

II. EXISTING CONDITIONS

Sheets A1 through A5 in Appendix A provide overall site information, including locations, soils, topography, and historical aerial photography. For the purposes of this study, the Linville River within the property has been separated into three reaches:

- Reach 1: Sloop Dam to approximately 100 feet upstream of new bridge (4,400 feet)
- Reach 2: 100 feet upstream of new bridge to private property boundary (2,900 feet)
- Reach 3: Private property boundary to Greene Road bridge (1,400 feet)

Existing conditions within these reaches of the Linville River are detailed below. Potential restoration options for these areas are described in Section IV.

Reach 1

Most of Reach 1 flows through well-vegetated areas, and is laterally and vertically stable. An exception to this is 600 feet of the left bank which is steep, highly erodible, and adjacent to a field with minimal buffer (Photo 1). Additionally, minor bank erosion exists on the right bank at the outside of the large meander bend (Photo 2).

Generally, the left bank is well-vegetated with a mix of river birch (*Betula nigra*), white pine (*Pinus strobus*), yellow poplar (*Liriodendron tulipifera*), and an understory of rhododendron (*Rhododendron* sp.) and mountain laurel (*Kalmia latifolia*). However, an historic levee does exist along much of the left bank, limiting floodplain access.

Vegetation on the right bank is composed of mixed hardwoods with some white pine (*Pinus strobus*) and rhododendron (*Rhododendron* sp.). Very good herbaceous cover exists at the toe of the slope, along the right edge of the channel.

Reach 1 has multiple property owners on the right bank of the Linville River near the upstream end of the NCFS property. The right bank along private property is stable and is not recommended as a site for structural or vegetation work at this time.



Photo 1: Reach 1, downstream view from adjacent field



Photo 2: Reach 1, right bank erosion

The streambed throughout this reach is dominated by shallow water features, such as riffles, runs, and glides. Some pools do exist, though bedform diversity could be increased through deepening existing pools and/or creating new pools. Cross-section dimensions are generally

uniform in the reach, with exceptions occurring in two locations: the channel is over-wide at the confluence with Mill Timber Creek, and again approximately 1,000 feet upstream of the bridge. In these locations, the wide channel has become braided, through the deposition of sand, gravel, and cobble.

Reach 2

Reach 2 contains two bridges: one recently constructed and one several decades old. At the upstream bridge, riprap exists on the streambanks, though the bridge piers remain susceptible to scour at high flows. The downstream bridge was designed for use during times of low flow, and is currently not used at all, due to damage to the bridge deck. A nursery-related irrigation line is affixed to this low water bridge. Between the two bridges, streambanks are covered with mowed grass, and lack deep-rooted vegetation (Photo 3).



Photo 3: Reach 2, upstream view from low-water bridge

A large mid-channel bar (approximately 440 feet long and 28,000 square feet in area) exists downstream of the low-water bridge (Photo 4). The bar is primarily vegetated with tag alder (*Alnus serrulata*), with some areas covered by willow (*Salix* sp.) and sedges (*Carex* sp.).



Photo 4: Reach 2, downstream view from low-water bridge, mid-channel bar on right

The right bank through much of Reach 2 is steep and very high (up to 14 feet). This steep slope provides a very narrow stream buffer (approximately 20 feet wide) dominated by American beech (*Fagus grandifolia*) trees and a rhododendron (*Rhododendron* sp.) understory.

The left bank, from the mid-channel bar to the end of Reach 2, contains a mixed hardwood forest, with yellow poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), American beech (*Fagus grandifolia*), river birch (*Betula nigra*), and northern red oak (*Quercus rubra*). The understory contains rhododendron (*Rhododendron* sp.), and doghobble (*Leucothoe* sp.). Between the low water bridge and the confluence with Tributary 1, the vegetated buffer is narrow (generally 20-30 feet wide), and is topped by a levee protecting wastewater infrastructure. Further downstream, the buffer widens and the levee disappears. Within the widened buffer are a small wetland and tributary (Tributary 1).

The existing longitudinal profile of Reach 2 is included as Sheet A6 in Appendix A. The vertical change in the water surface along Reach 2 is 10.4 feet, resulting in an average water surface slope of 0.0036 feet/foot, or 0.36%. The bedform is dominated by shallow water features, such as riffles, runs, and glides. Two notable pools do occur in Reach 2: one in the vicinity

of the new bridge, and one downstream of a prominent bedrock ledge (Photo 5). This bedrock provides a vertical drop of 1.4 feet in the water surface, followed by 500 feet of flat water. A water intake for irrigation is located on the right bank upstream of the bedrock.



Photo 5: Reach 2, bedrock step with water intake just upstream

Cross-section data from Reach 2 is presented in Sheet A7. Measured cross-section dimensions indicate the river channel is over-wide (existing bankfull width is 80-140 feet, compared to reference width of approximately 70 feet). Downstream of the low-water bridge, the channel is also incised, with reduced floodplain access. This is confirmed by measured existing bank height ratios, which range from over 2.0 (due to left bank levee) to near 1.2 (near downstream end of reach).

The streambed substrate was quantified with a pebble count, with results in Sheet A8. The median particle size on the streambed was 90 millimeters, or a small cobble. However, only 26% of measured particles were cobbles; the remainder included sand (17%), gravel (26%), and boulders (14%). Bedrock does exist in multiple locations, though only at the aforementioned ledge is it prominent across the entire width of the stream.

Bank erodibility was approximated using the Bank Erosion Hazard Index (BEHI). This index was used for both the left and right streambanks in Reach 2 (Sheet A9). All BEHI classifications in Reach 2 were moderate, low, or very low. However, observed near bank stress (NBS) was often high, particularly in the vicinity of the mid-channel bar, indicating high erodibility. The combinations of BEHI and NBS were used to approximate streambank erosion rates, resulting in an estimated 68 cubic yards (102 tons) of sediment lost annually due to bank erosion.

Reach 3

Most of Reach 3 is a multi-thread channel, with flow split around two large mid-channel bars. The upstream mid-channel bar begins near the upstream extent of Reach 3, with the lower bar ending at the Greene Road bridge, at the bottom of Reach 3 (Photo 6). Vegetation on the upstream bar is dominated by tag alder (*Alnus serrulata*), with the lower bar containing mixed hardwood trees.

Reach 3 has multiple property owners on the left bank of the Linville River. The NCFS owns land to the right of the river throughout the reach; however, three private landowners own the entirety of the left bank. The left bank in the vicinity of the houses is characterized by eroding streambanks and a mowed grass buffer. The adjacent mid-channel bar and confluence with a tributary (Tributary 2) exacerbate the bank erosion. Near the Greene Road bridge, the left bank is better vegetated, with some alder and mixed hardwoods. Throughout Reach 3, the right bank is well-vegetated. Red maple (*Acer rubrum*) is dominant, with some hickory (*Carya* Sp.), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), and northern red oak (*Quercus rubra*).



Photo 6: Reach 3, upstream view of mid-channel bar from Greene Road bridge

Like Reach 2, Reach 3 suffers from lack of bedform diversity and an over-wide channel. However, Reach 3 is less incised, with generally good floodplain access, particularly on the right bank. However, an historic levee does exist along portions of the right bank, restricting the available floodplain width.

Forest Access Road Crossings

The Forest Access Road crosses tributaries flowing through culverts at five locations. Maintenance needs and retrofit possibilities were identified at each of these crossings to improve stream and road stability and to reduce downstream sedimentation. Common issues to be addressed at these culvert crossings include the following:

- Upstream clogging with sediment and plant debris following heavy runoff events. Culverts should be regularly inspected for clogging and cleaned out manually or mechanically to ensure full access during high flow events, minimizing the amount of flow across the road surface. Additionally, each culvert should be evaluated to ensure that it is the proper diameter and length.
- Downstream head-cutting of the channel undermining the culvert and road. This has resulted in the downstream ends of all five culverts perched above the streambed, impairing fish passage and exacerbating erosion. Rock steps should be installed from the culvert outlet down to the stable streambed to carry flows without causing additional scouring of the bed and banks.
- Rills and gullies on the road surface resulting from runoff along and across the road. Water bars, broad-based dips, or other suitable diversions should be installed along the roads sloping down toward culvert crossings to reduce concentrated flow and sediment load at the culvert crossings. In some locations, the roadbed in the vicinity of the culvert should be re-graded with an inslope to promote flow toward the upstream end of the culvert.

Due to changing conditions at the road culverts following runoff events and heavy road use by logging trucks, it is recommended that site-specific engineering solutions be developed for each crossing at the time of maintenance to address existing conditions appropriately. Followup maintenance to remove future clogging and rills is essential for long-term stream and road protection.