Back to Table of Contents

Appendix R-8

Unstable Features Checklist

The following list of definitions will be used by Plum Creek foresters to identify and delineate unstable features within the Project Area. NFHCP Commitments Rp7 and R2 require that specific protective measures be carried out relative to riparian management zone delineation or new road construction, respectively, when theses unstable features are encountered. This checklist is intended to be used as a tool in order to help foresters determine if an encountered landscape feature meets the definition of "unstable feature" as referenced in commitments Rp7 and R2. These definitions were taken from Washington State's *Forest and Fish Report* dated April 29, 1999.

Bedrock hollows (colluvium-filled bedrock hollows or hollows; also referred to as zero-order basins, swales, or bedrock depressions) means landforms which are commonly spoon-shaped areas of convergent topography (upward or contour concavity) within unchannelled valleys on hill slopes. Hollows are formed on slopes of varying steepness and tend to be longitudinally linear on the slope. Their upper ends can extend to the ridge, or begin as much as several hundred feet below. Most hollows are approximately 75 to 200 feet wide at the top and may narrow to 30 to 60 feet downhill. They terminate at distinct channels, either at the point of channel initiation or along a stream side. Unless they have recently experienced scouring by landslide or debris flow, bedrock hollows are partially or completely filled with colluvial soils that are typically deeper than those on the adjacent spurs and planar slopes. (Hollows that are completely filled with colluvium may show no surface continuity.) Many hollows have no surface water, but others contain seeps and springs. Hollows should not be confused with other hillslope concavities such as small valleys, the bodies of large landslides, tree-throw holes, or low-gradient grassy swales. Bedrock hollows typically experience episodic evacuation of debris by shallow-rapid mass movement, followed by slow refilling with colluvium. Debris slides that begin within bedrock hollows commonly evolve into debris torrents, which have the potential to reach great distances downhill and downstream.

Convergent headwalls (or headwalls) means landforms which are teardrop-shaped, broad at the ridgetop and terminate where headwaters converge into a single channel. They are broadly concave both longitudinally and across the slope, but may contain sharp ridges that separate the headwater channels. Convergent headwalls generally range in size from about 30 to 300 acres; slope gradients are typically steeper than 35 degrees and may exceed 45 degrees. Soils are thin because slides are frequent in these landforms. It is the arrangement of bedrock hollows and first-order channels on the landscape that causes a convergent headwall to be a unique mass-wasting feature. The highly convergent shape of the slopes, coupled with thin soils, allows rapid saturation during rainfall and/or snowmelt. The mass-wasting response of these areas to storms, to natural disturbances such as fire, and to forest practices is much greater than is observed on other steep hill slopes in the same geologic settings. Convergent headwalls are also prone to surface erosion. Landslides that evolve into debris flows in convergent headwalls typically deliver debris to larger channels downstream. Channel gradients are extremely steep within headwalls, and generally remain so for long distances downstream. Channels that exit the bottoms of headwalls have been formed by repeated debris flows and have forms and gradients that are efficient at conducting them. Convergent headwalls commonly have debris fans at the base of their slopes.

Deep-seated landslides means landslides in which the zone of movement is below the maximum rooting depth of forest trees, to depths of tens to hundreds of feet. Deep-seated landslides can vary greatly in size (up to thousands of acres) and activity level and can occur almost anywhere on the hillslope. Deep-seated landslides are usually formed in incompetent materials such as glacial deposits, volcaniclastic rocks, and fault gouges. Commonly, development of a deep-seated landslide begins after a slope has been over-steepened by glacial or fluvial undertowing; however, the initiation of such slides has also been associated with changes in land use, increases in ground-water levels, and the degradation of material strength through natural processes. Movement can be translational, rotational, or complex, range from slow to rapid, and include small to large displacements. Deep-seated landslides in bedrock commonly occur in masses that are relatively weak. These can include bodies in which the rocks themselves are incompetent, such as certain types of clay-rich sediments and volcanics (e.g., some shales and tuffs), or low-grade metallic rocks (e.g., phyllite) or in highly weathered materials, such as deeply weathered rock and saprolite. In other cases, the geologic structure weakens the rock strength; bedding planes, joints, and faults commonly act as planes of weakness that can become slide surfaces. Deep-seated landslides in glacial deposits are common in thicker glacial deposits, usually where very permeable and impermeable materials are juxtaposed. Impermeable deposits can perch ground water, causing elevated pore-water pressures in the overlying deposits which can then slide out and downward. Groundwater recharge areas for glacial deep-seated slides is the area upslope that can contribute water to the landslide. (This assumes that there is an impermeable perching layer in or under a deep-seated landslide in glacial deposits). It is assumed to be equivalent to the topographically defined sub-basin directly above the active slide. The spatial extent of the groundwater recharge area can be identified in the field using one of several accepted methods as explained in greater detail in the *Forest Practices Board Manual*. Many deep-seated landslides occur in the lower portions of hillslopes and extend directly into stream channels. In such situations, streams can undercut the landslide toes, promoting further movement; such over-steepened toes can also be sensitive to changes caused by harvest and road construction. On the other hand, deep-seated landslides confined to the upper slopes may not have the ability to deposit material directly into stream channels. The ability of scarps and marginal streams to deliver sediment to waters or structures varies with local topography. Steep marginal streams can be subject to debris-flow initiation.

Inner gorges means canyon walls created by a combination of the downcutting and undercutting action of a stream and mass movement on the slope walls. Inner gorges may show evidence of recent movement, such as obvious landslides, vertical tracks of disturbance vegetation, or areas that are concave in contour and/or profile. In competent bedrock, slope gradients of 35 degrees or steeper can be maintained, but soil mantles are increasingly sensitive to root-strength loss at these angles; slope gradients as gentle as 28 degrees can be unstable in gorges cut into incompetent bedrock. The top of the inner gorge is typically a distinct break in slope but in some places the upper boundary is a subtle zone where the slope becomes markedly steeper or convex downhill. Inner gorge walls can be continuous for great lengths, as along a highly confined stream that is actively downcutting; or they can be discontinuous, as along a flood-plain channel that is undercutting the adjacent hillslopes in isolated places where the stream has meandered to the valley edge. Inner gorges experiencing mass wasting are likely to deliver sediment to waters or structures downhill. Exceptions can occur where benches of sufficient size to stop moving material exist along the gorge walls but these are uncommon. Inner gorges are distinguished from ordinary steep valley sides; ordinary valleys can be V-shaped with distinct slope breaks at the top, but they commonly do not show evidence of recent movement. In practice, a minimum vertical height of 10 feet should be applied to distinguish between inner gorges and slightly incised streams. The upper boundary of an inner gorge is assumed to be a line along the first break in slope of at least 10 degrees or the line above which slope gradients are typically gentler than 30 degrees.