Stream Restoration Design Checklist
NCSU Stream Restoration Program

Project name & location	
Assessed by	Date
Watershed area (acres or sq miles)	Valley type (alluvial, confined)
Watershed land use	Stream length (ft)
Streambed substrate (sand, gravel, cobble, bedrock)	Stream slope (< 2%, 2-4%, > 4%)

Channel Morphology	**Target**
A_{bkf}: Riffle bankfull cross-section area (ft^2) matches (slightly less) existing bankfull indicators, watershed channel-forming hydrology models & hydraulic geometry regional curves	matching (slightly less) existing bankfull, regional curves, models
W_{bkf} / d_{bkf}: Width-to-depth ratio supports sediment transport, habitats & bank stability during flood flows soon after construction	8 – 13 (E, high bedload) 11 – 20 (C, low bedload)
d_{mbkf} / d_{bkf}: Max riffle depth ratio supports sed transport & habitat	1.2 – 1.5 (thalweg located near mid-channel)
d_{mpool} / d_{bkf}: Max pool depth ratio supports sed transport & habitat	2 – 3 (thalweg located near outside bend)
Streambank side slopes support bank stability & dense vegetation (depending on soil type & revetments/vanes)	2:1 to 4:1 side slope
Point bar side slopes support sediment transport, bank stability & dense vegetation (depending on bedload, soil type & revetments/vanes)	5:1 to 10:1 side slope
$K = L_{tw} / L_{val}$: Sinuosity of channel thalweg matches valley slope, desired habitat conditions & confinement (natural or unnatural)	1 – 1.2 (confined, steep) 1.3 – 1.6 (wide, flat)
L_m / W_{bkf}: Meander length ratio matches valley conditions	10 – 20 (confined, steep) 5 – 11 (wide, flat)
W_{blt} / W_{bkf}: Meander width ratio matches valley conditions	1 – 3 (confined, steep) 2 – 8 (wide, flat)
R_c / W_{bkf}: Radius of curvature ratio supports bank stability & habitats	2 – 3
L_{rif} / W_{bkf}: Riffle length ratio supports sediment transport & habitats	1 – 1
L_{pool} / W_{bkf}: Pool length ratio supports sediment transport & habitats	1 – 4
S_{rif} / S_{av}: Riffle slope ratio matches bed substrate & applied shear stress	1.5 – 3
$Spacing_{pool} / W_{bkf}$: Pool spacing ratio provides for energy dissipation	1 – 3 (steep, step-pool) 3 – 5 (flat, meander-pool)
Floodplain Morphology	**Target**
$ER = W_{fpa} / W_{bkf}$: Entrenchment ratio provides wide floodplain for flood energy dissipation, sediment retention, stormwater retention/treatment & riparian habitats	> 5 (wide valley) > 2.5 (confined valley)
$BHR = LBH / d_{mbkf}$: Bank height ratio provides floodplain access at bankfull stage consistently down valley on both banks	1
Floodplain orientation minimizes flood flow stresses (straight down valley & consistent width with no obstructions)	Straight with no obstructions or sharp transitions
Surface topography supports floodwater retention, micro-pools, flow diversity & riparian habitats	Backwater retention, wetlands, diverse topo

Hydrologic & Hydraulic Analysis	**Target**
Q_{bkf}: Bankfull discharge (cfs) appropriate for watershed size, hydrology, sediment transport & valley conditions	matching existing bankfull, models & regional curves
$V_{av} = Q_{bkf} / A_{bkf}$: Bankfull average velocity (ft/s) appropriate for valley, soils, bed material	1 - 3 (<1% valley slope) 3 - 5 (1-2% valley slope) 5 - 7 (2-4% valley slope)
τ_{av}: Bankfull average applied shear stress (lb/ft^2) & local max stresses appropriate for sediment transport conditions & bed/bank restistance	Sed transport analysis to maintain equilibrium
ω_{av}: Bankfull average stream power (lb/ft/s) appropriate for sediment transport conditions	Sed transport analysis to maintain equilibrium
Riffle substrate size distribution appropriate for hydraulic conditions & habitats	Sed transport analysis (existing/supplement)
Streambank protection to resist excess erosion (short-term & long-term)	Temporary matting, revetments & vegetation
In-stream Rock and Log Structures	**Target**
Boulders and logs sized to resist washout	> 1 ton boulders > 1 ft diameter logs
Vanes oriented to provide bank protection & maintain position	20 – 30 degree angle 2 – 5% arm slope
Footers, splash rocks, backer logs, sills, chinking, geotextiles, backfilling to maintain structure stability	Specs & details
Drops/steps support aquatic organism passage & structure stability	< 0.5 ft drop
Habitats and Vegetation	**Target**
In-stream macro- and micro-habitats include diverse bedform & flow conditions, wood in riffles/pools, plant roots, leaf pack snags	diversity & complexity
Floodplain habitats include diverse topography & wood	diversity & complexity
Riparian buffer width appropriate for ecosystem services	> 50 ft
Native riparian plant communities appropriate for climate, soils, water	8 – 10 species
Invasive plant management appropriate for site conditions	maintenance plan
Soil preparation and planting plan appropriate for site conditions	soil fertility test
Site and Watershed Conditions	**Target**
Bridges, culverts & utility crossings protected while maintaining geomorphic stability, sediment transport & aquatic organism passage	vanes, step-pools, revetments
Parallel infrastructure (utilities, roads, buildings, fill slopes) protected while maintaining geomorphic stability	vanes, deflectors, revetments
Stormwater pipe & ditch outfalls addressed for energy dissipation & water quality treatment (on floodplain or at streambank)	floodplain retention, stilling basins, revetments, vanes
Livestock access limited or eliminated	fencing, controlled crossings at riffles
Human access to channel & floodplain provided with protected banks	vanes, deflectors, steps
Upstream flows, sediment & discharges managed for water quality, habitat & stability	watershed management
Monitoring, maintenance & education plans	adequate plan