

Wildfire Landscape Change Impacts on Water Quantity

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Effects of Wildfire on Burn Area

Hydrophobic Soils

Following a fire with very high temperatures, a *hydrophobic* layer of soil can form on the surface (Figure 1). The hydrophobic layer is formed during fires from a combination of ash and heated soil which repels water and increases surface runoff. This decreases infiltration and increases erosion and sedimentation in lakes and streams following precipitation events. These soils may also prohibit growth many years after the fire occurs, slow the forest regeneration process, and alter the hydrosphere.



[Figure 1](#). Burnt soil following high severity fire in Sutherland Canyon, WA

Reduced Evapotranspiration

Following a fire, there are immediate decreases to evapotranspiration, or the transfer of water from the land to the atmosphere by plants. This is because the burning of vegetation hinders a plant's ability to photosynthesize or transpire (Figure 2). This could potentially lead to more water ending up in streams, and less in the atmosphere. While this has a relatively smaller impact on overall water quantity, it is an important part of the hydrologic cycle that is altered by fires.



[Figure 2](#). Trees with burnt off pine needles following wildfire in Yellowstone, WY

Canopy Destruction

When fires burn the canopy of a forest the amount of sun that reaches the forest floor increases, leading to less snow being held by trees, more snow on the ground, and faster melting in the spring. Peak flows may then become greater than normal, leading to less water in streams by the late summer months because of earlier snowmelt. Canopy destruction is initially very damaging to ecosystems, but some species such as lodgepole pine (Figure 3) germinate after fires and take advantage of the increased amount of sunlight to start regeneration of the forest.



[Figure 3](#). Destroyed forest canopy following High Park Fire in Colorado, 2012.

Associated Risks

Flash Flooding

Many of the above effects from fires lead to higher runoff following precipitation events. This can lead to flash flooding in watersheds that have been burnt. Floods cause direct problems such as damage to ecosystems and infrastructure. They can also lead to pollution and sedimentation as the flood carries debris from the fire downstream.

Erosion

As surface runoff increases following a wildfire there often an associated risk of erosion. This can also result in the removal of important topsoil that plants depend on for growth, and further inhibit the ability for a watershed forest to recover following a wildfire. The physical aspects of streams can also be impacted by erosion as riverbanks deteriorate and deposition increases downstream.

Late Summer Drought

As seen in the case of the 2012 High Park Fire, peak flow following wildfires can be increased dramatically. While this is often due to more runoff from precipitation events, snowmelt also typically occurs earlier in the year. This means by the late summer month's there is no longer an input of water into streams from snowmelt, leading to lower water quantity even if the initial amount of snowfall was the same before and after a wildfire occurs.