By Wendy Lathrop, LS, CFM

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Fire and Rain

The current fires raging near Yosemite are bringing back vivid memories of driving alongside flames bordering a Nebraska highway late one night. My friends and I had taken a few weeks off from our summer jobs just before our next college semester would start, heading west to hit as many national parks as we could. During one friend's turn to drive, the brightness in the night ahead of us grew into a glowing strip of flames and shooting embers perhaps a hundred feet from the road. Apparently a recent train had dropped an ember, and the railroad tracks were ablaze for miles. With no roads to turn off onto, we uneasily decided Larry should floor it to get up ahead of the seemingly calm if extensive fire. Our tuna-boat-sized Chevy Impala wasn't exactly a speed demon, but eventually the relief of night's darkness once again engulfed us as we left the blaze behind.

It wasn't until a few mornings later as we drove on a California road just re-opened hours earlier that we realized the danger we had dodged. The charred and still steaming forest remnants on both sides of the highway signified what could easily have flared up and engulfed us. The lingering heat created a thick fog filled with ash that nearly choked us and obscured the road. But the rain that day signified a greater impact of which we were totally unaware. Today's papers more fully advise the public of the aftereffects of high temperature fires, including flooding, erosion, and sedimentation into water sources.

How can this be? Shouldn't we welcome rain to quench fire and lower ground temperatures as a return to normal? The answer depends upon several factors, including vegetation density and type, soils and geology, and exposure (the direction slopes face).

Photo by Andrea Booher/FEMA News Photo

Los Alamos, N.M., May 4, 2000—Trees still smolder from a forest fire in Santa Fe National forest.

"Rather than classify all fires and floods as 'Acts of God,' we should acknowledge most of them as periodic and foreseeable conditions."

Under normal circumstances, we rely on vegetation to absorb a good deal of rainfall, or at least slow its downhill trajectory. Just as on stripped construction sites, areas denuded of plants by fire are subject to sheet flow, with runoff carrying sediment in the form of ashes and soil particles. The outcome: erosion and polluted watercourses.

We generally think of steep slopes as areas subject to eroding away under rainfall, but burned sites are especially at risk for mudflows. These are rivers of liquefied soil-turned-mud, flowing over everything in their paths with force and weight greater than floodwater alone. When the ground is saturated, whether from rapid snowmelt

or from heavy or prolonged rainfall, conditions are ripe for mudflows.

For a particularly graphic description of how life-threatening this situation can be, read John McPhee's *The Control of Nature* in which he describes one harrowing example: "...the Genofile family nearly suffocated as a mudflow raced down the slope, smashing in and filling their home to within inches of the ceiling with mud, rocks, and water on its gravity-driven course."

For the dubious, take 45 seconds to watch a video of a 2010 Dunmovin, California debris flow in real time, posted at theguzzler.blogspot.com/2010/08/dunmovin-mudslide-clean-up-continues.html The flow's speed and force over this relatively flat desert area tells what must have been happening in the steep mountains visible in the background.

Why else are burnt sites so floodprone? Aside from loss of surface vegetation, there is also chemical change occurring in soils subjected to intense heat. Temperatures at ground level can be high enough to release resins, oils, and waxy fats from plants and leaf litter as they vaporize in the inferno. Because soil is an insulator, the temperature just below the surface stays just cool enough for the vaporized materials to infiltrate and re-condense, forming a hydrophobic layer. This impermeable layer keeps water from seeping into the soil more than to a shallow depth, and slow infiltration leads to more surface runoff and erosion. (Clay soils are less likely to be susceptible to this nonwettable condition than sandy or sandy loam soils.) Combining sloped terrain and hydrophobic soils with saturation is a good recipe for creating post-fire landslide conditions.

But how does all this talk about fire affect our lives as design professionals? We should be aware of environmental factors that could be detrimental to our clients' plans and even their safety. Consider location and site conditions: do they create potential for human-induced disasters? Rather than classify all fires and floods as "Acts of God," we should acknowledge most of them as periodic and foreseeable conditions.

Use of fire sets humans apart from other creatures, and our discovery of how to create it rather than waiting for it has shaped our cultures. For millennia we have used it to clear woods for new agricultural areas, light our way through darkness, cook our food, heat our cold bodies, melt ice for water, and soften metal so we can shape it.

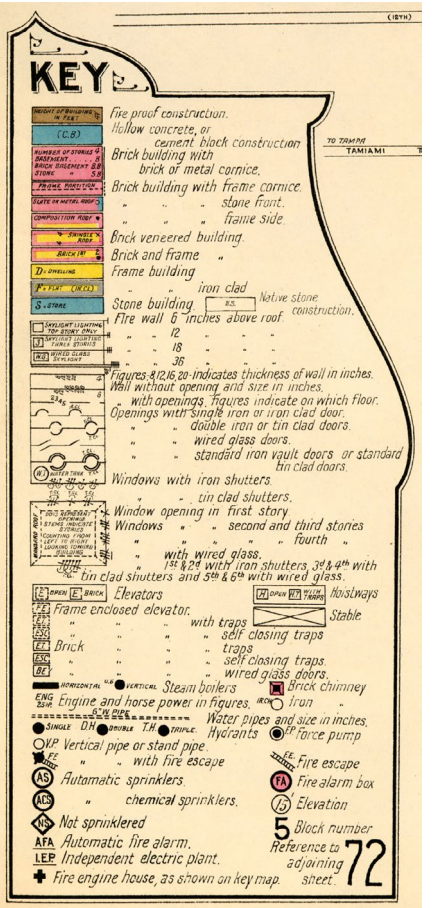
Andrea Booher/FEMA

San Diego, Calif., October 25, 2007—Helicopters drop water and retardant on the Harris fire, near the Mexican border, to stop the wildfire from advancing. Currently the fires in Southern California have burned nearly 350,000 acres.

But not all fires begin intentionally. Lightning strikes. Downed electrical wires. Sparks from falling rocks. Spontaneous combustion from the heat of wet or green hay baled and stored too soon. Some of these are predictable, some we can safeguard against, some are random. Planning where we live and work and how we build are a large part of the solution.

Fire certainly shaped the way urban Americans live. Wooden structures easily pass flames from one to another, and over time some cities have banned them in favor of more fire-resistant materials to reduce such spread. "Fire atlases" reported which buildings were masonry and which were wood, with annotations about presence of sprinklers and distance to hydrants and other water sources. These allowed insurance companies to set premiums based on calculated risks, as fire can travel both by contact of flames and by radiant heat exposure.

In less densely populated areas, it is not the distance between residences but the distance to forests and other undeveloped vegetated lands that we should be attending to: that is, the wildland/urban interface. This is an aesthetically lovely place, a rural haven amidst nature. But without a fuel break, or removal of vegetation between nature and human development, the same hazards exist as in cities (flames and



Key to a typical Fire Atlas.

radiant heat)—perhaps even higher risks if accounting for distance to water and proximity to sheer mass of potential fuel. Add the danger of flames to the increased risk of flooding from charred areas, and the wildland/urban interface becomes an even more hazardous place.