

2.0 Stream Management Plan Recommendations

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2.0 Stream Stewardship Recommendations

Traditional stream management practices typically focus on a single objective, such as bank stabilization, or flood threat reduction. While rip-rap, gabions and other hard armoring techniques may achieve the goal of localized streambank stability in the short term, the application of these methods generally doesn't consider potential impacts outside the immediate project area, or on other stream functions such as stream and floodplain ecology, sediment transport or water quality. In many cases, ongoing evolutionary changes in stream form are only interrupted by local stabilization techniques, and these interruptions may cause stream instability to shift upstream or downstream. In many cases, work undertaken to address one form of instability may create a domino effect of instability elsewhere.

2.1 Stream Stewardship Recommendations – Management Unit Summary Tables

Section 2.1 presents complete summary tables of the 19 Management Units (MUs) defined and described in Section 1.0. The tables condense all stream and infrastructure feature data mapped, assessed and described as part of the stream assessment conducted in 2001. This section presents summary tables for each of the MU and provides specific recommendations or suggested further assessments for each feature or set of features. The following summary tables follow the same outline presented in each MU, with added rows at the top of each outlining the recommended Intervention Level (defined below), Morphology (general assessment of stability). Flooding and Erosion Hazard section includes a summary of the percent by length of eroding bank and hardening measures, as well as the number of Monumented Cross-sections (MCSs) set up to monitor specific eroding banks. The final row provides a brief summary of recommended further assessments, monitoring or other actions not discussed elsewhere.

Intervention Level Descriptions:

Preservation – The stream and surrounding floodplain in certain MUs or sections of MUs are in excellent condition, with low flooding and erosion threats, good water quality and sustainable, functioning aquatic and terrestrial habitat. These sections should be actively preserved, as valuable anchor points for stable stream morphology and good habitat, as well as helping to preserve or even enhance water quality and flood dynamics that may be compromised through other MUs.

Passive – Some MUs or sections of MUs are in generally good condition, exhibiting apparent stability and sustainable function without further needs for any intensive management or changes. These MUs are not necessarily in the most stable condition that would warrant special protection, but are sections that are functioning well and may evolve to preservation status over time. There may even be sections that are somewhat unstable, but may recover unassisted over time. Some monitoring or visual inspection of certain features or areas may be warranted, but generally no active management is recommended.

Assisted Recovery - Partial intervention, or “assisted recovery”, involves direct management intervention on a small scale. Assisted recovery must be done carefully and with a good understanding of the stream type and setting to avoid further instability. Assisted recovery may be as simple as planting riparian vegetation to maintain bank stability, or as complicated as

designing comprehensive stormwater management retrofits or reconstructing large sections of stream bank. Riparian landowners effectively promote assisted recovery in a number of ways including planting trees and shrubs, limiting mowing or brush removal and can careful selection of disposal areas for their yard waste.

Full Restoration – This intervention level requires the most intensive management, and is generally reserved for the most severe locations of stream instability with the greatest impact to management goals. Certain MUs contain sections that will require complete assessment, design and reconstruction of the stream channel, banks and in some cases adjacent hillsides, to return the MU to a stable, functioning condition that satisfies multiple management goals. This level of management requires much greater time and financial resources, as well as technical expertise, to ensure stability restoration is consistent both with management goals, as well as the stream type and setting that will ensure project success and longevity. The stream stability restoration demonstration project constructed in MU3 in 2000, described in detail in the Appendix, Section 4.1.1.1 , details some of the intensive methods required for a successful project.

Table 1. Management Unit 1 Recommendations and Intervention Level

Intervention Level	Preservation - (Reference Reach); Assisted Recovery - (road embankment/rip-rap, culvert outfalls)
Morphology	Relatively stable, multiple stream types, some entrenched with large bed material, one G section
Mapped/monumented bank conditions	0% eroding; 13% hardened; no MCSs
Eroding banks	none
Berms	none
Clay exposures	none
Japanese Knotweed	none
Culvert/bridge recommendations	Evaluate 1 mid-reach culvert for replacement or removal
Revegetation recommendations	1. Culvert outlets 2. Lower rip-rap section 3. Right bank at DEC turnout
Dumpsites	none
I. Flooding and Erosion Threats	Minor - primarily road embankment and culvert instability
A. Infrastructure and Private Property	1. Visually inspect reach above head-cut near the road, 2. Revegetate culvert outfalls, 3. Evaluate failing culvert mid-reach
B. History of Streamwork	1. Rip-rap and dumped rock fill - lower section vulnerable to ongoing maintenance, evaluate to potentially replace with stacked rock, and/or revegetate
C. Exposed Banks	1. Minor erosion opposite rip-rap, and at road fill at DEC turnout - revegetate DEC turnout area
II. Water Quality Issues	Minor - no clay; primarily road runoff
A. Sediment	No clay, minor sediment inputs
B. Dumping sites	None
C. Other	1. Road runoff in poorly vegetated areas - revegetate sparse riparian areas
III. Stream Ecology Condition	Good, excellent in reference reach area
A. Aquatic habitat and populations	Reference Reach monitoring shows healthy trout populations
B. Riparian Vegetation	Good overall, under-vegetated sections near the road should be augmented
Further Assessments/Monitoring	1. Continue Reference Reach monitoring (elevation survey and biological monitoring), 2. Visually inspect head-cut area periodically, 3. Test shallow well for water quality (or drill deep well for residential water supply) if to be used.

Table 2. Management Unit 2 Recommendations and Intervention Level

Intervention Level	Full Restoration - (private bridges); Assisted Recovery - (road fill/bank areas)
Morphology	Relatively unstable, predominantly confined, entrenched stream types, close proximity to the road
Mapped/monumented bank conditions	17% eroding; 25% hardened; 7 MCSs (MCS 27 includes both banks)
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	5% (155 feet) - evaluate for removal/restructuring
Clay exposures	8% (230 feet) - associated with eroding banks, see above
Japanese Knotweed	3% (95 feet) - remove and revegetate with competitive natives
Culvert/bridge recommendations	Evaluate private bridges for potential replacement/reconstruction
Revegetation recommendations	1. Eroding road embankments 2. Hardened areas 3. Private property 4. Berm area if removed/restructured
Dumpsites	6% (180 feet)
I. Flooding and Erosion Threats	Moderate - eroding banks threatening road fill, private bridges and property
A. Infrastructure and Private Property	1. Evaluate private bridges for possible replacement or reconstruction to reduce structural damage from stream bank and bed erosion (long term); revegetate banks upstream/downstream to reduce bank erosion (short term); 2. Revegetate eroding banks in residential areas to protect property, 3. Adjust management along road embankments to protect existing riparian trees, augment with additional vegetation
B. History of Streamwork	1. Evaluate replacing dumped rock fill with stacked rock or dense vegetation or a combination (long term), or revegetate (short term); 2. Evaluate removal or restructuring of berm to return floodplain bench functions, revegetate
C. Exposed Banks	1. Dumping site at MCS 26 should be cleaned up, and the bank regraded (if necessary) and revegetated; 2. Adjust management of road fill areas to include preservation of existing trees, as well as augmenting with additional trees/vegetation; 3. Residential exposed banks should be revegetated and/or regraded (if necessary) to protect property
II. Water Quality Issues	Moderate - 2 clay exposures, multiple eroding banks contribute sediment, lack of riparian vegetation to absorb road runoff
A. Sediment	1. One clay exposure at MCS 22 (berm) - evaluate for removal or restructuring berm to reduce pressure on eroding bank and stream bed; 2. revegetate or restructure other eroding areas to prevent further sediment inputs
B. Dumping sites	1. Largest dumping site in the Broadstreet Hollow - should be removed, bank regraded (if necessary) and vegetated, 2. Remove Japanese Knotweed, revegetate
C. Other	1. Road runoff in poorly vegetated areas - revegetate sparse riparian areas
III. Stream Ecology Condition	Poor - insufficient riparian vegetation along the road, Japanese Knotweed could provide seed crop to invade downstream areas
A. Aquatic habitat and populations	Impact of stream bank/channel and riparian instability on aquatic populations is unknown
B. Riparian Vegetation	1. Revegetate rip-rap and dumped rock fill areas (before/after/instead of restructuring or reconstruction); 2. Remove Japanese Knotweed and replant with competitive native species; 3. Revegetate residential areas to protect property
Further Assessments/Monitoring	1. Continue monitoring of monumented cross-sections 22-28 in this unit, reprioritize treatments as appropriate.

Table 3. Management Unit 3 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (monitoring and revegetation of Stability Restoration Demonstration Project)
Morphology	Reconstructed reach, built to stable dimensions, though requires vegetation establishment for full functionality
Mapped/monumented bank conditions	0% eroding, 14% hardened*; multiple MCSs
Eroding banks	none
Berms	none
Clay exposures	6% (140 feet) - no action recommended, project site adjustment following construction
Japanese Knotweed	none - present in upstream units
Culvert/bridge recommendations	Evaluate County Bridge 3-20124-0 for reconstruction - ensure appropriate width
Revegetation recommendations	1. augment existing planting plan as needed, see O&M and Landowners guides 2. Revegetate banks around bridges
Dumpsites	none
I. Flooding and Erosion Threats	Minor - project adjustments following construction
A. Infrastructure and Private Property	1. County Bridge 3-20123-0: revegetate banks up/downstream
B. History of Streamwork	*1. Stream stability restoration demonstration project site contains 13 boulder cross-vanes, (not included in summary of hardened banks). Visually inspect and resurvey this site annually and following flood events, and complete reconstruction or repair work as needed.
C. Exposed Banks	None
II. Water Quality Issues	Minor - small clay exposures as project adjusts
A. Sediment	1. Visually inspect several small clay exposures mapped in 2001. No additional action recommended at this time, unless project surveys reveal structural problems.
B. Dumping sites	None
C. Other	1. Augment bioengineering activities already in place as needed; 2. Augment or create vegetated riparian zones in residential lawn areas and road/bridge embankment areas to maintain filtering capacity for nutrients or other pollutants.
III. Stream Ecology Condition	Fair - riparian vegetation still adjusting following construction
A. Aquatic habitat and populations	1. Continue fish and macroinvertebrate population monitoring should continue, to track improvements following construction due to habitat improvement
B. Riparian Vegetation	1. Continue to augment and improve riparian vegetation to ensure success, implement planting, watering and management schedule as recommended in the Operation and Maintenance Plan, and Landowners Guide
Further Assessments/Monitoring	1. Continue monitoring monumented cross-sections throughout the reconstructed reach; 2. Continue aquatic habitat and biological monitoring as part of a triplicate reach study (with reference and control sites, see MU1 and MU17); 3. Follow and update O&M Plan; 4. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 4. Management Unit 4 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (no space for Full Restoration between the road and the valley wall)
Morphology	Relatively unstable, multiple shifts in stream type, many entrenched sections, close proximity to the road
Mapped/monumented bank conditions	14% eroding; 36% hardened; 3 MCSs
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	21% (695 feet) - variety of materials, location and purpose - evaluate for removal/restructuring and revegetation
Clay exposures	none
Japanese Knotweed	none
Culvert/bridge recommendations	none
Revegetation recommendations	revegetate few culvert outfalls
Dumpsites	none
I. Flooding and Erosion Threats	Moderate - multiple hardened banks, long eroding bank, no structures threatened
A. Infrastructure and Private Property	1. Evaluate County Bridge 3-20124-0 for reconstruction to accommodate natural stream width (long term), revegetate banks up/downstream to reduce ongoing erosion damage (short term); 2. Replace County Bridge 3-21022-0 as per GC Highway Dept rating;
B. History of Streamwork	1. Revegetate road embankments and hardened areas; 2. Evaluate berms for removal or set berms back from the stream, and stabilize materials with vegetation; 3. Evaluate material storage berms for stabilization, removal, or protection.
C. Exposed Banks	1. Evaluate long eroding bank at MCS 19 and 20 for regrading, stabilization and bioengineering; 2. Evaluate eroding bank opposite Jay Hand Hollow for potential bioengineering, or impact to road embankment.
II. Water Quality Issues	Moderate - water heating from contact with rock, sediment inputs from banks, no clay
A. Sediment	1. Revegetate under-vegetated roadside ditches and culvert outfalls to reduce fine sediment inputs from outside drainage; 2. Evaluate eroding banks and prioritize stabilization to prevent additional fine sediment inputs.
B. Dumping sites	None
C. Other	1. Revegetate culvert outfalls and roadside ditches with additional grasses/herbs to increase uptake of nutrient or other pollutants in runoff;
III. Stream Ecology Condition	Fair - reach would benefit from additional floodplain bench areas, riparian augmentation/replacement
A. Aquatic habitat and populations	No specific assessments completed - impact of stream bank/channel and riparian instability is unknown
B. Riparian Vegetation	1. Revegetate under-vegetated rip-rap and stacked rock wall areas; 2. Revegetate stabilized areas or bermed areas (before/after/instead of restructuring or reconstruction); 3. Evaluate berms for removal or set berms back to provide additional areas for riparian establishment.
Further Assessments/Monitoring	1. Continue monitoring of monumented cross-sections in this unit, reprioritize treatments as needed; 2. Visually monitor small eroding bank just upstream from residential lawn area below County Bridge 3-20122-0; 3. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 5. Management Unit 5 Recommendations and Intervention Level

Intervention Level	Full Restoration - (failing clay valley wall hillside, culvert replacement)
Morphology	Relatively stable, excepting one entrenched section with failing clay valley wall hillslope
Mapped/monumented bank conditions	35% eroding; 5% hardened; 1 MCS
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	5% (65 feet) - address as part of MU4
Clay exposures	37% (490 feet) - associated with eroding bank, see above
Japanese Knotweed	none
Culvert/bridge recommendations	evaluate 1 culvert for upgrade replacement
Revegetation recommendations	address in conjunction with eroding banks, proximity to road
Dumpsites	4% (50 feet)
I. Flooding and Erosion Threats	Moderate - large failing hillside, no structures threatened
A. Infrastructure and Private Property	1. Evaluate culvert plugged with sediment and debris for upgrade/replacement.
B. History of Streamwork	1. Address berm section with MU4.
C. Exposed Banks	1. Evaluate extensive eroding bank at MCS 18 for full restoration.
II. Water Quality Issues	High - extensive clay exposure along valley wall at MCS 18
A. Sediment	1. Evaluate clay hillside and bank for stabilization; 2. Visually inspect smaller clay exposure at the bottom of the unit to detect increased erosion rates or instability.
B. Dumping sites	1. Remove refuse materials from the stream bank and floodplain areas mapped along 4% of stream banks in the unit - revegetate any disturbed areas.
C. Other	1. Augment sparse riparian vegetation as needed near the top of the unit to reduce impacts from road runoff.
III. Stream Ecology Condition	Fair - good riparian condition on right bank, poor on left bank
A. Aquatic habitat and populations	No specific assessments completed - impact of stream bank/channel and riparian instability is unknown
B. Riparian Vegetation	1. Replace riparian vegetation as part of a full restoration (as appropriate) of eroding valley wall hillside at MCS 18 (long term).
Further Assessments/Monitoring	1. Continue survey monitoring of MCS 18 as needed to reprioritize restoration, assess erosion rates; 2. Conduct a geotechnical survey of this hillside to assess failure mechanism and advise restoration design as appropriate; 3. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 6. Management Unit 6 Recommendations and Intervention Level

Intervention Level	Passive - (except removal of one dumping site in the floodplain)
Morphology	Relatively stable, some stream type shifts, but good riparian condition and floodplain bench area.
Mapped/monumented bank conditions	0% eroding; 7% hardened; no MCSs
Eroding banks	none
Berms	7% (75 feet) - no recommendation
Clay exposures	16% (165 feet) - visually monitor, no stabilization recommended
Japanese Knotweed	none
Culvert/bridge recommendations	none
Revegetation recommendations	none
Dumpsites	14% (145 feet) - behind berm, low priority
I. Flooding and Erosion Threats	Minor - no infrastructure or structures
A. Infrastructure and Private Property	No infrastructure or structures
B. History of Streamwork	1. One berm section is relatively stable, no action recommended.
C. Exposed Banks	1. Visually inspect minor eroding bank with clay exposure for changes in condition or stability.
II. Water Quality Issues	Minor - one clay exposure, one dumping site in floodplain
A. Sediment	1. visually inspect minor eroding bank with clay exposure for changes in condition or stability, does not appear to be a significant sediment source as of 2001.
B. Dumping sites	1. Remove refuse materials from the floodplain areas mapped along 14% of stream bank in the unit - revegetate any disturbed areas. This site is low priority, as materials are behind the berm, and not commonly in contact with the stream.
C. Other	No recommendations
III. Stream Ecology Condition	Good
A. Aquatic habitat and populations	No specific assessments completed - impact of minor stream bank/channel instability is unknown.
B. Riparian Vegetation	Good overall - no recommendations
Further Assessments/Monitoring	1. Visually inspect minor eroding bank with clay exposure periodically; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 7. Management Unit 7 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (regrade and revegetate failing rip-rap and eroding bank areas)	
Morphology	Relatively stable, primarily non-entrenched stream types, good floodplain bench network	
Mapped/monumented bank conditions	6% eroding; 24% hardened; 1 MCS	
Eroding banks	see Monitoring Cross-Section summary tables for prioritization	
Berms	none	
Clay exposures	2% (20 feet) - visually monitor, no stabilization recommended	
Japanese Knotweed	none	
Culvert/bridge recommendations	none	
Revegetation recommendations	1. Lower rip-rap section, including eroding banks flanking rip-rap 2. Upper stacked rock section 3. Tributary culvert	
Dumpsites	none	
I. Flooding and Erosion Threats	Minor - failing rip-rap, no structures threatened	
	A. Infrastructure and Private Property	No structures/infrastructure threatened.
	B. History of Streamwork	1. Evaluate partially failing rip-rap and eroding bank at managed terrace near the bottom of the unit for regrading and stabilization; re-establish riparian vegetation to further protect property; 2. Augment vegetation at stacked rock wall.
	C. Exposed Banks	1. Regrade (if necessary) and revegetate eroding banks in vicinity of rip-rap sections, re-establish riparian vegetation.
II. Water Quality Issues	Minor - small clay exposure, eroding bank areas	
	A. Sediment	1. Evaluate eroding bank areas and failing rip-rap areas for stabilization; 2. Visually inspect clay exposure mapped in 2001.
	B. Dumping sites	None
	C. Other	1. Augment riparian vegetation at road embankment at the top of the unit, at tributary culvert.
III. Stream Ecology Condition	Good - generally healthy riparian vegetation excepting rip-rap area	
	A. Aquatic habitat and populations	No specific assessments completed - impact of minor stream bank/channel instability is unknown.
	B. Riparian Vegetation	1. Revegetate under-vegetated areas before/after/instead of regrading or reconstruction of eroding banks and rip-rap areas; 2. Re-establish riparian vegetation along terrace above partially failing rip-rap, left bank near the bottom of the unit.
Further Assessments/Monitoring	1. Continue survey monitoring of MCS 17 as needed to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.	

Table 8a. Management Unit 8 (Downstream) Recommendations and Intervention Level

Intervention Level	Full Restoration - (eroding hillside/channel at MCS 11-13); Assisted Recovery - (eroding banks/channel at MCS 14,)
Morphology	Generally unstable, long entrenched section with massive bank erosion; very little floodplain access
Mapped/monumented bank conditions	49% eroding; 19% hardened; 4 MCSs
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	150 feet - evaluate for removal or restructuring, revegetation, in conjunction with eroding bank opposite
Clay exposures	associated with 440-foot eroding hillside, see above
Japanese Knotweed	none
Culvert/bridge recommendations	none
Revegetation recommendations	in conjunction with stabilization projects
Dumpsites	none
I. Flooding and Erosion Threats	Significant - massive failing hillside across from residential lawn, no structures threatened
A. Infrastructure and Private Property	No structures or infrastructure are currently threatened
B. History of Streamwork	1. Evaluate the berm at MCS 11-13 to remove or restructure to a set-back position, with revegetation, to return floodplain access to the stream in this area, reduce erosion pressure on the valley wall/terrace, and lower flood stage.
C. Exposed Banks	1. Evaluate stream channel at MCS 11-13, between berm and eroding valley wall/terrace hillslope, for full stability restoration construction to address failing hillslope and ongoing stream instability; 2. Evaluate eroding bank at MCS 14 for potential stabilization, no structures or infrastructure threatened
II. Water Quality Issues	Major - over 300 feet of exposed and eroding valley wall with clay exposures
A. Sediment	1. Evaluate stabilization of stream channel, with full restoration, including extensive clay exposures at MCS 11-13; 2. Minor sediment inputs from bank at MCS 14, regrading and revegetation would reduce inputs.
B. Dumping sites	None
C. Other	None
III. Stream Ecology Condition	Poor - insufficient riparian vegetation along both banks to provide full riparian benefits
A. Aquatic habitat and populations	No specific assessments completed - impact of major stream bank/channel instability or constriction by bermed area is unknown.
B. Riparian Vegetation	1. In conjunction with potential full restoration of eroding/failing valley wall hillside and unstable stream channel at MCS 11-13, re-establish full native riparian vegetation, to increase stability and provide riparian habitat benefits. Wetland area at the top of the terrace should be preserved, to maintain habitat quality of this valuable resource; 2. Revegetate eroding bank area at MCS 14, before/after/instead of reconstruction or regrading (for short term stabilization and riparian improvement).
Further Assessments/Monitoring	1. As appropriate, conduct geotechnical and detailed channel and slope stability analysis at failing valley wall/terrace hillslope at MCS11-13; 2. Evaluate extent and character of perched wetland on high terrace above failing hillslope at MCS 12-13; 3. Continue survey monitoring of MCSs as needed to reprioritize restoration, assess erosion rates; 4. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 8b. Management Unit 8 (Upstream) Recommendations and Intervention Level

Intervention Level		Full Restoration - (potential reconstruction of bridge near top of unit); Assisted Recovery - (eroding banks/channel at MCS 15-16);
Morphology		Relatively stable, though many stream type shifts and very close proximity to the road make this section vulnerable, some floodplain bench capacity
Mapped/monumented bank conditions		13% eroding; 18% hardened; 2 MCSs
Eroding banks		see Monitoring Cross-Section summary tables for prioritization
Berms		none
Clay exposures		none
Japanese Knotweed		none
Culvert/bridge recommendations		Evaluate private bridge for reconstruction
Revegetation recommendations		1. Two stacked rock walls and rip-rap areas 2. Culvert outlets and road embankment areas
Dumpsites		none
I. Flooding and Erosion Threats		Moderate - road embankment close to stream, no structures threatened
	A. Infrastructure and Private Property	1. Evaluate private bridge at the top of the unit for reconstruction to accommodate the natural width of the stream (span = 21', stream width = 35' avg.); 2. Revegetate or augment riparian vegetation along road embankment, especially near the top of the unit.
	B. History of Streamwork	1. Revegetate new stacked rock wall at MCS 15 to improve stability of overlying road fill; 2. Augment vegetation at existing hardened areas to improve stability (priority areas are along the road, or where the toe is in direct contact with the stream).
	C. Exposed Banks	No structures threatened in either MCS 15 or 16
II. Water Quality Issues		Minor - no clay exposures, two short eroding banks - moderate potential for road runoff
	A. Sediment	1. Evaluate eroding bank at MCS 16 for regrading (if necessary) and revegetation to reduce fine sediment inputs; 2. Augment vegetation in under-vegetated areas to mitigate any additional suspended sediment from road runoff.
	B. Dumping sites	None
	C. Other	1. Revegetate hardened areas and under-vegetated areas, including culvert outfalls, to increase uptake and filtering of salts or other pollutants from road runoff.
III. Stream Ecology Condition		Fair - vegetation in good condition on left bank, road embankment needs augmented riparian
	A. Aquatic habitat and populations	No specific assessments completed - impact of minor stream bank/channel instability or proximity to the road is unknown.
	B. Riparian Vegetation	1. To increase shading and improve water temperature conditions, revegetate or augment vegetation along road embankment areas; 2. Revegetate eroding bank areas before/after/instead of regrading or construction.
Further Assessments/Monitoring		1. Continue survey monitoring of MCS 16 as needed to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 9. Management Unit 9 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (vegetation along hardened road embankments)
Morphology	Relatively stable, primarily non-entrenched stream types, good floodplain bench network along left bank
Mapped/monumented bank conditions	0% eroding; 55% hardened; no MCSs
Eroding banks	none
Berms	7% (120 feet) - evaluate for removal or restructuring, revegetation
Clay exposures	none
Japanese Knotweed	none
Culvert/bridge recommendations	none
Revegetation recommendations	1. Extensive rip-rap on right bank 2. Road embankment areas 3. Downstream culvert outlet
Dumpsites	none
I. Flooding and Erosion Threats	Moderate - close proximity to road, much bank hardening
A. Infrastructure and Private Property	1. Replant hardened areas along the road embankment to reduce need for ongoing revetment/maintenance; 2. Provide additional vegetation to new culvert in lower half of the unit, to reduce erosion from the outfall drop.
B. History of Streamwork	1. Revegetate dumped rock fill areas in the lower half of the unit to increase stability, or evaluate for replacement with stacked rock wall with additional bioengineering; 2. Evaluate berm in upstream half of unit opposite the road, for removal or restructuring, regrade and revegetate, to reduce pressure on road embankment areas.
C. Exposed Banks	None
II. Water Quality Issues	Minor - no clay, primarily road runoff and culvert drainage
A. Sediment	1. Augment riparian vegetation along road embankment to increase filtering of fine sediment; 2. Augment or replace vegetation at culvert outfalls to slow incoming waters and encourage sediment deposition.
B. Dumping sites	None
C. Other	1. Augment riparian vegetation along road embankment to increase filtering and uptake of salts or other pollutants from road runoff; 2. Augment or replace vegetation at culvert outfalls from road ditch drainage to increase filtering and uptake of salts or other pollutants from road runoff.
III. Stream Ecology Condition	Fair - Riparian vegetation along right bank (road embankment) insufficient
A. Aquatic habitat and populations	No specific assessments completed - impact of major stream bank/channel instability or constriction by bermed area is unknown.
B. Riparian Vegetation	1. Revegetate road embankment, particularly 450 feet of continuous quarried boulder rip-rap, to decrease water heating from contact with rip-rap areas, and increase shading and cover.
Further Assessments/Monitoring	No further assessments recommended

Table 10. Management Unit 10 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (revegetate hardened areas, regrade and revegetate eroding areas)
Morphology	Relatively stable, some entrenched and confined stream types between road fill/embankment and high terraces, but good floodplain bench network
Mapped/monumented bank conditions	11% eroding; 23% hardened; 2 MCSs
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	none
Clay exposures	none
Japanese Knotweed	none
Culvert/bridge recommendations	1. Visually inspect private bridge for changes in stability 2. Visually inspect culvert associated with private bridge
Revegetation recommendations	1. New stacked rock wall 2. New dumped rock fill/bank run 3. Rip-rap and associated eroding banks 4. Road embankment 5. Culvert outfalls
Dumpsites	18% (227 feet) - remove materials, revegetate if needed
I. Flooding and Erosion Threats	Moderate - close proximity to the road, bank erosion areas
A. Infrastructure and Private Property	1. Visually inspect private bridge yearly to detect structural problems related to stream instability; 2. Revegetate road embankments and hardened areas along the road to increase stability and reduce need for ongoing stabilizations; 3. Evaluate eroding bank area at MCS 9 along residential property for potential stabilization to reduce property damage and improve aesthetic value of streamside property.
B. History of Streamwork	1. Revegetate stacked rock wall and rip-rap areas to augment bank stability protection; 2. Evaluate dumped rock fill and bank run areas for replacement with stacked rock or intensive bioengineering to improve bank stability and reduce ongoing maintenance of failures; 3. Culverts: annually visually inspect top (1st) culvert for erosive impact on stacked rock wall toe, annually visually inspect 3rd culvert and augment steep outfall bank with vegetation (as needed) to reduce bank erosion, annually visually inspect 4th culvert for changes in stability - no recommendations at this time for 2nd and 5th culverts.
C. Exposed Banks	1. Evaluate for regrading and revegetate (bioengineer) eroding bank area along road embankment to reduce and prevent future hardening needs, and protect road fill/embankment. Visually inspect, in addition to monitoring MCS 10, to assess erosion rates and reprioritize restoration action as needed; 2. visually inspect additional marginally unstable bank areas for changes in stability, augment riparian vegetation as needed to prevent increased instability.
II. Water Quality Issues	Moderate - no clay exposures, but close proximity to the road, bank erosion areas provide sediment and road runoff inputs
A. Sediment	1. Revegetate eroding banks, either before/after/instead of regrading or reconstructing - both on residential lawn area and along road fill/embankment area, to reduce sediment inputs from these raw banks; 2. Augment vegetation at culvert outfalls to encourage filtration and deposition of sediment from road ditch drainage; 3. Revegetate dumped rock fill and bank run areas to reduce sediment inputs from continued failure of these materials.
B. Dumping sites	1. Remove refuse materials from the stream bank area mapped along 18% of stream bank in the unit - revegetate any disturbed areas. This site is medium priority for dumping sites on Broadstreet Hollow, as it is the longest section containing refuse materials, commonly in contact with the stream, but sparse.
C. Other	1. Revegetate or augment vegetation along all road fill/embankment areas to increase filtration and uptake of road salts or other pollutants from road runoff; 2. Revegetate or augment vegetation at culvert outfalls that provide drainage to roadside ditches.
III. Stream Ecology Condition	Fair - good riparian condition for much of the left bank, poor riparian condition for much of the right bank (along the road)
A. Aquatic habitat and populations	No specific assessments completed - impact of stream bank/channel instability or proximity to unshaded road fill areas is unknown.
B. Riparian Vegetation	1. Revegetate or augment vegetation along all road fill/embankment areas to increase shade and cover, and potentially reduce stream temperature or keep temperatures cool; 2. Vegetate culvert outfalls, particularly those that cause water to come in contact with hot stone, to keep water temperatures cool.
Further Assessments/Monitoring	1. Continue survey monitoring of MCS 9 and 10 as needed to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 11. Management Unit 11 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (primarily passive, though tributary culvert may need replacement)
Morphology	Generally stable, though entrenched - (may be more vulnerable), some floodplain bench network
Mapped/monumented bank conditions	5% eroding; 9% hardened; 1 MCS (both banks)
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	none
Clay exposures	2% (20 feet) - associated with eroding left bank at MCS, see above
Japanese Knotweed	none
Culvert/bridge recommendations	evaluate tributary culvert for upgrade/replacement
Revegetation recommendations	1. Augment roadside vegetation 2. Revegetate eroding bank areas
Dumpsites	none
I. Flooding and Erosion Threats	Minor - short road embankment contact, no structures threatened
A. Infrastructure and Private Property	1. Evaluate tributary culvert for replacement, and reconfigure so water enters the stream at a lower angle and/or with added vegetation to minimize erosive impact and preserve cool water temperatures.
B. History of Streamwork	No recommendations - historic roadside rip-rap is in good condition, and well-vegetated with large trees.
C. Exposed Banks	1. Evaluate two eroding banks at MCS 8 for regrading/revegetation, low priority - no structures threatened.
II. Water Quality Issues	Minor - one small bed/bank clay exposure, short eroding banks, some road runoff
A. Sediment	1. Regrade and revegetate right eroding bank at MCS 8 to reduce sediment inputs from silts, install additional woody vegetation to floodplain bench at left bank to stabilize clay - regrading not recommended.
B. Dumping sites	None
C. Other	1. Augment vegetation along road embankment to increase filtering and deposition of sediments in road runoff.
III. Stream Ecology Condition	Good - small tributary wetland provides filtering and habitat area, riparian area OK
A. Aquatic habitat and populations	No specific assessments completed - impact of minor stream bank/channel instability or proximity to road fill areas is unknown, though small undercut benches even in eroding bank areas can provide good fish habitat.
B. Riparian Vegetation	1. Augment vegetation along road embankment and culvert tributary outlet to increase shade and cover, and keep water temperatures cool.
Further Assessments/Monitoring	1. Continue survey monitoring of MCS 8 as needed to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 12. Management Unit 12 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (stream course fixed by valley wall, bridges and road courses, no space for full restoration)
Morphology	Generally unstable, entrenched stream types, multiple hardened banks, one section of stable but multiple-channel stream type in the middle away from the road.
Mapped/monumented bank conditions	0% eroding (separate from failing hardened banks); 34% hardened; no MCSs
Eroding banks	none
Berms	9% (205 feet) - assess reach conditions associated with two berms for possible removal/reconfiguration
Clay exposures	none
Japanese Knotweed	none
Culvert/bridge recommendations	1. Evaluate David Merwin bridge for reconstruction, gabion removal 2. Evaluate county bridge 3-34671-0 for bank instability
Revegetation recommendations	1. Rip-rap areas, especially near road embankments 2. Stacked rock walls
Dumpsites	none
I. Flooding and Erosion Threats	Moderate - two bridges, multiple bank hardening and road fill areas
A. Infrastructure and Private Property	1. Evaluate County Bridge 3-34671-0 for reconstruction to accommodate natural stream width, and reduce ongoing erosion and revetment damages upstream and downstream. 2. Evaluate for regrading and bioengineering, or consider installing stacked rock wall with interplanted riparian shrubs (long term) or revegetate (short term) failing rip-rap on the left bank upstream of County Bridge 3-34671-0 to protect eroding road embankment.
B. History of Streamwork	1. Evaluate split stream channel, banks and berms on right and left banks below County Bridge 3-34671-0 for reconstruction to accommodate stream morphology and flooding behavior, regrading to accommodate floods and erosion, and revegetation to reduce property damage and maintenance costs; 2. Evaluate removal of gabions, with regrading and revegetating banks below David Merwin Bridge (2-22457-0) to accommodate natural stream width and reduce potential for headcut migration and gabion failure; 3. Evaluate removal of left bank berm downstream of County Bridge 3-34671-0 to decrease constriction and pressure on opposite bank (private property); 4. Augment vegetation at existing under-vegetated revetments to improve stability.
C. Exposed Banks	None documented apart from failing, threatened or constricting revetments (gabions, rip-rap mentioned above)
II. Water Quality Issues	Fair - some sediment from eroding or failing revetments, potential for road runoff impacts
A. Sediment	1. Revegetate or augment vegetation at failing or threatened revetments or hardened areas to reduce sediment inputs, especially from road runoff.
B. Dumping sites	None documented
C. Other	1. Augment vegetation along road embankment and bridge abutment areas to increase filtering of salts or other pollutants in road runoff.
III. Stream Ecology Condition	Fair - stable section in the middle of the unit with good riparian condition, exposed and hardened banks near bridges
A. Aquatic habitat and populations	No specific assessments completed - impact of stream bank/channel instability, proximity to road fill areas and under-vegetated hardened areas is unknown, though stable DA3 section provides complex habitat areas.
B. Riparian Vegetation	1. Revegetate or augment vegetation at failing or threatened revetments or hardened areas to improve shade and cover, and keep cool water temperatures; 2. Interplant existing rock walls and rip-rap to improve riparian conditions.
Further Assessments/Monitoring	1. Visually inspect failing rip-rap along road embankment, upstream from County Bridge 3-34671-0, to assess changes in stability and evaluate additional monitoring needs; 2. Visually inspect other banks and stream channel in the vicinity of County Bridge 3-34671-0 for additional instability resulting from eddy scour or bank erosion; 3. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 13. Management Unit 13 Recommendations and Intervention Level

Intervention Level	Preservation - (very stable reach, excellent habitat, far from the road with no development on either side)
Morphology	Stable, multiple-channel form with stable, well-vegetated islands between side channels, excellent network of floodplains and floodplain benches.
Mapped/monumented bank conditions	0% eroding; 0% hardened; no MCSs
Eroding banks	none
Berms	none (address berm in MU12 for impact on MU13)
Clay exposures	5% (95 feet) - visually inspect, no stabilization recommended
Japanese Knotweed	none
Culvert/bridge recommendations	none
Revegetation recommendations	1. Exposed low clay right bank
Dumpsites	none
I. Flooding and Erosion Threats	Minor - short section 40 feet from the road with one culvert, but good floodplain
A. Infrastructure and Private Property	No direct threats to infrastructure or structures; 1. Evaluate the bottom of MU12 and top of MU13 together in protection of property at this location for reconstruction of current boulder/wood debris berm to accommodate flood behavior and prevent ongoing damage in flood side channel at base of hillside on the right bank (looking downstream), also accommodate stable stream morphology and preserve highly stable channel form in this unit.
B. History of Streamwork	1. Evaluate berm at the bottom of MU12 for reconstruction and revegetation at hillside below residential home and road (on high terrace above the stream), impacting stream flow and dynamics into the top of MU13, to prevent damage during flooding when floodwaters occupy all side channels in this unit.
C. Exposed Banks	1. Augment riparian vegetation at one exposed bank, low priority due to low potential for ongoing erosion and no hazard to infrastructure or structures.
II. Water Quality Issues	Good - one clay exposure is associated with a minor exposed bank, low erosion potential, excellent riparian for filtering
A. Sediment	1. Potentially revegetate clay exposure to reduce sediment loadings, minor erosion potential presents minor source.
B. Dumping sites	None documented
C. Other	No current threats, culverts drain to well-vegetated, flat floodplain areas that would slow inputs of any pollutants from road runoff.
III. Stream Ecology Condition	Excellent - well developed riparian vegetation, little hardening or erosion, many habitat niches within stream and floodplain
A. Aquatic habitat and populations	No specific assessments completed - stable DA3 section provides complex habitat areas for many life stages of aquatic and terrestrial species that depend on streams.
B. Riparian Vegetation	1. Ensure any work done on berm and side channel areas at the top of the unit include careful reconstruction of riparian vegetation to preserve good riparian community throughout the rest of the unit; 2. Preserve existing large woody debris present in the reach, providing physical habitat substrate for cover and nutrients, with low hazard for debris jam development.
Further Assessments/Monitoring	1. Evaluate riparian conditions in this reach as a blueprint for a stable riparian vegetation for other stream sections in similar settings; 2. Visually inspect clay exposure and minor erosion for any changes in stability; 3. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream - open eroding bank is likely most vulnerable to colonization, any work area at the top of the reach that presents a disturbed area should also be inspected and adequately vegetated with competitive natives to ensure Knotweed doesn't get a foothold.

Table 14. Management Unit 14 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (eroding clay terrace/bank regrading and revegetation); Passive - (the remainder of the unit sustains good function)
Morphology	Generally stable, entrenched stream type has good floodplain benches and healthy riparian vegetation, increasing stability
Mapped/monumented bank conditions	20% eroding; 0% hardened; 1 MCS
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	none
Clay exposures	20% (210) - associated with eroding bank, see above
Japanese Knotweed	none
Culvert/bridge recommendations	none
Revegetation recommendations	in conjunction with any stabilization work at eroding bank
Dumpsites	none
I. Flooding and Erosion Threats	Minor - one eroding bank, no infrastructure or structures threatened
A. Infrastructure and Private Property	No infrastructure or structures threatened, property damage from erosion in un-developed area
B. History of Streamwork	No history of stream work, no hardening or berming evident
C. Exposed Banks	1. Evaluate for regrading and revegetating eroding terrace/bank at MCS7, low priority for flood hazard due to undeveloped valley section.
II. Water Quality Issues	Fair - clay exposure at MCS7 will continue to contribute clay during high flow events, continue failing
A. Sediment	1. Evaluate for regrading and revegetating eroding terrace/bank and surrounding hillside at MCS7, higher priority for water quality due to clay inputs.
B. Dumping sites	None documented
C. Other	No threats from road runoff or other pollutants documented
III. Stream Ecology Condition	Good - good riparian vegetation, even undercut banks at clay exposure may provide valuable cover areas for fish
A. Aquatic habitat and populations	No specific assessments completed - effects of eroding bank and clay exposure are unknown.
B. Riparian Vegetation	1. Any regrading work on the eroding clay terrace/bank at MCS7 should include careful revegetation to preserve the healthy riparian forest in this unit.
Further Assessments/Monitoring	1. Continue survey monitoring of MCS7 to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream - open eroding bank is likely most vulnerable to colonization, any work done at MCS7 that creates a disturbed area should also be adequately vegetated with competitive natives to ensure Knotweed doesn't get a foothold.

Table 15. Management Unit 15 Recommendations and Intervention Level

Intervention Level	Full Restoration - (eroding clay hillside/valley wall at MCS 5); Assisted Recovery - (other eroding bank areas, under-vegetated bank areas or constricted areas)
Morphology	Generally unstable, over-widened channel, restricted access to any floodplain areas throughout the unit
Mapped/monumented bank conditions	29% eroding; 17% hardened; 2 MCSs
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	15% (295 feet) - address with eroding opposite bank, see above
Clay exposures	14% (315 feet) - in two sections, address with eroding bank, see above
Japanese Knotweed	none
Culvert/bridge recommendations	visually inspect pond drainage culverts
Revegetation recommendations	1. Culvert outlets 2. Any stabilization efforts should include riparian reestablishment 3. Berm and eroding bank areas
Dumpsites	none
I. Flooding and Erosion Threats	Major - no structures threatened, eroding hillside and bermed pond opposite have high damage risks
A. Infrastructure and Private Property	No structures threatened, though constructed pond and associated water diversion and outlet culverts are at some (unknown) risk of breach, and should be addressed in a full restoration of this reach to remove stress against eroding hillside opposite and return appropriate stable morphology to this reach.
B. History of Streamwork	1. As part of a full reconstruction in this reach (as appropriate), the berm containing the constructed pond should be addressed specifically with regard to stream entrenchment: the presence of the berm creates an entrenched condition, which may increase flood stage and erosion potential on the opposite massively eroding hillside. Berm height needs to be addressed to create a sustainable level of entrenchment in this section.
C. Exposed Banks	1. Full restoration, subject to priority, recommended in reach containing eroding/failing hillslope at MCS 5; 2. Evaluate eroding bank at MCS 6 for regrading and revegetating; 3. Short term augmentation of vegetation along the berm area at the constructed pond to protect the berm and reduce instability caused by culvert outfall erosion, and stream bank erosion from over-wide conditions.
II. Water Quality Issues	Poor - lengthy bed and bank clay exposure associated with massive failing valley wall hillslope
A. Sediment	1. Full restoration, subject to priority, recommended in reach containing eroding/failing hillslope at MCS 5, with careful and complete revegetation to restore riparian area to reduce sediment inputs from clays; 2. Evaluate for regrading and revegetating, including deeply rooted tree species as well as understory vegetation, at eroding bank at MCS 6 to reduce sediment inputs from ongoing erosion.
B. Dumping sites	None documented
C. Other	No threats from road runoff or other pollutants documented
III. Stream Ecology Condition	Poor - overwidened, shifting bed conditions in this unit, with insufficient riparian vegetation
A. Aquatic habitat and populations	No specific assessments completed - effects of massive eroding valley wall hillslope and insufficient riparian vegetation is unknown. Undercut bank at MCS 6 may actually contribute cover for fish in the absence of cover in the overwidened section.
B. Riparian Vegetation	1. Augment or replace vegetation along the bermed area (either before/after/instead of reconstruction - short term); 2. Revegetate eroding bank at MCS 6 with woody species to preserve wooded terrace conditions; 3. Subject to priority of restoration, full restoration in overwidened stream section at MCS 5 must include careful re-establishment of riparian vegetation to ensure sustainable stream morphology, preservation of banks in the vicinity of the constructed pond (perhaps at greater risk), and prevent colonization by opportunistic invasive species such as Japanese Knotweed.
Further Assessments/Monitoring	1. Continue survey monitoring of MCS 5 and 6 to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream - open and disturbed eroding bank and bar areas are most vulnerable to colonization, any work done at MCS 5 or 6 that creates a disturbed area should also be adequately vegetated with competitive natives to ensure Knotweed doesn't get a foothold.

Table 16. Management Unit 16 Recommendations and Intervention Level

Intervention Level		Assisted Recovery - (one eroding bank into rip-rap at pond inlet)
Morphology		Generally stable, appropriate stream type for the valley setting, with good floodplain access and mostly healthy riparian vegetation holding channel banks.
Mapped/monumented bank conditions		20% eroding; 4% hardened (one berm); 1 MCS
Eroding banks		see Monitoring Cross-Section summary tables for prioritization
Berms		none
Clay exposures		none
Japanese Knotweed		none
Culvert/bridge recommendations		none
Revegetation recommendations		1. augment vegetation in and around rip-rap area 2. Eroding bank area
Dumpsites		<1% (7 feet) - very minor, low priority
I. Flooding and Erosion Threats		Moderate - pond inlet area with boulder rip-rap is the weak point in this unit, no structures threatened
	A. Infrastructure and Private Property	1. Evaluate pond inlet for reconfiguring the area to match floodplain elevations and reduce any abrupt changes in elevation that could cause increased erosion during flood conditions when this area is inundated. Revegetate to increase protection from floodwater overflows into the floodplain or terrace areas.
	B. History of Streamwork	1. Evaluate replacement of current rip-rap area with regraded bank and intensive bioengineering, or minimize use of rock materials if they must be used, to reduce further eddy erosion or abrupt elevation changes.
	C. Exposed Banks	1. Regrade and revegetate eroding bank at MCS 4, low priority for protection in wooded area.
II. Water Quality Issues		Good - sufficient floodplain access to slow waters and encourage sediment deposition, no clay exposures
	A. Sediment	1. Reduce sediment inputs from eroding bank at MCS 4 by regrading/revegetating, lower priority site with forested terrace above.
	B. Dumping sites	1. Remove refuse materials from the stream bank area mapped along <1% of stream bank in the unit - revegetate any disturbed areas. This site is low priority for dumping sites on Broadstreet Hollow, as it is the smallest section containing refuse materials, though commonly in contact with the stream.
	C. Other	No threats from road runoff or other pollutants documented
III. Stream Ecology Condition		Good - generally healthy riparian vegetation, well vegetated terrace and floodplain areas
	A. Aquatic habitat and populations	No specific assessments completed - effects of eroding bank is unknown.
	B. Riparian Vegetation	1. As appropriate, augment vegetation at boulder rip-rapped area, either before/after/instead of (short term) reconstruction of pond inlet area, to improve stability here and replace hard rock materials with riparian vegetation providing water quality and stability benefits; 2. Make efforts to save existing trees, particularly sycamores currently threatened in the vicinity of the boulder rip-rap area.
Further Assessments/Monitoring		1. Continue survey monitoring of MCS 4 as needed to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream; 3. Assess pond inlet area, in context of any project extending into the top of MU17 with the constructed pond, associated berm and eroding clay valley wall hillside on the opposite bank.

Table 17. Management Unit 17 Recommendations and Intervention Level

Intervention Level	Full Restoration - (massive failing clay valley wall with bermed area opposite at private residential property)
Morphology	Generally unstable, primarily in entrenched stream type with multiple bermed areas and massive failing clay valley wall - this unit contains a "control" reach representing unstable conditions similar to the stream in MU3 prior to the stability restoration demonstration project.
Mapped/monumented bank conditions	15% eroding; 53% hardened (all berms); 2 MCSs
Eroding banks	see Monitoring Cross-Section summary tables for prioritization
Berms	53% (470 feet) - one associated with eroding bank area (see above), two others on left bank - evaluate for removal
Clay exposures	90 feet - associated with eroding bank area, see above
Japanese Knotweed	none
Culvert/bridge recommendations	none
Revegetation recommendations	1. In conjunction with any bank or stabilization work
Dumpsites	70 feet - medium priority, far back from stream
I. Flooding and Erosion Threats	Moderate - no structures threatened, continued failure of clay hillside may threaten property opposite
A. Infrastructure and Private Property	1. Constructed pond area - evaluate potential to reconfigure berms, or reconfigure and revegetate pond inlet and outlet areas to reduce inundation/concentration damages, allowing floodwaters access to the floodplain while minimizing property damage. No other structures threatened directly, no infrastructure.
B. History of Streamwork	1. Consider removing or reconfiguring, then revegetating, berms on the left bank in this unit to return floodplain access to the stream and reduce erosion pressure on both banks (particularly the eroding high terrace and valley walls at MCS 3 and 3.5) - these berms do not provide any protection to structures of infrastructure or improved property; 2. Evaluate berm along the right bank, across from massive failing valley wall, for reconfiguration and revegetation to continue to provide protection from property inundation (if desired) for constructed pond area, without concentrating flow behind the berm, and creating as much floodplain access as possible to reduce flood stage and erosion pressure on opposite bank.
C. Exposed Banks	1. Subject to priority, reconstruct and revegetate the reach associated with MCS 3 and 3.5 with a Full Restoration project, to create a naturally sustainable stream morphology and reduce continuing hillslope failure and bank erosion.
II. Water Quality Issues	Poor - large eroding high terrace and long failing clay valley wall contribute fine sediments
A. Sediment	1. Evaluate potential to regrade and revegetate eroding high terrace at MCS 3, if not implement a full restoration projects for the entire reach, to reduce sediment inputs from this bank area; 2. As appropriate, implementing a full restoration in the reach associated with MCS 3.5 is the only recommended solution to ongoing long-term water quality problems associated with bed, bank and hillslope clay exposures in this reach.
B. Dumping sites	1. Remove refuse materials from the 70 foot dumping area mapped in the floodplain area, behind a bermed area - revegetate any disturbed areas. This site is medium priority for dumping sites on Broadstreet Hollow, as it is on a slope away from the stream, not commonly in contact with the stream, though is quite extensive.
C. Other	No threats from road runoff or other pollutants documented
III. Stream Ecology Condition	Poor - large eroding high terrace and long failing clay valley wall with insufficient riparian vegetation
A. Aquatic habitat and populations	No specific assessments completed - effects of massive eroding valley wall hillslope and insufficient riparian vegetation is unknown.
B. Riparian Vegetation	1. Revegetate disturbed areas - no short term revegetation is recommended for eroding high terrace and failing clay valley wall without channel reconstruction; 2. Revegetate undervegetated berm areas on left bank, before/after/ instead of (short term) reconstruction or removal.
Further Assessments/Monitoring	1. In conjunction with evaluation of full restoration, as appropriate, conduct geotechnical and detailed channel and slope stability at failing valley clay wall/terrace hillslope at MCS 3 and 3.5; 2. Continue survey monitoring of MCSs as needed to reprioritize restoration, assess erosion rates; 3. Evaluate and assess restoration possibilities for constructed pond area to reduce ongoing property damage and preserve stream channel stability; 4. Visually inspect reach for colonization by Japanese Knotweed, present in MUs upstream.

Table 18. Management Unit 18 Recommendations and Intervention Level

Intervention Level		Assisted Recovery - (very narrow and straight section, highly managed and bounded by houses, private property or high terraces, forming a tightly controlled bridge approach for NYS Rte. 28)
Morphology		Generally unstable, confined and highly entrenched - more vulnerable to instability including bank erosion and downcutting
Mapped/monumented bank conditions		8% eroding; 54% hardened; 1 MCS - this reach is within the 100 year floodplain for Esopus Creek
Eroding banks		see Monitoring Cross-Section summary tables for prioritization
Berms		19% (170 feet) - evaluate for removal
Clay exposures		none
Japanese Knotweed		5% (50 feet) - remove and revegetate with competitive natives
Culvert/bridge recommendations		none
Revegetation recommendations		1. Undervegetated or failing hardened areas 2. In conjunction with any stabilization or berm removal
Dumpsites		16% (150 feet) - remove materials, medium priority
I. Flooding and Erosion Threats		High - potential for ongoing bank erosion and degradation through bridge approach
	A. Infrastructure and Private Property	1. Augment existing revetment on banks in bridge vicinity with additional vegetation to improve stability, particularly on steep slopes where mixes of dumped rock fill and other materials are used that have high failure rates; 2. Revegetate rip-rap or other hardening materials used throughout this reach, particularly where such measures were installed to protect private properties experiencing ongoing damage; 3. Additional revetments should be keyed into the stream bed and banks, and well vegetated to reduce ongoing maintenance needs.
	B. History of Streamwork	1. If no further bank hardening is planned for individual sections, revegetation/augmenting existing vegetation is highly recommended to preserve stability and reduce ongoing maintenance needs; 2. if further bank hardening measures are planned, addressing the stream morphology, flood processes and bank angle is highly recommended, to avoid installing materials too steep, or installing rock without keys at the toe, preventing or reducing future maintenance needs. Strongly consider alternatives to dumped rock fill. As above, revegetation is also highly recommended to increase stability in this narrow section, to slow flood waters and reduce stress on banks; 3. evaluate berms on left bank for removal or restructuring, revegetate disturbed sections, to return floodplain bench function and potentially reduce flood stage.
	C. Exposed Banks	1. Evaluate, for potential regrading and revegetating, eroding banks at MCS 2, including removal of the berm on the left bank to increase floodplain access and reduce stress on opposite bank.
II. Water Quality Issues		Fair - no clay exposures, though confined flows increase potential for downcutting and stream bed/bank erosion
	A. Sediment	1. Evaluate, for potential regrading and revegetating, eroding banks at MCS 2, including removal of the berm on the left bank to increase floodplain access and reduce stress on opposite bank - to reduce inputs of fine sediments from this bank; 2. Additional vegetation, and reconstruction or removal of berms, should slow flood waters and reduce erosive power, potentially reducing degradation and additional sediment from stream bed and bank sources; 3. Adding vegetation to edges of hardened areas should also reduce eddy scour and erosion at these vulnerable areas.
	B. Dumping sites	1. Remove refuse materials from the 150 foot dumping area mapped on the stream bank - revegetate disturbed areas. This site is medium priority for dumping sites on Broadstreet Hollow, as it is fairly sparse, though is commonly in contact with the stream and may pose a safety hazard (if not a water quality hazard).
	C. Other	1. Augment or replace vegetation in and around bridge abutment and road embankment areas for Rte 28, to reduce impacts from road runoff from Rte. 28 and the bridge.
III. Stream Ecology Condition		Poor - entrenched, poor riparian vegetation and concentrated flood flows with high velocities
	A. Aquatic habitat and populations	No specific assessments completed - impact of major stream bank/channel instability or constriction by berms is unknown.
	B. Riparian Vegetation	1. Replace or augment riparian vegetation, especially at recently hardened areas with exposed rock materials, and eroding areas at revetment boundaries and bermed areas; 2. Remove Japanese Knotweed in this unit, replace with competitive native species - follow-up monitoring is highly recommended to prevent recolonization.
Further Assessments/Monitoring		1. Continue survey monitoring of MCS 4 as needed to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for additional colonization by Japanese Knotweed, present in this and other MUs upstream.

Table 19. Management Unit 19 Recommendations and Intervention Level

Intervention Level	Assisted Recovery - (eroding bank at residential lawn area, potential instability associated with confluence area)	
Morphology	Generally stable, appropriate stream type for this valley setting, though some development and instability should be addressed (not associated with typically unstable confluence areas)	
Mapped/monumented bank conditions	38% eroding (20% active and unstable); 14% hardened; 1 MCS - this reach is within the 100 year floodplain for Esopus Creek	
Eroding banks	see Monitoring Cross-Section summary tables for prioritization	
Berms	8% (73 feet) - visually monitor for stability changes, stream impacts	
Clay exposures	none	
Japanese Knotweed	2% (15 feet) - remove and revegetate with competitive natives	
Culvert/bridge recommendations	none	
Revegetation recommendations	1. Eroding bank areas 2. Rte 28 embankment areas	
Dumpsites	none	
I. Flooding and Erosion Threats	Moderate - pond inlet, eroding residential lawn area	
	A. Infrastructure and Private Property	No infrastructure or structures threatened
	B. History of Streamwork	1. Visually inspect berms constructed to protect pond inlet, ensure they do not impact stream stability in the vulnerable confluence area. Ensure these areas remain well vegetated.
	C. Exposed Banks	1. Regrade and revegetate eroding bank at MCS 1, on the left at residential lawn area.
II. Water Quality Issues	Good - no clay exposures, one eroding bank contributes some fine sediments	
	A. Sediment	1. Regrade and revegetate eroding bank at MCS 1, on the left at residential lawn area to reduce sediment inputs.
	B. Dumping sites	None documented
	C. Other	1. Augment vegetation along road embankment downstream from Rte. 28 bridge, to reduce any impact from salt or other pollutants from road runoff.
III. Stream Ecology Condition	Good - healthy riparian vegetation in general, well shaded stream section	
	A. Aquatic habitat and populations	No specific assessments completed - impact of minor stream bank/channel instability is unknown. Undercut bank along right bank of MCS 1 may provide important cover for fish. Continue ongoing volunteer efforts by Trout Unlimited chapters at the mouth of Broadstreet Hollow, to ensure continued access by migrating trout species into this important spawning stream.
	B. Riparian Vegetation	1. Revegetate eroding left bank at MCS 1 (residential lawn area) either before/after/instead of (short term) reconstruction to improve shade and cover in this area; 2. Remove Japanese Knotweed in this unit, replace with competitive native species - follow-up monitoring is highly recommended to prevent recolonization.
Further Assessments/Monitoring	1. Continue survey monitoring of MCS 1 as needed to reprioritize restoration, assess erosion rates; 2. Visually inspect reach for additional colonization by Japanese Knotweed, present in this and other MUs upstream.	