What is the difference between soil burn severity, fire or burn severity, vegetation mortality, and fire intensity?

Soil Burn Severity (SBS) is the fire-induced changes in physical, chemical, and biological soil properties that impact hydrological and biological soil functions; the classification of post-fire soil based on fire-induced changes in properties. These changes include the depth of char (a downward heat pulse into the soil), loss of organic matter through consumption of duff, litter, and fine roots, altered surface color, damage to soil structure, and reduced infiltration.

Burn severity can vary across the fire area depending on topography, weather conditions, fuel types, and rate of fire spread. When organic materials on the ground and within the soil structure burn hot and slow, they form a layer on the surface and within the soil, reducing the ability of water to move downward into the soil and resulting in an increase in surface runoff. The degree of soil burn severity is dependent on the peak temperatures and duration of those temperatures within the soil. Observable post-fire ground parameters are often used to classify soil burn severity.

BAER teams, when evaluating the need for post-fire stabilization treatments, are particularly interested in the post-fire soil properties that impact soil hydrological functions as these changes are associated with increased potential for flooding and erosion. Satellite imagery is often used to produce Burned Area Reflectance Classification (BARC) maps which are then field verified with ground data collection. Field verification of soil burn severity may include a general inspection of ground parameters, testing for soil water repellency, and examination of changes in fine root characteristics. The correct use of the soil burn severity map created in the BAER process is to predict accelerated risk of runoff and erosion.

The most important purpose of a soil burn severity map (see attached) in a BAER assessment is to identify areas of impaired soil function. The soil burn severity map is the key element in determining if threats exist. It is not a map of vegetation mortality, or timber mortality, nor does it represent a composite of fire effects to all resources. It is not a temporal geospatial representation of ecological condition, nor does it reflect a historical range in variability for the fire regimes over a landscape.

Fire or burn severity is also commonly used in a more general sense in the post-fire community. The term fire severity was born out of the need to provide a description of how fire intensity affected ecosystems, particularly following wildfires where direct information on fire intensity was absent and effects are often quite variable within and between different ecosystems. In this more general terminology, fire severity is the effect of a fire on ecosystem properties, usually defined by the degree of soil heating or mortality of vegetation.

The severity of a fire depends on the fire intensity and the degree to which ecosystem properties are fire resistant. For example, a fire of exactly the same fireline intensity might kill thin-barked trees but have little effect on thick-barked trees. Therefore, fire severity is, in part, a function of the ecosystem being burned and is not simply indexed from fireline intensity. If a fire has a long residence time, fire severity will usually increase. Forest ecologists define severity by the degree of overstory plant mortality.

Tree mortality has been widely used as a measure of fire severity in conifer forests in North America that historically have been exposed to low-severity or mixed-severity fire regimes where normally there is substantial tree survival. Although the thresholds are subjective, in general, overstory mortality below
approximately 30 percent is considered low severity, 30 to 70 percent is considered moderate severity, and greater than 70 percent is considered high severity.

Fire intensity is another term commonly used when discussing fire impacts. Fire intensity is defined as the amount of energy or heat release per unit time and describes the physical combustion process of energy release from organic matter. There are several different metrics and intensity measures used to describe fire intensity.