

## Reduce, Reuse and Recycle within the State Materials Lab building

The WSDOT State Materials Lab has taken action close to home to reduce, reuse and recycle. We now recycle nearly every type of material we encounter: testing waste (aggregates, concrete, asphalt and steel), paper, cardboard, plastics and plastic sheeting, wooden pallets and even kitchen waste (wet or soiled paper towels, food waste, coffee grounds – all are taken for compost). The local waste hauler has certified the State Materials Lab as a Certified Green Program.

Additionally, WSDOT's State Materials Lab reviewed chemicals stored in the Chemistry Lab, evaluating the real need for having them on hand. By reducing those chemicals on hand (eliminating over 600 chemicals) we reduced consumption, the risk of storing potentially hazardous chemicals and the associated costs. Now, if we need a specialty chemical for a specific test, small quantities are ordered and after completion of the expected testing the remainder is recycled, greatly reducing hazardous chemical storage onsite.



WSDOT's State Materials Lab, located in Tumwater.

## Future Activities

### More Warm Mix Asphalt Trials

Asphalt pavement makes up 63.3% of our state highways. Making asphalt pavement requires heating up the rock and asphalt binder (the "glue"), to drive off moisture and make it pliable when it is placed. New technologies can reduce the mixing temperature by 50° F or more, in a process called "warm mix asphalt" or WMA (as opposed to the current "hot mix asphalt"). Less heat means less fuel and lower emissions, conserving fossil fuels while reducing greenhouse gases. Our first warm mix asphalt test project was built in the summer of 2008 and more test projects are planned for 2009.

### Solar Powered Traffic Systems

Solar power holds promise for a variety of traffic systems, especially in remote locations. We are examining solar powered systems for both new installations and for retrofitting old locations. In the right location solar power can reduce greenhouse gas emissions, reduce consumption and decrease costs.

### Advancing Groundwater Infiltration

Highway runoff can overwhelm natural water courses, so ponds are built to help moderate the rate of infiltration. New research in groundwater infiltration may find better methods using the highway side slopes to infiltrate groundwater, saving money and resources by eliminating or greatly reducing the size of infiltration ponds.

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From the  
WSDOT State Materials Lab  
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# Sustainability: Highway Materials



**WSDOT recognizes the need for sustainable transportation systems. Although sustainability may mean different things to different people, common definitions do exist.**

**"Sustainable development** is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Source: *Our Common Future, The Report of the Brundtland Commission, 1987.*

**"Sustainability**, in a broad sense, is the capacity of maintaining a certain process or state. It is now most frequently used in connection with biological and human systems. In an ecological context, sustainability can be defined as the ability of an ecosystem to maintain ecological processes, functions, biodiversity and productivity into the future."

Source: *Wikipedia 22 January 2009 at 19:42*

## Three Key Words

**Reduce, Reuse, Recycle:** three key words in the world of sustainability. You reduce by building to last and by not using as much material in the first place. You reuse by taking a material and returning it back to the same use. Recycling takes one material manufactured for a specific use and remanufactures that material for a different use.

## Reduce

Reducing involves working to eliminate the need to replace what you have built. Building higher quality, longer lasting facilities reduces the need to regularly replace those facilities. Better roads and better bridges last longer, reduce the need for maintenance and repair, and reduce the consumption of resources.

WSDOT designs highways to be functional and durable. The basic infrastructure for any highway, the embankment and the roadbed, do not need replacement once built. The basic alignment and the roadbed beneath the pavement remain in place indefinitely.

### Pavement Design

Asphalt pavement designs preserve the pavement structure by driving the distress to the surface. The surface course is easily replaced, leaving the pavement's base course and subbase course untouched. Today's asphalt pavement structures will not need to be rehabilitated for very long periods of time, exceeding 30 years or more. Asphalt pavement wearing surfaces last an average of 16 years on the west side of the mountains and over 12 years east of the Cascades.

WSDOT's concrete pavements have proven to be extremely durable. While making up only

9% of the state highway system, concrete pavements carry 32% of the truck miles and 35% of the total vehicle miles traveled. Today over 60% of our concrete pavements are 30 years old or older. Designed for a 20 year design life, these pavements now exceed their original design life by 50%. New concrete pavement designs use dowel bars to transfer loads between panels and are built thicker to handle greater traffic loads and to allow grinding of studded tire damage. These new designs should last 50 years or more.

### Making Old Pavement New Again

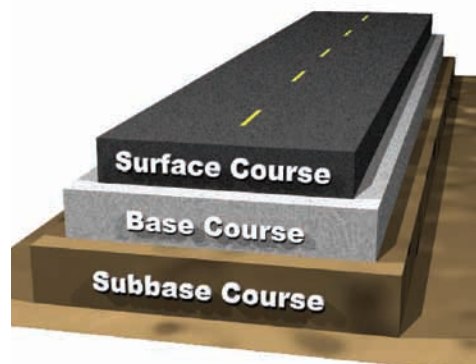
Dowel Bar Retrofit (DBR) extends the pavement life of old concrete pavements. Adding dowel bars and grinding old concrete pavement smooth adds years to the life of these pavements. Extending pavement life reduces consumption, improving sustainability, while also saving money. WSDOT is a nationwide leader in the design and implementation of dowel bar retrofits.



A contractor installs dowel bars into a slot on a Dowel Bar Retrofit project. The dowels strengthen the joint between concrete panels, transferring heavy truck loads from panel to panel.



Completed Dowel Bar Retrofit (DBR) Project. Finished DBR project shows typical markings where dowels were placed in the old concrete pavement, strengthening the pavement and extending its life.



Typical Pavement Structure. Only the top of surface course would be removed and replaced as it is worn by traffic; the rest of the pavement structure remains in place.

### Pavement Management

WSDOT's Pavement Management System (WSPMS) increases pavement life while providing pavements at the lowest life cycle cost. The lowest life cycle cost occurs when you replace the surface course just before it fails and causes damage to the pavement beneath. Replace the surface course too soon and pavement life is wasted. Replace the surface course too late and costly pavement repair becomes necessary. Each year we measure all WSDOT pavements for smoothness, structural condition and rutting to find that specific point of lowest life cycle cost. Knowing when to replace the surface course preserves the pavement, decreases resource use and increases sustainability.

### Alternative Hydraulic Cements

Portland cement is a wonderful material: it creates the concrete that meets many needs in construction. Production of portland cement, though, produces significant quantities of greenhouse gases, both from the fuels used in the manufacturing and the CO2 driven off the minerals used to make portland cement. Alternative hydraulic cements allow WSDOT to reduce the amount of portland cement used while still producing a high quality, durable concrete. Many of the alternative cements were once categorized as hazardous wastes and were disposed of in landfills. Today, materials such as flyash, microsilica and ground, granulated blast furnace slag find uses in a wide variety of WSDOT concretes, reducing the need for greater quantities of portland cement.

### LED Traffic Signal Heads

WSDOT aggressively updated signal heads from incandescent lamps to light emitting diode (LED) lamps, dramatically reducing energy consumption. LEDs are more durable and last much longer than incandescent lamps, saving even more money and reducing consumption, improving sustainability.

### Warm Mix Asphalt: New Technology

Heating the aggregate and the asphalt binder to make asphalt pavement is expensive and consumes considerable fuel (diesel of lower grades of bunker fuel). Warm Mix Asphalt (WMA) uses special modifiers that lower the mixing temperature for asphalt. Decreases of 50 F or more are possible. We placed our first test section on I-90 in 2008 and more will follow.



Milling operation, removing worn asphalt wearing surface and hauling it back to the asphalt plant to be reused. Typically only the top two inches of the wearing surface are removed, leaving the rest of the pavement intact.

## Reuse

Reuse involves taking a material and returning it in place as the same material. Reuse differs from recycling by not altering the nature of the material. You reuse an aluminum pop can when it is turned into another pop can; you recycle aluminum foil when it is used to make new car parts.

### Reclaimed Asphalt Pavement

Far and away, the greatest reused material in the USA is asphalt pavement. Nationwide, Reclaimed Asphalt Pavement (RAP) amounts to over 72 million tons, with another 18 million tons of asphalt pavement being recycled into other pavement materials.<sup>1</sup> As a comparison, in 1990, only about 20 million tons of paper and paperboard were recycled and only 2.6 million tons of glass.<sup>2</sup> In fact, in 1990 the total of all commonly reused materials (paper, glass, metals, plastics, rubber, textiles, wood and others) was only a little over 29 million tons, or less than half of the total RAP tonnage.<sup>3</sup>

WSDOT was an early leader in reusing asphalt pavements, beginning in the oil crisis years in the late 1970s. Our original trials used up to 90% RAP, but continued research showed that a more modest rate of 20% would yield good results without increasing the complexity of manufacturing the pavement. Today at this

<sup>1</sup> A Study of the Use of Recycled Paving Material: Report to Congress, June 1993, Federal Highway Administration and United States Environmental Protection Agency, Washington D.C. FHWA-RD-93-147 and EPA/600/R-93/095.

<sup>2</sup> Municipal Solid Waste in the United States: 2007 Facts and Figures. US EPA EPA530-R-08-010 November 2008

<sup>3</sup> Ibid



Reclaimed Asphalt Pavement (RAP) pile at an asphalt paving company yard.



A cold-in-place (CIP) recycling train.

20% rate, the Washington Asphalt Pavement Association reports that WSDOT is using all of the RAP it is producing through pavement rehabilitation.

RAP starts as old pavement, is milled from the road, crushed and sent through an asphalt plant and mixed with new aggregate and asphalt binder, to return to the road as new asphalt pavement. When that new pavement reaches the end of its useful life it will again be reclaimed.

### Hot-In-Place (HIP) Recycling

Hot-In-Place (HIP) recycling (really reuse rather than recycling) is another technology being investigated by WSDOT. HIP performs the same function as RAP, but it is done in the field, while the pavement is still on the road. Large mobile heating plants heat the old roadway, milling machines grind the surface and mix it with additional asphalt and then it is compacted back onto the existing pavement. HIP has the potential to reduce trucking costs and environmental impacts by reusing the asphalt pavement right in the field.

## Recycle

The final option for increasing sustainability is recycling: taking a material in one form and converting it to a material in another form.

### Cold-In-Place Recycling

Cold-In-Place recycling reconditions low volume roadways, turning worn out pavement into sound new base. The pavement is milled in place, treated with a binding agent and compacted. This new, strong base is overlaid with either new asphalt pavement or a chip

seal (sprayed liquid asphalt with rock chips embedded into it). The process is inexpensive and has been very successful.

### Asphalt Shingle Recycling

Asphalt shingles present a possible opportunity for recycling, using the asphalt binder in the shingle to make new asphalt pavement. WSDOT's State Materials Lab is working closely with King County as they build a test project using recycled shingles. We will help with testing and analysis of the pavement and will help track its performance over time.

### Plants and Compost

WSDOT salvages plants before the start of construction and uses them to restore other areas. Trees and logs are saved and converted to habitat features within streams, wetlands and other natural areas. We convert what was once waste plant material into mulch, placing it back on site to reduce runoff and encourage plant growth. WSDOT is a national leader in using compost created from yard waste and other sources to control erosion and sediment on our projects.

### Other

Other recycled materials used on WSDOT projects include benches and picnic tables manufactured from recycled pop bottles, converting brush onsite into compost for use within the project and crushing old concrete into new aggregate for base or subbase courses.