# TECHNICAL BRIEF

# Estimate of Annual Studded Tire Damage to Asphalt Pavements

## January 30, 2012 Update

Washington State
Department of Transportation

Engineering and Regional Operations
Construction Division
State Materials Laboratory

## Summary: A new estimate of the damage from studded tires to WSDOT's asphalt pavement reveals an estimated damage cost of $7,800,000 to $11,300,000 per year.

Studded tires damage asphalt pavements through raveling: the physical loss of aggregate from the surface of the pavement. As this loss accumulates, ruts form in the pavement. When these ruts reach 0.50 inch in depth (12.5 mm) these surfaces are programmed for replacement.

The rutting due to raveling will depend on the rate of wear and the number of vehicles with studded tires driving on the road. Estimates for the wear rate on asphalt pavements ranges from Alaska DOT's estimates of 0.102 – 0.148 inches per million passes, to Oregon DOT's reports of 0.34 inches per million passes. For this estimate, a wear rate between those of Alaska and Oregon rates is used: 0.170 inches per million passes. Studded tire usage rates vary from the west side of the state (estimated at about nine percent of vehicles) to the eastside of the state (estimated at 25 percent of vehicles).

Considering an average west side highway, with 15,000 cars per day per lane and nine percent of the cars having studded tires on one set of axles, then there are 1350 cars per day with studded tires. From November to March, or for 150 days, there are 202,500 cars with studded tires per year on that stretch of highway, and 202,500 passes per year. Using the wear rate of 0.17 inches per million passes, this level of traffic equates to 0.0344 inches of wear per year. WSDOT allows up to 0.5 inch (12.5 mm) of wear before programming rehabilitation, so this roadway would need to be rehabilitated in year 15. The normal life for the hot-mix asphalt on this roadway is over 17 years on the west side; therefore, the effect of studded tires reduces the asphalt surface life by approximately two years, or 12.0%. Given the uncertainty in wear rates a range of 10% to 14% loss of pavement life is assumed for western Washington.

For eastern Washington, on a highway with 8,000 cars per day per lane, and where studded tire usage is higher (estimated at 25 percent) the pavement surface life would be reduced from an average 11 years to 10 years or a 10.0% decrease. Given this uncertainty in wear rates a range of 8% to 12% loss of pavement life is assumed for eastern Washington.

The asphalt paving budget for the 2009-2011 biennium was $170.1 million statewide. Assuming a 60/40 split (westside to eastside) approximately $51.1M/year is invested in western Washington asphalt pavements and $34.0M/year in eastern Washington asphalt pavements. Using the percent reduction in pavement life from above, for the Westside 10.0% of $51.1M is $5.1M. 14% of $51.1M is $7.2M and for the eastside 8.0% of $34.0M is $2.7M. 12% of $34M is $4.1M. The total statewide asphalt cost due to studded tires can be estimated at $7.8M per year to $11.3M per year.

Variables: studded tire usage and wear rates are the greatest variables. As wear rates increase to the high end of Oregon's numbers, the damage and costs increase greatly. As studded tire usage increases, so do costs. Many vehicles are using studs on all four tires, which double the wear rates per vehicle. Alternate approaches to estimate studded tire damage costs may provide higher annual stud wear costs.

Notes:

1. Based on original estimating done by Robyn Moore, State Pavement Engineer in 1996, and Linda Pierce, State Pavement Engineer in 2002-8.

2. The percent of studded tires is based on a 1996-1997 WSDOT survey of shopping malls across the state.
3. Alaska DOT reports from 0.102 – 0.148 inches per million passes and Oregon DOT reports 0.34 inches per million passes on hot-mix asphalt pavements. Averaging these rates (Alaska's at 0.125 inches per million passes and Oregon's at 0.34 inches per million passes yields 0.2325 inches per million passes.