Management Unit 16

Ulster County - Town of Shandaken
Warner Creek to Silver Hollow Bridge

Management Unit Description

This management unit begins at the Warner Creek confluence with Stony Clove Creek and continues approximately 1,366 ft. to the Silver Hollow Road Bridge. The drainage area ranges from 17.4 mi^2 at the top of the management unit to 26.5 mi^2 at the bottom of the unit, adding the significant Warner Creek drainage. The valley slope is 3.0% and stream water surface slope is 3.2%.

This highly modified unit presents a number of management challenges. A morphological transition at the confluence of Warner Creek manifests in marked change in valley form, channel slope, bed material size and cross-sectional area. Extensive infrastructure encroachment on both banks and at the abutments of two major stream crossings has resulted in a history of bank stabilization efforts, currently leading to channel incision. Aquatic habitat in this unit is severely impaired, and the exposure of glacial lake clays in the unit, as well as in the Warner Creek watershed, poses a threat to water quality. Restoration efforts in this unit should focus on establishing grade control, and enhancement of riparian vegetation and bank stability.

Summary of Recommendations Management Unit 16	
Intervention Level	Full Restoration
Stream Morphology	Conduct feasibility study on full restoration of channel stability through establishment of step-pool rock structures for grade, cross-section and planform control
Riparian Vegetation	None
Infrastructure	Stabilize embankments through channel restoration and grade control
Aquatic Habitat	Improve low flow passage, increase shallow margin areas and enhance overhead cover
Flood Related Threats	Resurvey National Flood Insurance Program (NFIP) maps to more accurately reflect the active stream channel
Water Quality	Mitigate erosion of clay exposures in bed and banks
Further Assessment	Ongoing monitoring of bank erosion monitoring sites #21 & #22 Evaluate Bank Erodibility Hazard Index at erosion sites on Warner Creek and prioritize for treatment those with water quality implications (clay exposures)

Historic Conditions

As the glaciers retreated about 12,000 years ago, they left their "tracks' in the Catskills. Rubin (1996) mapped the presence of glacial *lodgement till* along the entire corridor of this management unit (See Section 2.4, Geology of the Stony Clove Creek, for a description of these deposits). As described below, clay-rich lodgment till was exposed in stream banks in several places and is presumably covered by the extensive rip-rap revetment in the lower portion of this unit. Stream channels incised into lodgement till tend to have unstable stream banks that are often over-steepened and fail by episodic mass wasting.

By 1875, when F.W. Beers published his Atlas of Ulster County, the road up Silver Hollow had led to settlement along Warner Creek as far as the Woodstock town line, with several sawmills in operation (Fig. 2). The watershed further upstream on this, the largest of the tributaries of Stony Clove Creek, had already been tapped for hemlock by Colonel Edwards during the mid-1800s via his bark road extension at Edgewood. Hardwood logging also reached into the top of Silver Hollow.

Figure 2 Excerpt from F.W. Beers 1875 Atlas of Ulster County

Figure 3 Looking upstream under the railroad trestle, toward Warner Creek, Courtesy of the Gale Collection

This resource use undoubtedly had a significant impact on the hydrology and drainage network of Silver Hollow, ultimately increasing the sediment load supplied to the Stony Clove from the newly deforested landscape.

The Stony Clove and Kaaterskill Railroad began operations in 1883, and it is likely that construction of the bridge abutments involved blasting at the stream margin for the footings (Fig. 3).

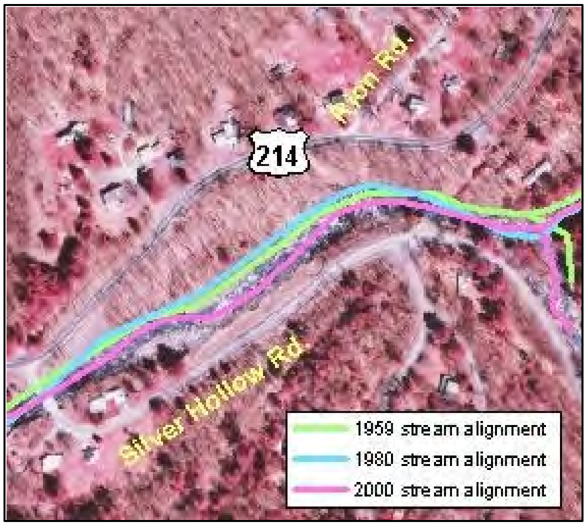


Figure 4 Historic stream alignments in Management Unit 16

As seen from the historical stream alignments, the *planform* of the channel has remained fairly stable over the years, owing primarily to confinement by the valley form (Fig. 4).

There has been some channel movement in the middle of the management unit, beginning at the old railroad abutments. Between 1980 and 2000, the stream channel was shifted to the left, toward Silver Hollow Road. Rip-rap revetment was placed on the right banks, which during the 1996 flood, caused severe erosion on the left stream bank. Ulster County Soil and Water Conservation District (UCSWCD) and the Natural Resources Conservations Service (NRCS) then installed rip-rap pavement on the left bank.

Figure 5 December 2000

According to available NYS DEC records there have been four stream disturbance permits issued in this management unit.

In 1989, near the top of the management unit, The Town of Shandaken was issued a permit to install 90 ft. of rip-rap on the left bank to stabilize an eroding embankment on Silver Hollow Road. After the 1996 flood, an emergency permit was issued to James Fergunson to install rip-rap and remove 100 yd^3 of gravel and debris. In 1997, John Horn was issued a permit to repair 240 ft. of rip-rap wall (Inset F & Fig. 6).

Figure 6 John Horn's property after 1996 Flood

In 1983, the NYS DOT was issued a permit to replace the Silver Hollow Bridge (Inset E). As the stream banks adjacent to this bridge had experienced serious erosion problems in the past, extensive rip-rap was placed on both stream banks at the new bridge, with concrete ajax structures and sheet piling to secure the toe of the banks.

Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2001 stream feature inventory revealed that 11% (303 ft.) of the stream banks exhibited signs of active erosion along 1,366 ft. of total channel length (Fig. 1). Revetment has been installed on 40% (1,103 ft.) of the stream banks. No berms were identified in this management unit at the time of the stream feature inventory.

Stream Morphology

The following description of stream morphology references insets in the foldout Figure 18. "Left" and "right" references are oriented looking downstream, photos are also oriented looking downstream unless otherwise noted. Italicized terms are defined in the glossary. This characterization is the result of a survey conducted in 2001.

Stream morphology, or shape (i.e., slope, width and depth), alternates between "F" and "B" *stream types* through this unit (Fig. 7, See Section 3.1 for description of stream types).

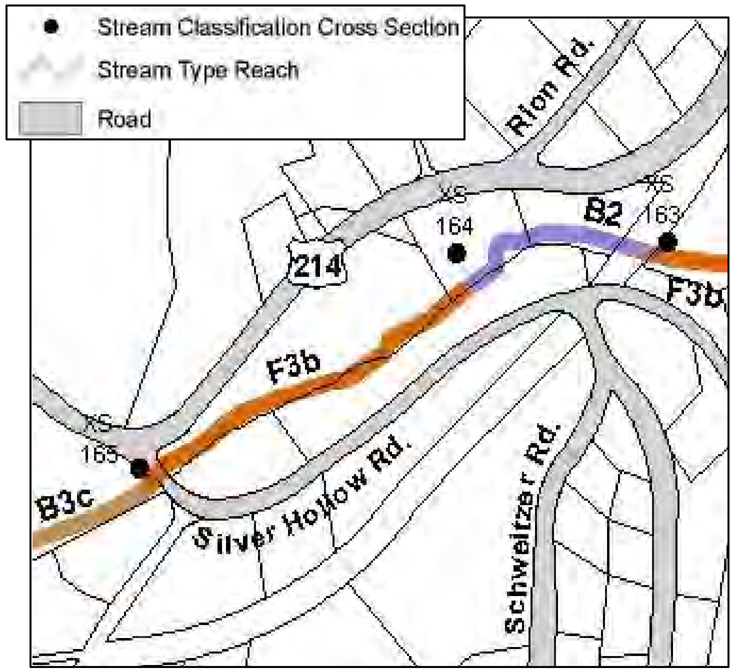


Figure 7 Cross-sections and Rosgen stream types in Management Unit 16

Constrained by road embankments, railroad crossing and valley form, this unit has been extensively manipulated. Bed material size is very large through much of the reach, and slope is quite steep. This unit includes the confluence of Warner Creek, contributing a 50% increase in drainage area. Clay exposures provide evidence of incision in the middle reaches of the unit, while just upstream of the Silver Hollow Road Bridge typical backwater aggradation is occurring.

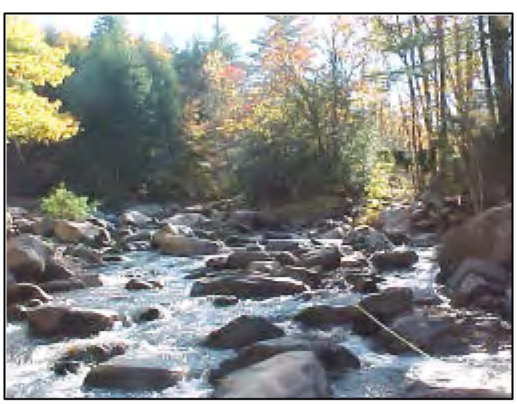


Figure 8 Cross-section 163
Stream Type F3b looking upstream

Management unit #16 begins with a 160 ft. reach of F3b stream type (Fig. 8). The channel is *entrenched*, or confined within the stream banks during high flood events. The slope of the stream channel is extremely steep at 4.1%. The dominant bed material is large cobble, but there are many large boulders.

At the top of this reach, the Warner Creek tributary enters the Stony Clove Creek from a split channel on the left stream bank (Fig. 9 & Inset D). Warner Creek is the largest Stony Clove Creek tributary, its headwaters originating on Plateau Mountain in the Town of Hunter, and running 10.1 miles along Silver Hollow Road into the Town of Woodstock. After flowing through a section of undeveloped state land, it enters into the Town of Shandaken, running along Silver Hollow Road before entering the Stony Clove Creek just before Chichester.

Figure 9 Warner Creek

The entire length of Warner Creek is classified as C(t) under the NYS DEC best usage classification system. This classification indicates the best usage of Warner Creek is supporting fisheries, including trout populations and non-contact activities.

Significant turbidity contributions from Warner Creek are apparent during even small storm flows, when visible contrast is evident where Warner Creek's more turbid flow enters the Stony Clove's. Downstream from the Warner Creek confluence, approximately 126 ft. of stacked rock wall has been installed on the left stream bank (Fig.10).

Figure 10 Stacked Rock Wall

At the top of this reach the stream passes between two relic railroad abutments built for the Stony Clove and Kaaterskill Railroad, which ran through the valley from 1883 to 1939 (Fig.11). At the top of the left abutment is a small parking area. The public uses a path adjacent to this abutment to access the creek. Foot traffic combined with runoff from the road is slowly eroding the stream bank.

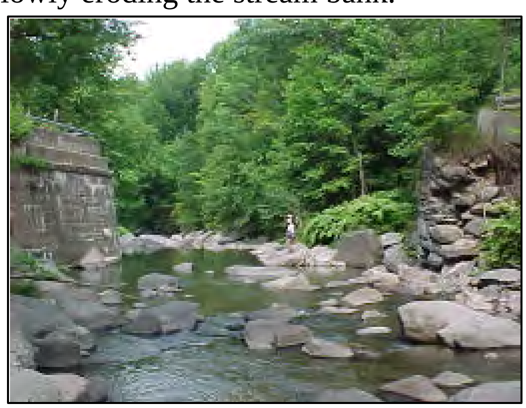


Figure 11 Abandoned Railroad Abutments

At the base of the right abutment is a clay exposure. Clay inputs into a stream are a serious water quality concern because they increase *turbidity*, degrade fish habitat, and can act as a carrier for other pollutants and pathogens.

Beyond the abutments, the channel gains limited access to its floodplain on the right bank, becomes moderately entrenched and the stream type changes to B2 for the next 443 ft. stream reach. The slope of this reach decreases but remains steep at 3.5%. The dominant bed material size increases significantly to large boulders.

Figure 12 Federally Designated Wetland

As the stream passes the abutment it bends to the left, and 5.1 acres of riparian area here have been designated by the U.S. Fish and Wildlife Service as wetland, classified as palustrine, forested, broad-leaved deciduous, and temporarily flooded (Fig. 12). The extent of this wetland, however, has been modified by infrastructure maintenance. Wetlands are recognized as important features in the landscape that provide numerous beneficial functions, including protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow during dry periods. (See Section 2.6 for wetland type descriptions and regulations)

The left stream bank continues to be exposed to significant *shear stress*, or force of flowing water, during flood flows, causing toe erosion at bank erosion monitoring site #21 (Inset H). This erosion site is approximately 216 ft. in length with an area of 6,054 ft^2. This erosion has left the face of the stream bank devoid of vegetation, and exposed clay deposits (Inset C). Large cracks in the hillslope have appeared (see curved shadow on plan view near Inset H location), indicating a potential for mass failure. Silver Hollow Road is located at the top of this bank and will be threatened if this erosion worsens.

The Bank Erodibility Hazard Index (*BEHI*) score of site #21 is ranked "Very High", the second highest prioritization category in terms of its vulnerability to erosion. This bank erosion site is considered a high priority for restoration because of its threat to infrastructure and water quality.

Figure 13 Cross-section 164 Stream Type F3b

At the end of the erosion site, the channel becomes entrenched, as stream type transitions back into F3b for the remaining 763 ft. of this management unit (Fig.13). Channel slope in this reach decreases but remains steep at 2.5%. Dominant bed material decreases to cobble but large boulders remain abundant.

Beginning at the top of this reach, the left stream bank has been armored with rip-rap paving (Inset G). This rip-rap was installed by UCSWCD and NRCS in response to severe erosion after the 1996 flood which threatened the stability of Silver Hollow Road.

Bank erosion monitoring site #22 (Inset B) is located along the right stream bank near the middle of this reach. Erosion on the bed and bank has led to channel incision, and consequently exposed a large deposit of glacial lake clay. The entire 197 ft. of stream bank is composed of this clay, which contributes turbidity during even small storm events.

The BEHI score of site #22 is ranked "Very High", the second highest prioritization category in terms of its vulnerability to erosion. This bank erosion site is considered a high priority for restoration because of its significant threat to water quality.

Restoration of the two erosion sites discussed above should be considered in the context of a larger restoration project area to extend from the railroad bridge abutments, to the NYS Route 214 bridge at Chichester, at the downstream end of Management Unit #18. Taken as a whole, this larger project would represent the highest priority restoration in the Stony Clove Creek. Recommendations to restore the reaches in Management Unit #16 include installing a series of large step/pool structures to control grade and direct erosive forces away from banks. A floodplain bench, vegetated with native tree and shrub species, should be established between the active channel and the eroding banks. In-depth survey and design would be required to plan a stream restoration project at this site. Providing opportunities for activities such as fishing and kayaking should be considered as a secondary objective of the project.

Proceeding downstream, there is a large gravel bar along the left stream bank. Gravel bars help maintain channel stability during flood events. In stable streams, the bars will erode away while the channel is in flood stage. The bars then are rebuilt as flow decreases, helping the stream maintain its stability by reestablishing its pools and riffles. If gravel bars are removed, these processes do not occur and instead, the flood water often dissipates its energy by eroding banks and scouring the stream bed.

As the stream approaches the Silver Hollow Road Bridge, both stream banks have been stabilized. On the left stream bank, 201 ft. of rip-rap has been installed to protect the Horn property (Inset F). Described in the stream disturbance permit section, this stream bank has suffered significant damage during high flow events.

Figure 14 "Ajack" structures

On the right stream bank, the NYS DOT installed 310 ft. of rip-rap when the bridge was replaced. NYS Route 214, located at the top of this high steep stream bank, would likely be threatened if the toe of this bank were exposed to severe erosion.

At the end of this management unit the channel passes under Silver Hollow Road Bridge (BIN #22244560), replaced in 1983 by NYS DOT (Inset E). Concrete "ajack" structures were placed at the water's edge to secure the toe of the bank and control abutment scour (Fig.14). The channel flattens as it passes under the bridge.

Sediment Transport

Streams move sediment as well as water. Channel and floodplain conditions determine whether the reach aggrades, degrades, or remains in balance over time. If more sediment enters than leaves, the reach aggrades. If more leaves than enters, the stream degrades (See Section 3.1 for more details on Stream Processes).

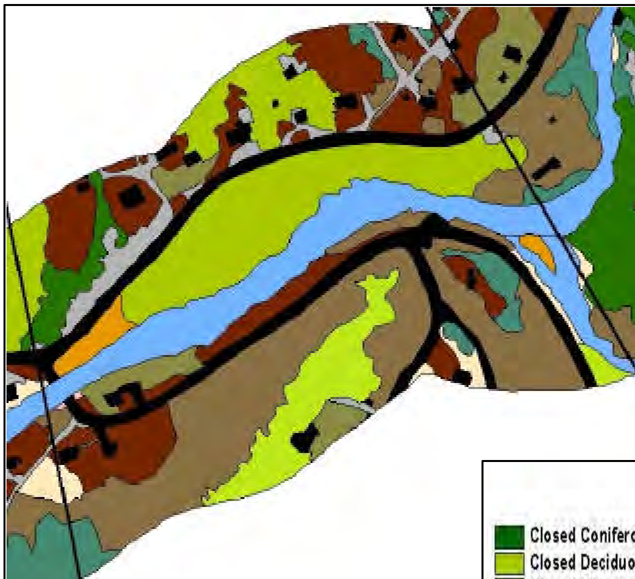
Sediment transport in this unit is extremely dynamic. Warner Creek adds an additional 50% to the drainage area, dramatically increasing stream power. Valley confinement, the abandoned railroad abutments and channel slope exacerbate these conditions, focusing stream power and creating a backwater condition above bankfull flow. The extremely large bed material, especially in the middle reaches of the unit, increases channel roughness, but also increases local variability in flow velocities, facilitating transport through the reach. This material also appears to be thwarting headward migration of incision, except where clays have become exposed in the bed. As the channel passes under the Silver Hollow Road Bridge, the bed appears to be aggrading.

Riparian Vegetation

One of the most cost-effective methods for landowners to protect streamside property is to maintain or replant a healthy buffer of trees and shrubs along the bank, especially within the first 30 to 50 ft. of the stream. A dense mat of roots under trees and shrubs bind the soil together, and makes it much less susceptible to erosion under flood flows. Grass does not provide adequate erosion protection on stream banks because it has a very shallow rooting system. Interplanting with native trees and shrubs can significantly increase the working life of existing rock rip-rap placed on streambanks for erosion protection. *Riparian*, or streamside, forest can buffer and filter contaminants coming from upland sources or overbank flows. Riparian plantings can include a great variety of flowering trees and shrubs native to the Catskills. Native species are adapted to regional climate and soil conditions and typically require little maintenance following installation and establishment.

Plant species that are not native can create difficulties for stream management, particularly if they are invasive. Japanese knotweed (*Polygonum cuspidatum*), for example, has become a widespread problem in recent years. Knotweed shades out other species with it's dense canopy structure (many large, overlapping leaves), but stands are sparse at ground level, with much bare space between narrow stems, and without adequate root structure to hold the soil of streambanks. The result can include rapid streambank erosion and increased surface runoff impacts.

An analysis of vegetation was conducted using aerial photography from 2001 and field inventories (Fig. 15, Appendix A). Japanese knotweed occurrences were documented as part of the MesoHABSIM aquatic habitat inventory conducted during the summer of 2002 (Appendix B).



The predominant vegetation type within the 300 ft. riparian buffer is forested (61%) followed by herbaceous (16%). Areas of herbaceous (non-woody) cover present opportunities to improve the riparian buffer with plantings of more flood-resistant species. *Impervious* area (12%) within this unit's buffer is primarily the NYS Route 214 and Silver Hollow Road along with private residences.

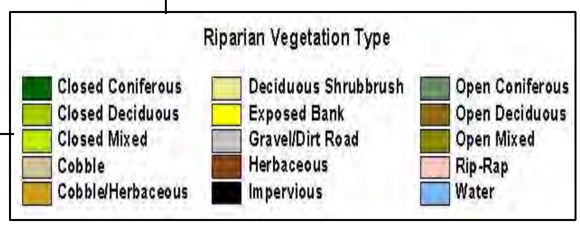


Figure 15 Riparian vegetation map for Management Unit 16

In June 2003, suitable riparian improvement planting sites were identified through a watershed-wide field evaluation of current riparian buffer conditions and existing stream channel morphology (Fig. 16). These locations indicate where plantings of trees and shrubs on and near stream banks can help reduce the threat of serious bank erosion, and can help improve aquatic habitat as well. In some cases, eligible locations include stream banks where rock rip-rap has already been placed, but where additional plantings could significantly improve stream channel stability in the long-term, as well as biological integrity of the stream and floodplain. Areas with serious erosion problems where the stream channel requires extensive reconstruction to restore long-term stability have been eliminated from this effort. In most cases, these sites can not be effectively treated with riparian enhancement alone, and full restoration efforts would include re-vegetation components. Due to the need for extensive restoration throughout this unit, individual planting sites were not identified within this management unit.

Flood Threats

Inundation

As part of its National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) performs hydrologic and hydraulic studies to produce Flood Insurance Rate Maps (FIRM), which identify areas prone to flooding. Initial identification for these maps was completed in 1976. Some areas of these maps may contain errors due to stream channel migration or infrastructure changes over time.

Figure 16 100-year floodplain boundary in Management Unit 16

To address the dated NFIP maps, the NYS DEC Bureau of Flood Protection is currently developing floodplain maps, using a new methodology called Light Detection And Ranging (LIDAR). LIDAR produces extremely detailed and accurate maps, which will indicate the depth of water across the floodplain under 100-year and other flood conditions. These maps should be completed for the Stony Clove Watershed in 2004.

According to the NFIP map, there are two houses within the 100-year floodplain boundary in this management unit (Fig. 16). The current NFIP maps are available for study at the Greene and Ulster County Soil & Water Conservation District offices.

Bank Erosion

Most of the stream banks within the management unit are stable, with only 11% of the stream banks experiencing major erosion. There are two bank erosion sites totaling 6749 ft^2 in area within this management unit. Channel incision in the middle reaches of the unit, however, has undermined the toe of the high Silver Hollow Road embankment, initiating a large slump, which is evident from an emerging scarp line. In addition to the water quality threat associated with the clay exposed at these erosion sites, conditions here also present a hazard to infrastructure.

Infrastructure

While there are no immanent threats to infrastructure in this management unit, bank failures at bank erosion monitoring sites #21 (Inset H) and #22 (Inset B) could threaten existing roadways if stabilization measures are not undertaken.

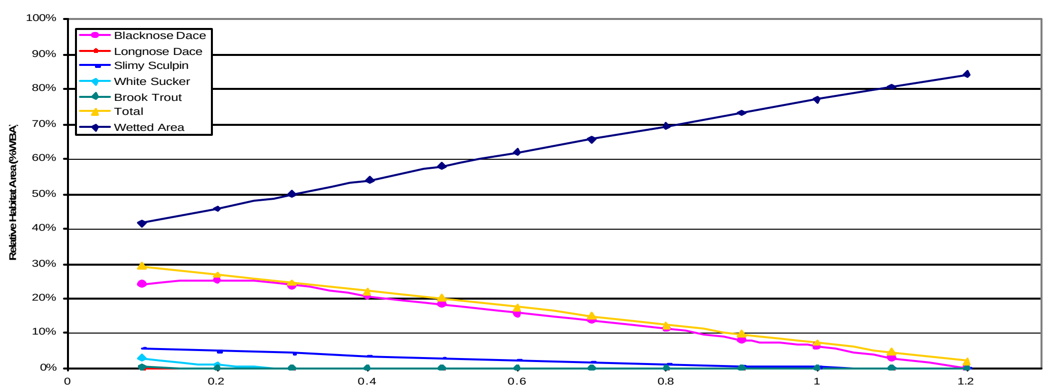
Bridges can be highly susceptible to damage or ongoing maintenance problems because they require the stream to pass through a narrow area during flood events. Bridge openings should be sized to eliminate backwater effects through at least bankfull stage, and to convey most larger flood flows without significant damage. Because many bridge approaches are constructed by filling in floodplain areas to raise the roadbed, additional culvert drainage in the floodplain under bridge approaches can also help reduce the risk of bridge failure. Floodplain drainage can also lower flood elevations and minimize sediment deposition upstream of the bridge and bank erosion or scour below the bridge. While this bridge does not appear to be backwatering at bankfull flows, some upstream aggradation is evident.

Aquatic Habitat

Aquatic habitat was analyzed for each management unit using Cornell University Instream Habitat Program's model called MesoHABSIM. This approach attempts to characterize the suitability of instream habitat for a *target community* of native fish, at the scale of individual stream features (the "meso" scale), such as riffles and pools. Habitat is mapped at this scale for a range of flows. Then the suitability of each type of habitat, for each species in the target community, is assessed through electrofishing. These are combined to predict the amount of habitat available in the management unit as a whole. The habitat rating curves in the figure below depict the amount of suitable habitat available at different flows. See Appendix B for a more detailed explanation of methods.

Management unit #16 is much deeper and somewhat faster than the other units, with highly diverse hydraulics (Fig.17). Boulders are abundant and no shallow margins exist. *Wetted area* covers 80% of bankfull wetted area and increases constantly with flow. This unit, like management unit #15, has a steep, entrenched channel, where habitat becomes more uniform in response to flow increases beginning at 0.1 cfsm. As a result, of the target community, only blacknose dace and slimy sculpin are supported, and only at the lowest observed flows. Habitat even for these two species falls to zero with increasing flows. Rainbow and brown trout have only minute amounts of suitable habitat through the entire range of flows. Barely any habitat overlaps exist in this unit. This unit represents the least suitable habitat for the target community in the entire study area.

The unit is characterized by physical (and potentially thermal) low flow barriers. Recommendations for habitat improvements in this unit include 1) developing step pool structures which facilitate passage at low flows and increase the quantity of shallow margins, and 2) establishing a stable bankfull bench vegetated with native trees and shrubs to provide overhead cover and shading. (See Section 6.6)



Rating curve for relative habitat area versus flow for Management Unit 16

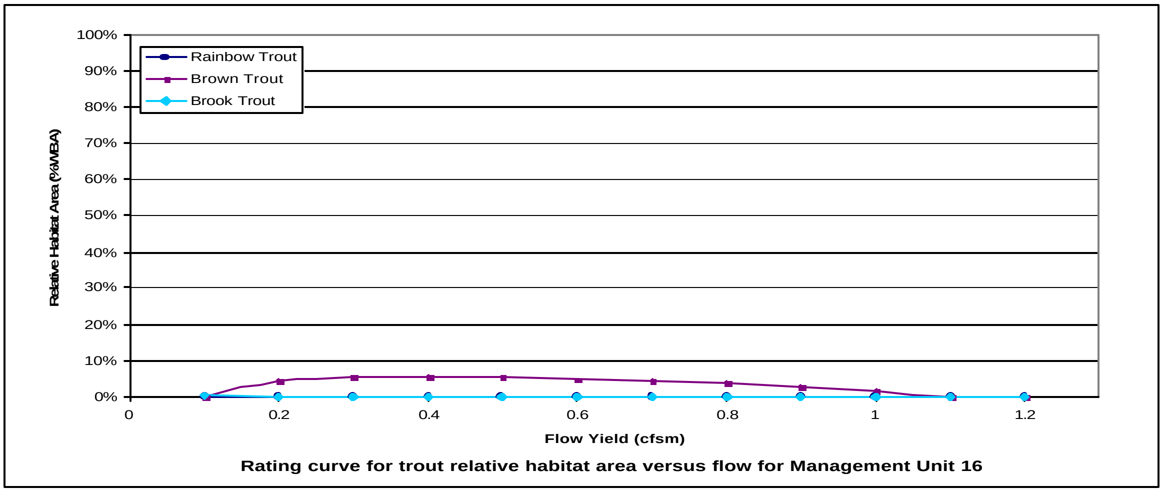


Figure 17 MesoHABSIM habitat rating curves for Management Unit 16

Water Quality

Clay exposures and sediment from stream bank and channel erosion pose a significant threat to water quality in Stony Clove Creek. Clay and sediment inputs into a stream may increase *turbidity* and act as a carrier for other pollutants and pathogens. There are significant clay exposures which need to be addressed in this management unit.

Contributions of suspended sediment from Warner Creek appear to add considerably to the overall turbidity of the Stony Clove Creek, and represent the most significant water quality threat in the management unit.

Stormwater runoff can also have a considerable impact on water quality. When it rains, water falls on roadways and flows untreated directly into Stony Clove Creek. The cumulative impact of oil, grease, sediment, salt, litter and other unseen pollutants found in road runoff can significantly impact water quality. No stormwater culverts were identified in this management unit at the time of the stream feature inventory. However, 946 feet of road lies within 50 ft. of the stream, and the Silver Hollow Road Bridge represents an even more direct source of contaminants.

Nutrient loading from failing septic systems is another potential source of water pollution. Leaking septic systems can contaminate water making it unhealthy for swimming or wading. There are many houses located in close proximity to the stream channel in this management unit. These homeowners should inspect their septic systems annually to make sure they are functioning properly. Each household should be on a regular septic service schedule to prevent over-accumulation of solids in their system. Servicing frequency varies per household and is determined by the following factors: household size, tank size, and presence of a garbage disposal. Pumping the septic system out every three to five years is recommended for a three-bedroom house with a 1,000-gallon tank; smaller tanks should be pumped more often.

The New York City Watershed Memorandum of Agreement (MOA) allocated 13.6 million dollars for residential septic system repair and replacement in the West-of-Hudson Watershed through 2002. Eligible systems included those that were less than 1,000-gallon capacity serving one- or two-family residences, or home and business combinations (CWC, 2003). One homeowner in this management unit made use of this program to replace or repair a septic system.