Approximately 150 meters (500 feet) of Grande Ronde Basalt and 140 meters (450 feet) of Wanapum Basalt of the Columbia River Basalt Group are exposed in the Bull Run Watershed. In Bull Run, the Grande Ronde Basalt is divided into three mappable units: "low Mg" $R_2$ (at least one flow), "low Mg" $N_2$ (approximately four flows), and "high Mg" $N_2$ (two to three flows). The Wanapum Basalt is represented by two members: Frenchman Springs Member (six flows) and Priest Rapids Member (one flow). These units are identified by instrumental neutron
activation analysis, paleomagnetism based on measurements with a fluxgate magnetometer, petrography, lithology, jointing, and stratigraphic position.

The Columbia River Basalt Group flows entered the area from the east, moving toward western Oregon and Washington through an east-west-trending trough whose northern boundary was north of the Columbia River and whose southern boundary was in the Clackamas River area. Between the Frenchman Springs and Priest Rapids flows, a westerly flowing river carved a channel at least 174 meters (580 feet) deep that was subsequently filled to overflowing by a Priest Rapids intracanyon flow characterized by at least 105 meters (345 feet) of bedded palagonite, a 9-meter (30-foot)-thick colonnade, and a 60-meter (200-foot)-thick entablature. This flow has been identified in the Hood River Valley to the east and has been traced through the watershed. It is assumed to have continued to the northwest to the Columbia Gorge, where it appears at Crown Point.

Major structures in the Bull Run Watershed are a syncline and anticline striking N. 60° E. These folds are on strike with the Mosier syncline and the Columbia Hills anticline to the northeast and may have been continuous with them before they were broken by faulting in the Hood River Valley. A N. 60° E.-striking thrust fault that dips 12° to the southeast has produced at least 180 meters (600 feet) of vertical offset. Numerous fractures and breccia zones with trends of N. 10-55° W. cut the basalt throughout the watershed, occurring most commonly near the thrust fault. Blazed Alder Creek and the north-northwest-flowing portion of the Bull Run River follow part of a
N. 10° W.-trending lineament that extends north through Tanner Creek to the Columbia Gorge. This lineament is characterized in Bull Run by numerous fractures and breccia zones, many of which trend N. 10°-20° W. Boring-type dikes trending N. 10° W. occur along Blazed Alder and Falls Creeks.

The folds, faults, fractures, breccia zones, and dikes found in the Bull Run Watershed are all consistent with a regional stress field of north-south compression and east-west extension.