Protecting Denver's Drinking Water:

Treatments to Reduce Erosion and Sedimentation and to Help Protect Water Quality after Wildfires

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In 2002, after devastating wildfires burned upstream and around Denver Water's key Cheesman and Strontia Springs reservoirs, Denver Water, in cooperation with their forest management contractor, the Colorado State Forest Service (CSFS), and the Natural Resources Conservation Service (NRCS), quickly developed an aggressive post-fire rehabilitation plan to help mitigate the expected impacts of the flooding, erosion and sedimentation from the lands immediately surrounding the reservoir. This was done in response to an earlier treatment proposal that suggested aerial mulching with straw dropped from helicopters that suggested treating 4,000 acres at a cost estimated at $3,000 per acre - - a total cost of $12,000,000 dollars! Denver Water's planning team thought that there were more effective alternative treatments that could be done at much less cost.

One of the most common treatments following wildfires is to spread grass seed to help provide quick vegetative surface cover and develop root systems to help hold the soil when heavy rains occur. Experience gained from an earlier fire (the 1996 Buffalo Creek Fire) showed that due to the very heavy rains that occur in this area and the hard-surfaced, water-resistant (hydrophobic) soils that are common after severe wildfires, grass seed was often washed off the slopes and into streams and rivers – a complete loss of the rehabilitation investment. To successfully establish grass on heavily burned soils it is often necessary to break up the hydrophobic soils and work the seed into the soil. If some type of mulch material can be developed to help reduce the impact of rain on the soil, provide protection for the young grass shoots, as well as help retain soil moisture, all the better. To develop these desired conditions to help the grass grow and become established many different treatments and combinations of treatments were undertaken. Three of the more successful methods are described below:

In 2002, a method of thinning brush and smaller trees was just being developed and tested. This method used large, powerful, mechanical equipment to grind and chop up trees and shrubs in a process that has become known as ***"mastication."*** Denver Water and the Colorado State Forest Service had successfully tested this methodology at the Cheesman Reservoir property as part of wildfire hazard reduction thinning projects. Based upon this experience it was decided to use mastication as a primary treatment method on about three thousand acres of burned land to create the desired conditions for grass establishment. Two separate contracts were let to two privately owned, commercial companies.

First, the treatment areas were seeded with grasses, primarily from the air using helicopters. Movement of the mastication equipment across the landscape as the machines maneuvered between trees would naturally breakup the crusted soil to some degree. But because the machines being used ran on large, wide tires to reduce soil compaction, the contracts specified the machines would work with heavy tire chains to better break up and punch small holes and depressions in the soil. These actions thoroughly mixed the seed with the soil, preparing an excellent seed bed for the grasses. The grinding and chopping of the trees and brush scattered wood chips and larger chunks of wood across the soil. This added important "roughness" to the soil surface reducing the impact of rain drops and slowing the movement of rain water as it moved across the surface. This greatly reduced erosion and allowed more of the water to be absorbed into the soil, providing essential moisture to help the grass seed to germinate and grow. This layer of woody debris on the soil surface also acted as a mulch to help retain soil

moisture, just like you might use mulch in your home garden or flower beds. It was found that if the terrain was not too broken, the machines could work on slopes of up to 45%; much steeper than was originally believed.

In addition to the mastication, another treatment was "bundled" with the contract and was completed concurrently. Trees were felled along the contour where they were bucked and limbed so that they lay directly on the soil surface. These logs serve as mini "check dams" slowing water movement and collecting sediment and soil behind the log barriers. One contractor hand felled and limbed the trees, while the other contractor machine-felled and limbed trees. (In review, the machine felling operation was more effective than the hand felling.) All this work was completed at a cost of about $400 per acre; much better than the original estimated cost of $3,000 per acre!

While the mastication is an excellent treatment, it is best done in areas with smaller trees (generally trees 8 to 10 inches in diameter or less). Many areas on the property had larger trees the machines could not easily chop and grind, and too few small trees to provide the desired mulch. Approximately 1,700 acres with these conditions were identified. In these areas another treatment was used:

A commercial contract was let to a sawmill located in Montrose, Colorado, in the southwest part of the state. Again, these areas were seeded from the air using helicopters. Traditional, but highly mechanized equipment was brought in and used to cut the larger trees. Large, powerful rubber tired skidders were used to drag ("skid") the cut trees to "landings" located near roads. It was again specified that these skidders were to operate with heavy tire chains for the same reasons that the mastication equipment were.

At the landings trees were limbed and logs were bucked from them into lengths the sawmill could saw lumber from. The bucked logs were loaded onto log trucks for the nearly 300 mile trip to the sawmill. As many as 25 to 30 truckloads of logs per day were sent to the sawmill. Using these processes nearly 10 million board feet of lumber was salvaged from this property instead of allowing this valuable product to simply rot over time and go to waste.

While salvaging logs and lumber from the burned forest was an important side benefit from the tree harvesting, it is important to remember that the primary objective of the work was to help grow and establish grass cover on the burned soils. Similar to mastication equipment, the movement and maneuvering of the tree felling and log skidding equipment churned up the crusted soil, broke up the hydrophobic layer, and incorporated the seed into the soil. Again, this prepared a seed bed and created conditions helpful for grass germination and growth.

A concern with this type of salvage logging following a wildfire is the creation of roads and skid trails. *(Roads and skid trails are the greatest contributor of soil erosion and sedimentation during logging operations.)* To reduce the likelihood of this kind of erosion occurring at Cheesman Reservoir, the skidders would haul limbs, branches and other non-useable material left from the trees back to the forest from the landings. This material was scattered in areas from which trees had already been harvested, as well as in the skid trails themselves. In addition, "waterbars" were constructed periodically across the skid trails to divert water from the trail, preventing erosion and the formation of gullies in the trail. This material scattered in the woods and along the skid trails again provided important roughness to the site, reducing rainwater impact and slowing the flow of water across the soil surface. Temporary roads were closed and rehabilitated and permanent roads had water turnouts, waterbars or rolling dips, and other erosion-reduction measures installed.

In this particular situation Denver Water gave the timber to the sawmill in exchange for them doing the necessary work. Rather than having them pay the relatively small amount of money that burned timber is worth, giving the wood to the sawmill allowed them to work steeper slopes, reach out further from roads, and to skid trees longer

distances. The net result was that many additional acres were treated to reduce erosion at little cost to Denver Water.

Of special interest is the fact that much of the Cheesman Reservoir property had been habitat for the endangered Pawnee Montane Skipper butterfly. This butterfly is found only along a relatively short stretch of the main stem of the South Platte and the North Fork of the South Platte Rivers. Careful planning and adjustments to mastication and harvesting specifications were made in hopes of creating the best opportunity for the butterfly to move back into the burned areas after they begin to recover.

Even with the best post-fire erosion reduction measures in place, some amount of soil, sediment and other debris will find their way into streams and drainages. Realizing this and to keep the material out of the reservoir, Denver Water also constructed, at a great deal of expense, two “leaky dams” in the Goose Creek and Turkey Creek drainages. “Leaky dams” are carefully designed and constructed using layers of different sized rock and gravel. Water flowing in the streams backs up behind the dam and the different sized rock material filters the sediment and debris from the water. These dams were quite effective. For the first several years after construction, the material that settled out and was caught by the dams had to be removed by excavators and was hauled by large trucks to different locations on the property for storage or spreading.

Besides the three treatment methods described above, many other kinds of treatments were used or tested by Denver Water at Cheesman Reservoir, all with the goal to reduce erosion and sedimentation. Virtually all of the 8,000-acre property was reseeded to grasses, with approximately 6,000 of those acres receiving additional treatments. In the final assessment of the project more acres were treated, treatments were to a higher level than originally prescribed, the work was completed within 9 months of the end of the fires, and at cost of about 60% of the original estimate.