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Quaternary Fault and Fold Database of the United States

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Boulder Creek-Canyon Creek fault (Class A) No. 598

Last Review Date: 2017-01-09

citation for this record: **Haller, K.M., and Barnett, E.A., compilers, 2017, Fault number 598, Boulder Creek-Canyon Creek fault, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 12/14/2020 03:04 PM.**

Synopsis	The Boulder Creek fault, originally mapped as a south-dipping normal fault that bounds the northern margin of the Chuckanut Formation and separates Chuckanut Formation from pre-Tertiary rocks to the north (see cross section in Miller and Misch, 1963 #6265); Tabor and others (2003 #7662) suggested it is a NE-SW–striking normal fault that places north-dipping Eocene Chuckanut Formation sandstones to the south against pre-Tertiary metamorphic rocks to the north. Holocene reverse sense of movement is inferred by Sherrod and others (2013 #7657). Canyon Creek fault is included herein because of the short length of each fault and faulting histories have been correlated (Haugerud, 2005 #7659; Barnett, 2007 #7658; Siedlecki, 2007 #7660, 2008 #7661).
Name comments	Part of the fault is known as the Kendall scarp (Sherrod and others, 2013 #7657).

County(s) and State(s)	WHATCOM COUNTY, WASHINGTON
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Location of fault from GER_Seismogenic_WGS84 (http://www.dnr.wa.gov/publications/ger_portal_seismogenic_features.zip, downloaded 05/23/2016) attributed to Dragovich and others (1997 #6258) and Barnett and others (2007 #7658).
Geologic setting	
Length (km)	km.
Average strike	
Sense of movement	Reverse *Comments:* The opposite the sense of displacement is observed on the nearby bedrock faults (Sherrod and others, 2013 #7657).
Dip Direction	S *Comments:* The Kendall fault scarp and the Canyon Creek scarp are located near the south-dipping Boulder Creek fault (Miller and Misch, 1963 #6265) and Canyon Creek fault (Tabor and others (2003 #7662), respectively.
Paleoseismology studies	Sherrod and others (2013 #7657) reports on two trenches, a coring study in a wetland near the fault, and report on another on the nearby Canyon Creek fault. The resulting composite chronology (which supersedes previous studies) is based on evidence from all of the study sites that suggests a history of three post-glacial coseismic surface ruptures. The oldest is constrained by the correlation of the event horizon to Mazama ash (Barnett, 2007 #7658) deposits in cores from the Kendall scarp wetland site. The age of this earthquake is 8,070–7,240 cal yr BP. The next event is constrained by an OxCal model of charcoal in the Hornet excavation and plant macrofossils from the wetland cores resulting in a modeled age 3,190–2,980 cal yr BP. The most recent earthquake, likewise is based on an OxCal model, with a sample of charcoal from the Hornet trench, and plant macrofossils from below the basal contact and at the base of couplet 3 in at the wetland that results in a modeled age of 910–

	740 cal yr BP. Site 598-1 Stellar's Jay trench located 2 km southwest of Maple Falls (Barnett, 2007 #7658) exposed late Pleistocene outwash overlain by fault scarp colluvium with soils. All units are deformed by faulting except for the uppermost colluvium and the surface soil. Radiocarbon ages from sampled event horizons suggest faulting events at about 3,000 yr BP and 900 yr BP. The scarp is 2.5 m high at the site. Site 598-2 Hornet trench located 4 km east of Kendall (Siedlecki, 2007 #7660, 2008 #7661; Sherrod and others, 2013 #7657), and 40 m west of Stellars Jay trench crossed a prominent scarp exposing Pleistocene glacial outwash and two overlying soils buried by colluvium that are cut by oblique or reverse faults. The trench contained evidence of three coseismic ruptures with 40–70 cm of vertical displacement occurring during the, most recent. Relief on the upper surface of a unit roughly 13,960–12,400 cal yr BP approximates the height of the scarp. Radiocarbon dates on detrital charcoal recovered from the buried soils provide maximum ages for two earthquakes, 3,200–2,890 cal yr BP and 1.1–0.9 ka. Site 598-3 Kendall scarp wetland site (Sherrod and others, 2013 #7657). The wetland provides an excellent environment to record past earthquakes. The best limiting ages for each earthquake came from cores of the marsh sequence. Site 598-4 Smuggler trench (Sherrod and others, 2013 #7657) across the Canyon Creek fault exposed folded and faulted stratified sandy gravels (unit 1), which correlates to 13,960–12,400 cal yr BP glacial deposits. Faulted, overlying forest soils developed on colluvial packages have calibrated radiocarbon ages of 3,200–2,890 cal yr BP and 1,120–930 cal yr BP. Relief on the upper surface of the glacial deposits roughly mirrors the scarp topography. The trench exposed evidence of three post-glacial coseismic events.
Geomorphic expression	Prominent scarps are locally observed along the mapped trace of the Boulder Creek-Canyon Creek fault. One scarp near Kendall is about 4.3 km long and 2–4.1 m high. A second, notable scarp is located east of Maple Falls and is about 2 km long and up to 6.9 m high near the Canyon Creek fault.
Age of faulted surficial deposits	late Quaternary glacial outwash

Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Trenches excavated across these scarps exposed folded and faulted late Quaternary glacial outwash, locally dated between 12 and 13 ka, and faulted Holocene buried soils and scarp colluvium (Sherrod and others, 2013 #7657).
Recurrence interval	*Comments:* Sherrod and others (2013 #7657) composite chronology shows variability in recurrence of large earthquakes on these faults. The most recent earthquakes date to 8,050–7,250 cal yr BP; 3,190–2,980 cal yr BP; and 910–740 cal yr BP. No evidence of earlier events (8–12 ka) is demonstrated.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Long-term vertical displacement rates using the total scarp height on late Pleistocene glacial outwash terraces (Columbia Valley and Nooksack River valley) and ages of the terrace surfaces are 0.3±0.1 mm/yr for the Kendall scarp and 0.65±0.1 mm/yr for the Canyon Creek scarp (Sherrod and others, 2013 #7657). Rates calculated for single-event and multiple-event intervals are between 0.3±0.1 and 0.5±0.2 mm/yr, which imply horizontal shortening at rates between 0.5 and 1.0 (on a 30° dipping fault). All of which indicates the0.2–1.0 mm/yr slip rate bin is appropriate.
Date and Compiler(s)	2017 Kathleen M. Haller, U.S. Geological Survey Elizabeth A. Barnett, Shannon & Wilson, Inc.
References	#7610 Barnett, E.A., 2007, Active faulting at the northeast margin of the greater Puget Lowland—A paleoseismic and magnetic-anomaly study of the Kendall fault scarp, Whatcom County, northwest Washington: Arcata, California, Humboldt State University, unpublished Master of Science thesis, 65 pages. #6258 Dragovich, J.D., Norman, D.K., Haugerud, R.A., and Pringle, P.T., 1997, Geologic map and interpreted geologic history of the Kendall and Deming 7.5-minute quadrangles, western Whatcom County, Washington: Washington Division of Geology and Earth Resources, Open-File Report 97-2, 39 p., 3 plates, scale 1:24,000.

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