and above zero degrees:







Here's a look at the temperature extremes by winter:



### How often do we talk about potholes in Edmonton?



Here's a look at the number of Edmonton Journal articles mentioning potholes from 1989 to March of 2013:

The two years with the most articles, 2007 and 2011, are also the two years with the most potholes filled. The jump in 1992 may be accounted for by the doubling of the pothole budget that year.



Here's a look at the number of pothole-related tweets posted by Edmontonians from 2009 to 2012. Unsurprisingly, more tweets are posted in March and April when the snow melts and potholes form and become visible:





### What other factors could be considered?

There are many other factors that could be considered when examining Edmonton's pothole problem, including:

- Information about snow removal
- Information about drainage and standing water
- Information about experiments with materials (asphalt, concrete, polymers, etc.)
- Details about the construction criteria for roads over time (thickness, etc.)
- Information about road maintenance programs in addition to pothole filling
- Further detail about traffic volumes on City streets
- Further detail about temperature and precipitation in regions of the City
- Data about utility placement and cutting (manhole covers, etc.)
- Information about soil
- Information about the number of buses and bus stops



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