

Brush Creek Geomorphic Assessment to Address Fish Passage Barriers

Location: Brush Creek is located within the Wenatchee National Forest north of Lake Wenatchee. Brush Creek is a tributary stream to the Chiwawa River that may support threatened and endangered chinook salmon, steelhead trout, and bull trout. The site is on U.S. Forest Service ownership in Section 33, Township 28 North, 17 East, W. M.

Existing Structures: The culvert for the USFS 6306 Road crossing of Brush Creek is undersized and poses a fish passage barrier. The site is located approximately 0.75 miles above the confluence with the Chiwawa River at about River Mile 12.5. The site will require a new drainage structure.

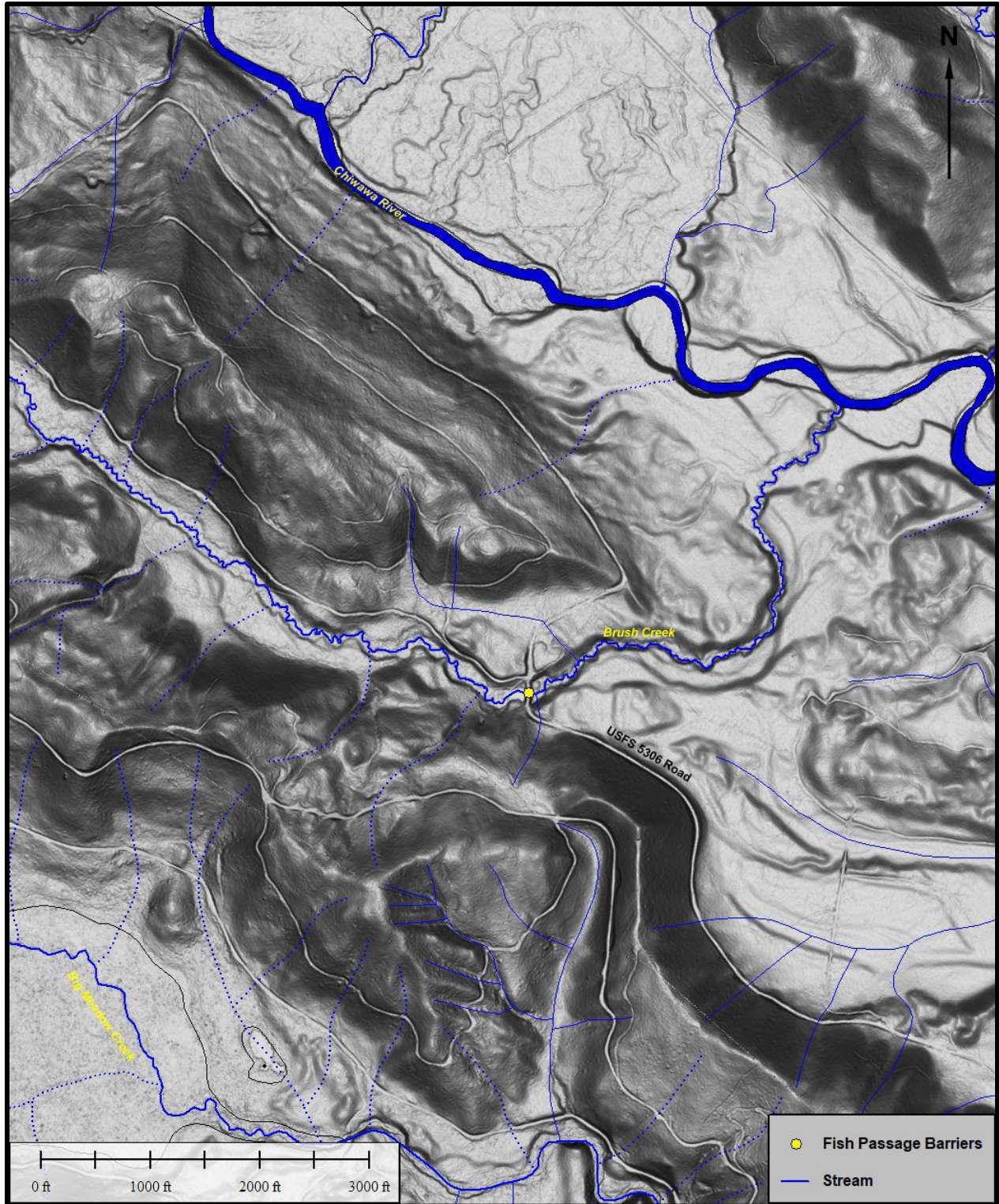
Access and Travel Management: The project area is accessed from U.S. Highway 2 to State Route 207 and then to Chiwawa Loop Road and Chelan County Road 22 at the east end of Lake Wenatchee before turning left onto Chiwawa River Road (USFS Road 62). After approximately 2 miles on Chiwawa River Road, turn left onto the USFS 6300 Road. Proceed for approximately 3 miles on the 6300 Road and turn right onto the USFS 6306 Road. The Brush Creek crossing is located about 2.4 miles down the 6306 Road.

Area Description: Brush Creek is situated on the east side of the Cascade Range with a basin area of 2,008 acres. The stream initiates from steep terrain that exceeds elevations of 5,600 feet above sea level near Chiwawa Ridge. The upper half of Brush Creek is tightly confined by bedrock but then becomes less confined as it flows onto glacial outwash terraces in the broad U-shaped Big Meadow Creek valley. The stream is moderately confined for most of its length from the 6306 Road crossing downstream to its confluence with the Chiwawa River.

Geology

The lower half of the Brush Creek basin is underlain by sedimentary rocks of the Chumstick Formation (Tabor et al. 1987). The Eocene-age Chumstick Formation consists of sandstone, shale, and conglomerate. The sedimentary bedrock is covered by alpine glacial drift deposits in most of the lower basin area. The Pleistocene glacial drift deposits range from till in the uplands and up-valley areas to gravelly outwash on broad valley floors. The upper Brush Creek basin is bisected by the north-south trending Leavenworth fault. Conglomerate and conglomeratic sandstone of the Chumstick Formation is mapped on the east side of the fault, while biotite schist and amphibolite of the Chiwaukum Schist Formation is present on the west side of the fault.

Interpretation: The proposed passage barrier correction work is located on moderate gradient slopes composed of unconsolidated alluvial and glacial outwash deposits that can have variable properties across the landscape. Unconsolidated materials on steeper slope gradients can be subject to erosion hazards and slope stability issues.



Shaded relief derived from 2015 Chelan County LiDAR digital elevation models

Figure 1. Shaded relief LiDAR map of the lower Brush Creek project area.

Soils

The lower Brush Creek basin is mapped primarily as Choralmont cindery sandy loam with a till substratum (NRCS 2022). The soils around the 6306 Road crossing and the valley bottom below the road are mapped as 3 to 30 percent gradient slopes, while the upland portions of the project area above the road are categorized as 30 to 60 percent gradient slopes. The well drained Choralmont cindery sandy loam has formed from volcanic ash and pumice over glacial till and in selected places, from local residuum. The rounded gravel from the glacial till ranges from 15 to 40 inches in depth and is situated above a strongly contrasting texture of cinders without any gravel. The depth to a restrictive layer or lithic bedrock is generally greater than 80 inches. The Brush Creek valley bottom about 1,500 feet above the 6306 Road crossing is mapped as Chiwaukum bouldery fine sandy loam on 3 to 30 percent slopes. The well-drained Chiwaukum soil type is derived from volcanic ash mixed with colluvium over glacial till. Glacial outwash with rounded to subrounded gravel and cobble in a matrix of sand and silt was also identified along the valley bottom and hillsides adjacent to the project reach. The Unified Soil Classification rating for the soil column is SM (silty sand) or SP (poorly graded, gravelly sand with few fines).

Interpretation: The Choralmont and Chiwaukum soil types have a high volcanic ash content and along with the glacial sediments can be subject to erosion, particularly following disturbance or compaction. Erosion control measures, such as slash placement, hay bales, or silt fences, will be needed to prevent sediment generated during ground-disturbing activities from reaching surface waters.

Vegetation

The vegetation around the beaver pond immediately upslope of the Brush Creek road crossing consists primarily of sedges (*Carex* spp.), reed canary grass (*Phalaris arundinacea*), hardhack (*Spirea* spp.), willow (*Salix* spp.), and alder (*Alnus* spp.) (Figure 2). The riparian vegetation in the valley bottom upstream and downstream of the beaver pond is comprised of a dense thicket of mountain alder (*Alnus incana*), sitka alder (*Alnus sinuata*), Douglas maple (*Acer glabrum*), willow (*Salix* spp.), and red-osier dogwood (*Cornus stolonifera*), with a few young black cottonwood (*Populus trichocarpa*) as well (Figure 3). A diverse stand of conifer trees is present in the uplands, including western red cedar (*Thuja plicata*), grand fir (*Abies grandis*), Douglas-fir (*Pseudotsuga menziesii*), mountain hemlock (*Tsuga mertensiana*), Pacific silver fir (*Abies amabilis*), and ponderosa pine (*Pinus ponderosa*). Much of the valley bottom and adjacent uplands show signs of past logging, with older stumps in the understory.

Interpretation: The riparian vegetation communities immediately adjacent to the Brush Creek road crossing have been impacted by the beaver pond and past riparian logging. In addition, invasive, non-native, reed canary grass has become established in the beaver pond area. The riparian zone within the valley bottom is dominated by hardwoods, such as alder and Douglas maple, while the uplands have a maturing stand of conifers trees. The dense thicket of trees and shrubs help to stabilize the stream banks and maintain cool water temperatures. The conifer trees in the uplands are unlikely to contribute much large woody debris to the stream channel due to their significant distance from the stream channel.



Figure 2. Typical conditions along Brush Creek immediately above the 6306 Road crossing.



Figure 3. Typical conditions along Brush Creek above the influence of the beaver pond.



Figure 4. Typical conditions along Brush Creek below the 6306 Road crossing.

Site History

The USFS 6306 Road crossing of lower Brush Creek was constructed just prior the earliest 1957 aerial photographs of the project area. The photographs show that three small patches of timber have been recently clear-cut on the north side of Brush Creek just beyond the road crossing, as well as about 3,000 feet upstream of the crossing and 5,000 feet above the crossing. No riparian buffers appear to have been provided along the northern side of the stream. The area immediately above the road crossing is forested and does not show any signs of ponding from beaver dams. Additional small clear-cut patches and partial cutting across a broader area has also occurred in the forest stand south of Brush Creek, but the riparian zone has remained intact along the stream. Aerial photographs from 1963, 1967, and 1974 do not show any significant changes in the Brush Creek basin, outside of additional road construction and primarily partial-cut patches of timber in the upper basin. The beaver pond at the inlet of the 6306 Road crossing first appears in the 1984 aerial photograph. The 1992 and 1998 aerial photographs show that beaver pond has persisted. Continued logging of small clear-cut patches has occurred along Brush Creek, with riparian buffers of varying width retained along the middle reach above the 6306 Road crossing. Multiple sets of aerial photographs taken between 2009 and 2021 did not show any additional disturbances in the Brush Creek basin.

Interpretation: Riparian logging and water impoundment from a beaver dam have significantly altered the vegetation community around the road crossing site. The beaver dam at the inlet to the road crossing appears to be a significant design issue for the crossing structure.

Slope Stability Issues

A review of historical aerial photographs from 1957 to 2021 did not show any signs of landslides or debris flows in the Brush Creek basin. Most of the lower Brush Creek basin area has slopes ranging from 10 to 60 percent gradient and are unlikely to have slope stability issues. The upper basin does include inner gorge terrain along tributary streams with side-slopes of 70 to 90 percent gradient, but no signs of historical debris flows or other slope movement were noted. The rugged, sparsely vegetated, north-facing slopes in the headwaters of Brush Creek did not show signs of landslides in the historical aerial photographs, but may to be subject to snow avalanches and rockfall.

Interpretation: The USFS 6306 Road crossing of Brush Creek does not have significant risks from landslides or debris flows.

Channel Type and Stability

The stream channel above the USFS 6306 Road crossing is consistently around 2 percent gradient for more than 1.5 miles (Figure 5). The reach below the 6306 Road crossing generally ranges from 2 to 3 percent gradient, except for a reach of 4 percent gradient above its confluence with the Chiwawa River.

The reach of Brush Creek immediately upstream of the beaver pond would be classified as a C4/C5 stream type according to the Rosgen classification system (Rosgen 1994). Brush Creek is a single-threaded, moderately sinuous channel with little to no entrenchment into the wet meadow along the valley bottom. The stream has a moderate width-to-depth ratio and an average bankfull channel width of approximately

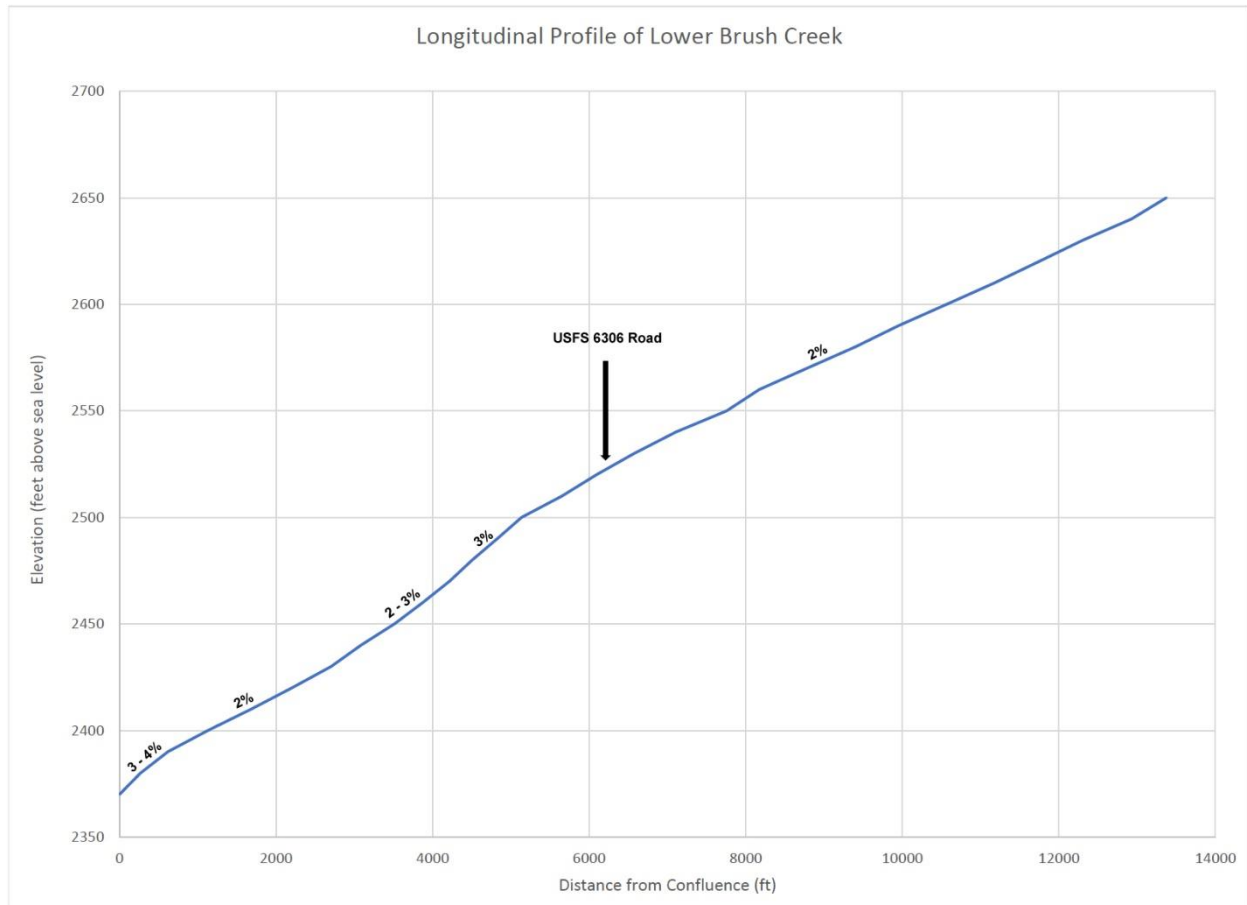


Figure 5. Longitudinal profile of lower Brush Creek above its confluence with the Chiwawa River.

7.5 feet. The channel substrate is characterized by a relatively even distribution of sand and gravel. Further upstream beyond the influence of the beaver pond, the channel bed has greater proportion of gravel and would be classified as a C4 stream type. The average bankfull channel width in this upstream reference reach is approximately 12 feet.

The lower reach of Brush Creek would be classified as a plane-bed channel by Montgomery and Buffington (1993), although large woody debris is effective in creating a forced pool-riffle morphology. Plane-bed channels have gradients ranging from 1 to 3 percent and are characterized by glides, riffles, and rapids. They generally lack discrete bars or pools and have a low width-to-depth ratio. Brush Creek has modest amounts of woody debris that can capture sediment and contribute to pool formation. Much of the functional wood in the channel is relatively small in diameter and short-lived hardwood debris because with larger-diameter conifer trees are generally set back a significant distance from the channel. The banks are generally not undercut, but are well stabilized by the dense thicket of riparian vegetation. The valley bottom is comprised mainly of alluvial deposits, with moderate to steep valley walls composed largely of glacial outwash sediments.

Interpretation: The lower reach of Brush Creek at the road crossing is a C4/C5 Rosgen stream type that primarily has a plane-bed/forced pool-riffle channel form. Modest amounts of woody debris in the channel help to store sediment and create pools. The primary consideration for grade control will be the persistence of the beaver dam and potential changes in bed elevations and channel gradient once the beaver dam is breached and the stream begins to erode the accumulated deposits. Grade control measures may be needed at the 6306 Road crossing due to the large accumulation of sediment behind the beaver dam and the potential for future head-cutting of the stream channel and downstream sediment aggradation following culvert replacement.

Large Woody Debris Hazard

Much of the functional wood in the channel consists of hardwoods that are relatively small in diameter and quick to break-up into smaller pieces. The channel lacks large woody debris because larger-diameter conifer trees are generally set back from the channel. Little debris transport is expected from this relatively small, low-gradient stream.

Interpretation: The USFS 6306 Road crossing appears to have a low potential for plugging as a result of mobile wood transport, but the stream is capable of moving smaller pieces of wood during high flows.

Risk of Sediment Retention

Plane-bed and forced pool-riffle channel types are considered transitional reaches between sediment transport and sediment deposition, depending on the bed material and roughness elements (Montgomery and Buffington 1993). The presence of the beaver dam and associated pond, however, indicates that the risk of sediment retention is high.

Interpretation: Brush Creek has a high risk of significant sediment deposition and retention at the 6306 Road crossing.

Streambank Sensitivity

The riparian area along Brush Creek is generally well vegetated with hardwood trees and shrubs. The densely rooted trees and shrubs help to maintain stable banks. Undercut banks are present in portions of this reach, indicating the effectiveness of the plant root systems.

Interpretation: The stream banks can adjust to minor changes in sediment transport and erosion without being destabilized.

Site Proximity to Important or Sensitive Resources

Brush Creek is known to support resident westslope cutthroat trout (*Oncorhynchus clarkia lewisi*), rainbow trout (*Oncorhynchus mykiss*), and eastern brook trout (*Salvelinus fontinalis*) (Washington Department of Fish and Wildlife 2022). Steelhead trout (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), and spring chinook (*Oncorhynchus tshawytscha*) are found in the Chiwawa River and may also utilize the lower reaches of Brush Creek for foraging and rearing.

Interpretation: The lower reaches of Brush Creek may be used by three different threatened and endangered fish species. The site design should have a high safety factor to minimize disturbance and maintain current channel conditions.

Overall Risk Assessment

Based on the lack of slope stability concerns in the basin, the relatively stable channel form, and mature riparian forest, the overall risk of geomorphic changes to the site is considered low.

Project Objectives:

- Provide free passage for aquatic species, sediment, and woody debris using a stream simulation design for the crossing structure.
- Minimize disturbance and sediment release during construction activities.

References

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