Management Unit 18

Ulster County - Town of Shandaken
Between Cross Section 172 & 173 to Chichester Bridge

Management Unit Description

This management unit begins between Cross Section 172 and 173, continuing approximately 1,229 ft. to the Chichester Bridge. The drainage area ranges from 26.9 mi^2 at the top of the management unit to 27.0 mi^2 at the bottom of the unit. The valley slope is 1.7% and stream water surface slope is 1.8%.

Widespread instabilities characterize this management unit, evident from the high percentage of armored banks noted at the time of the 2001 stream feature inventory. Historical channel realignment has resulted in incision upstream and aggradation downstream, aggravated by backwater conditions at the Chichester Bridge. This highly modified unit presents a number of management challenges. Aquatic habitat in this unit is impaired, and the exposure of glacial lake clays in the unit poses a threat to water quality. Restoration efforts in this unit should focus on establishing grade control, reduction of entrenched conditions in the upper reach, and enhancement of riparian vegetation and bank stability. Conduct feasibility study of the installation of floodplain drains at the Chichester Bridge.

Summary of Recommendations Management Unit 18	
Intervention Level	Full Restoration
Stream Morphology	Conduct feasibility study of full restoration of channel stability through installation of rock structures for grade, cross-section and planform control
Riparian Vegetation	Riparian plantings at identified planting site (PS # 48)
Infrastructure	Conduct feasibility study of increased floodplain conveyance through the Chichester Bridge
Aquatic Habitat	Improve overhead cover and riffle/pool diversity and complexity, and reduce sediment inputs
Flood Related Threats	Resurvey National Flood Insurance Program (NFIP) maps to more accurately reflect the active stream channel
Water Quality	Reduce sediment loading through restoration of bed and bank stability
Further Assessment	Geotechnical assessment of bank erosion monitoring site #24

Historic Conditions

As the glaciers retreated about 12,000 years ago, they left their "tracks' in the Catskills. Rubin (1996) mapped the presence of 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 is extensively exposed in the left stream bank along the upper reach of this unit.

Figure 2 Revetment along a till bank, Stony Clove Creek Courtesy of the Gale Collection

Figure 3 Looking upstream over the NYS Route 214 bridge at Chichester Courtesy of the Gale Collection

Stream channels incised into lodgement till tend to have unstable stream banks that are often over-steepened and fail by episodic mass wasting. As a result, historically they were frequently revetted, as shown in the image of log cribbing in Figure 2. Logs were plentiful, and able to be moved into place readily with a horse team at low flow, but big enough to withstand being pummelled by ice and boulders during spring floods.

While these glacial soils are susceptible to erosion on steep streambanks, they nonetheless will recover their vegetation (Fig. 3).

As seen from the historical stream alignments, the channel alignment has changed significantly over the years (Fig. 4).

Figure 4 Historic stream channel alignments in Management Unit 18

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

After the 1987 flood event, an emergency permit was issued to John Macko to repair log cribbing (Inset F) and rip-rap (Inset E) along his stream bank. In 1996, another permit was issued to John Macko to repair the log cribbing using gravel taken from the stream as backfill and to retrieve rip-rap washed into the stream during the flood. In 1996, DeSilva, Rainer, Biewald, et al. was issued an emergency permit to re-channel the stream through a gravel deposit, skimming gravel for use as backfill, and to stockpile large rocks for rip-rap (Inset C).

Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2001 stream feature inventory revealed that 25% (607 ft.) of the stream banks exhibited signs of active erosion along 1,229 ft. of total channel length (Fig. 1). Revetment has been installed on 38% (937 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 17. "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) changes several times in this unit (Fig. 5), creating small reaches with differing morphologic characteristics, which are classified as different *stream types* (See Section 3.1 for stream type descriptions).

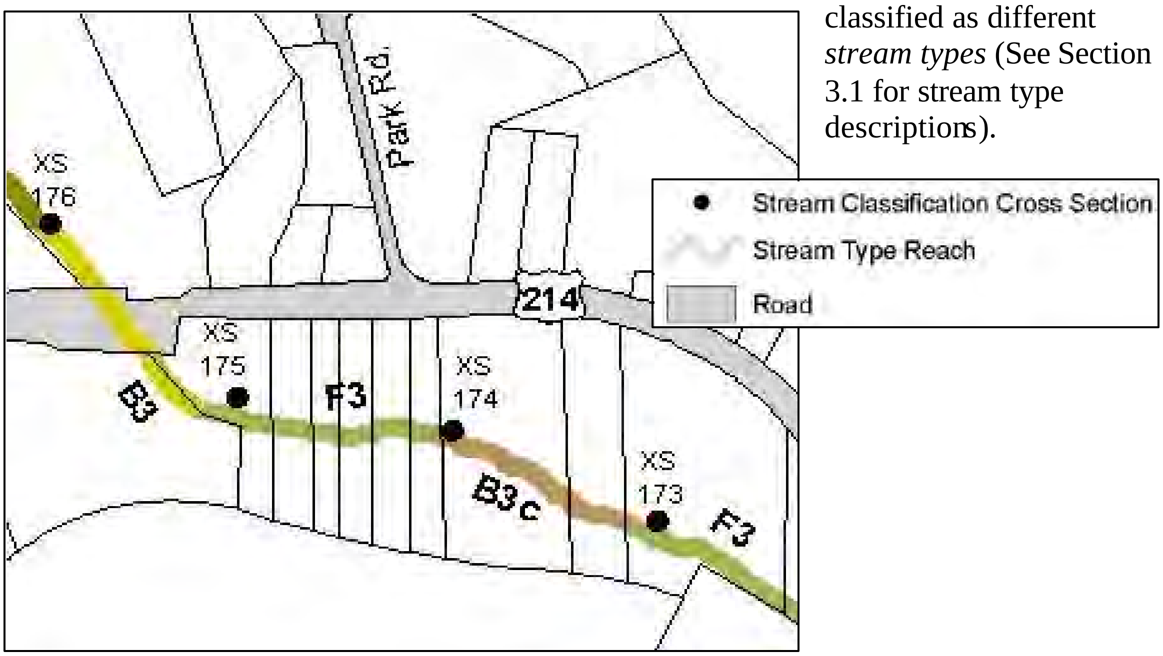


Figure 5 Cross-sections and Rosgen stream types in Management Unit 18

Entrenchment in this management unit is controlled in the upstream reaches by a high valley wall above the left bank. As the channel departs from the toe of the steep valley wall, entrenchment moderates, and bar development is apparent. Widespread revetment installations have limited the belt width of the meandering downstream reaches.

Figure 6 Severe Bank Erosion Stream Type F3

Management unit #18 begins with a 315 ft. reach of F3 stream type (Inset D). The channel is *entrenched*, or confined within the stream banks during high flood events. The channel slope is 1.9% and the bed material is dominated by cobble but there are many large boulders.

Beginning at the top of this management unit, there is approximately 607 ft. of severe erosion (Inset H) on the left stream bank. This is a continuation of bank erosion site #24 discussed in the previous management unit.

The *thalweg*, or deepest part of the stream channel flows up against the left valley wall (Fig. 6). The hillslope is being undermined by toe erosion, resulting in the mass wasting of the bank. This erosion has left the face of the stream bank unvegetated. The exposed lodgement till soil has a high silt and clay content, contributing sediment through both *wet and dry ravel* and yielding a significant suspended sediment load during rainfall events. 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.

Near the end of this reach the streambed has scoured resulting in a lowering of the stream bed elevation, leaving the channel deeply incised. The high right stream bank is faced with large stream boulders. At the top of this bank is a cleared residential lot which is currently being developed.

Restoration of the erosion site discussed above should be considered in the context of a larger restoration project area, to extend from the railroad bridge abutments in Management Unit #16, 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 #18 include installing a series of rock vane structures to control grade and direct erosive forces away from banks. A lower, bankfull 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, including geotechnical assessment of the high bank. Providing opportunities for activities such as fishing and kayaking should be considered as a secondary objective of the project.

There are two federally designated wetlands within this management unit (Fig. 7). The larger wetland, which is 2.5 acres in size, is classified as palustrine scrub-shrub, broad-leaf deciduous, and temporarily flooded (PSS1A). The smaller wetland, which is 1.2 acres in size, is riverine upper perennial, with an unconsolidated shore, and is seasonally flooded (R3USC).

Figure 7 Federally Designated Wetlands

Wetlands are 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)

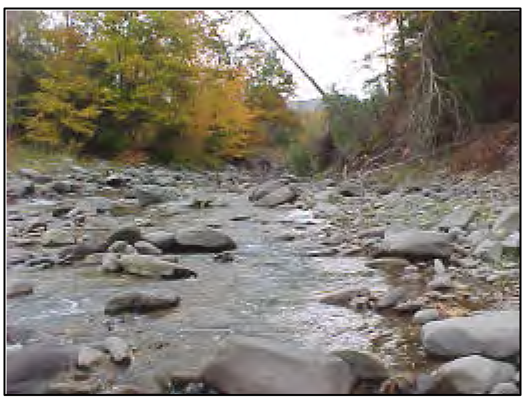


Figure 8 Cross-section 174
Stream Type B3c looking upstream

As stream slope decreases to 1.3%, the stream type transitions to B3c for this 388 ft. reach (Fig. 8). The channel straightens and becomes moderately entrenched as it gains limited access to its floodplain towards the end of the reach. The left stream bank decreases in height but continues to erode throughout this reach.

Proceeding downstream, the bankfull channel widens but the floodplain once again becomes entrenched as the stream type reverts back to F3. The slope of this 295 ft. reach steepens to 1.9%.

Rip-rap has been installed along 286 ft. of the right stream bank to protect several residential yards at the top this bank (Inset C). Significant channel management has taken place in this reach over the years. A large gravel bar has formed 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. In response to channel alignment alterations that occurred in the 1996 flood, this channel was realigned to the left, through this gravel bar. Deposited gravel was excavated for use as backfill on the right bank. Large stream rocks were also removed from the stream channel for use as rip-rap.

As the channel widens and gains limited access to its floodplain, the stream type changes to B3 for the remaining 231 ft. of this management unit (Fig. 9).

Figure 9 Cross-section 175
Stream Type B3

This reach is overwide. Deposition of bed materials is common in overwide channels because they lose their ability to transport the stream's *bedload*. Under these conditions streams often *aggrade*, or rise in stream bed elevation due to excessive deposition. A large gravel bar has formed along the right stream bank. As can been seen in the aerial photograph (Fig. 17), aggradation often causes the stream to become divided into multiple threads.

The thalweg flows directly against the outside of the left meander bend of this reach, causing repeated erosion damages over the years due to the high *shear stress* endured by this bank during flood events. This bank has been heavily armored with 85 ft. of rip-rap (Inset G) and 112 ft. of log cribbing (Inset F and Fig. 10) to protect the private residence at the top of the bank.

Due to an exceptionally high amount of precipitation between August and December 2003, this log cribbing has deteriorated, leaving the residence vulnerable. The landowners plan to install a stacked rock wall, tentatively scheduled to be built in summer 2004, to protect their property. To ensure this stacked rock wall is effective, a solid footing for the wall must be *keyed-in*, or dug into a trench, below the level of streambed scour. If possible, trees or shrubs should be planted through the rock wall as it is being built. The rootmass of these plantings will add to the cohesive strength behind the wall, while also improving the aesthetics of the wall. Silt fabric should be laid behind the rock wall to keep fine soil material from filtering out through the cracks in the rocks when the soil is saturated. This *piping* of soil through the revetment can result in so much soil loss that the bank above the wall may collapse. The potential for this type of collapse on this bank is considered high, because the bank extends well above height of the wall, and these conditions will produce high *hydrostatic pressure* behind the wall during wet years. The soils in this area are a mixture of clays, sands and gravels, often in very stratified layers

Figure 10 Log cribbing August 16, 2001

which can move easily under the pressure of *artesian springs*. The stacked rock wall should extend only slightly higher than the floodplain on the opposite side of the stream and *bioengineering* planting options should be considered to stabilize the bank above the wall.

As the stream approaches the Chichester Bridge (NYS Route 214), both stream banks have been stabilized. Rip-rap has been installed along 384 ft. of the right stream bank (Inset B). At the top of this bank are several residential backyards. Rip-rap has also been installed along 141 ft. of the left stream bank (Inset E).

At the downstream end of this management unit the stream passes under the NYS Route 214 Bridge (BIN #1041240). In 1991, the NYS DOT replaced this bridge (Inset A).

Figure 11 NYS Route 214 bridge

As mentioned previously, a large gravel bar has formed along the right stream bank (Fig. 11). Gravel deposits upstream of bridges are commonly caused by inadequate sizing of the bridge opening. An undersized bridge opening causes water to back up upstream of the bridge, reducing stream velocity, which results in sediment deposition. In high stage, the floodwater may seek conveyance through alternative paths, forming new channels around the bridge constriction, as appears to have happened at this site. Additional *floodplain drainage*, using culverts set at the floodplain elevation under the north bridge approach, may help mitigate this problem. While bankfull flows appear to flow freely through this bridge, higher flows appear to backwater, resulting in the upstream aggradation.

Sediment Transport

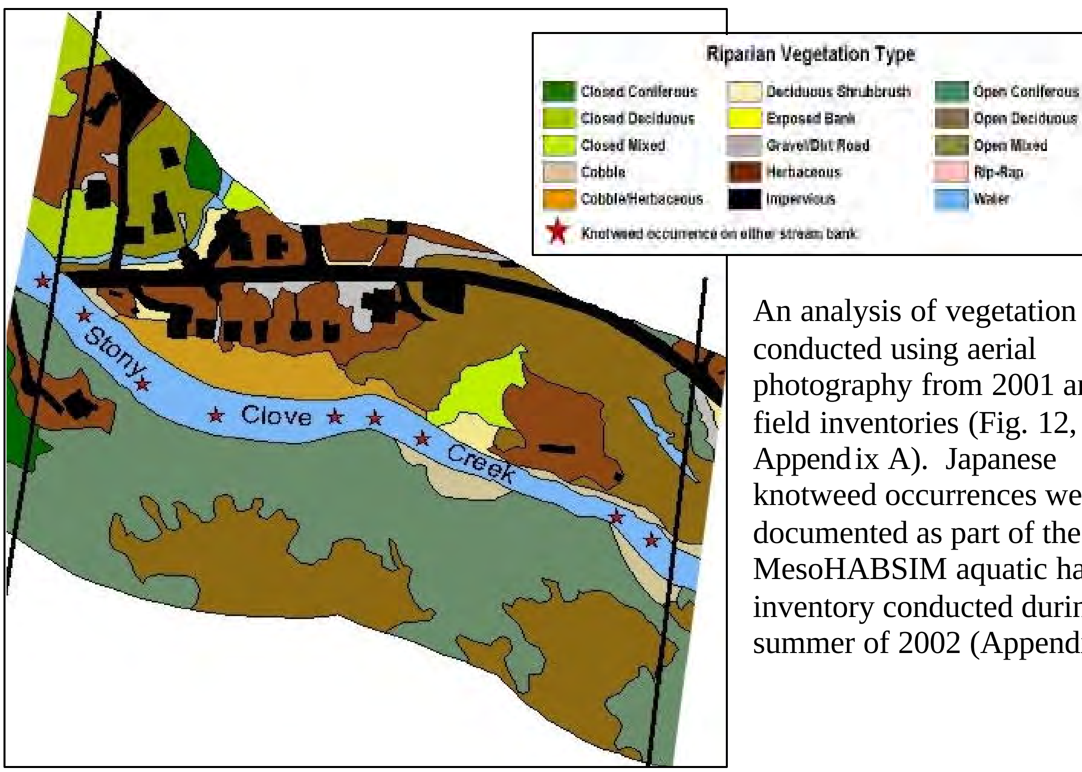
Streams move sediment as well as water. Channel and floodplain conditions determine whether the reach aggrades, degrades, or remains in balance over time. If more sediment enters than leaves, the reach aggrades. If more leaves than enters, the stream degrades (See Section 3.1 for more details on Stream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

Entrenched conditions in the upstream reaches of this management unit have resulted in channel incision as the channel bed –both the bedload pavement and the clay sub-pavement-- is scoured deeper than it is refilled during floods. As the sediment exported from those reaches during flood flows approaches the Chichester Bridge, backwatering and overwide channel conditions hamper the channel's capacity to continue transporting those materials, and deposition is the result. Accelerated bar development, noted in the reaches just upstream of the Chichester Bridge, confirms aggradational processes at work here. Installation of flood plain drainage, and/or reduction of the width/depth ratio of the channel under NYS Route 214 would reduce the backwater conditions and improve sediment transport continuity at the bridge.

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. 12, Appendix A). Japanese knotweed occurrences were documented as part of the MesoHABSIM aquatic habitat inventory conducted during the summer of 2002 (Appendix B).

Figure 12 Riparian vegetation map of Management Unit 18

The predominant vegetation type within the 300 ft. riparian buffer is forested (67%) followed by herbaceous (13%). Areas of herbaceous (non-woody) cover present opportunities to improve the riparian buffer with plantings of more flood-resistant species. *Impervious* area (9%) within this unit's buffer is primarily the NYS Route 214 along with private residences.

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. 13). 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. One appropriate planting site was documented within this management unit.

Figure 13 Planting sites location map for Management Unit 18

Planting site #48 includes parts of eight separate residential properties, on the right stream bank, at the downstream end of this management unit. These upland areas are currently large backyards mowed to the edge of the stream bank (Fig. 14).


Figure 14 Planting Site #48

Recommendations for this site include planting native trees and shrubs along the edge of the stream bank and the upland area. Buffer width should be increased by the greatest amount agreeable to the landowners, but increasing the buffer width by at least 20 feet will increase the buffer functionality and improve stream bank stability while still allowing a significant lawn area.

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.

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.

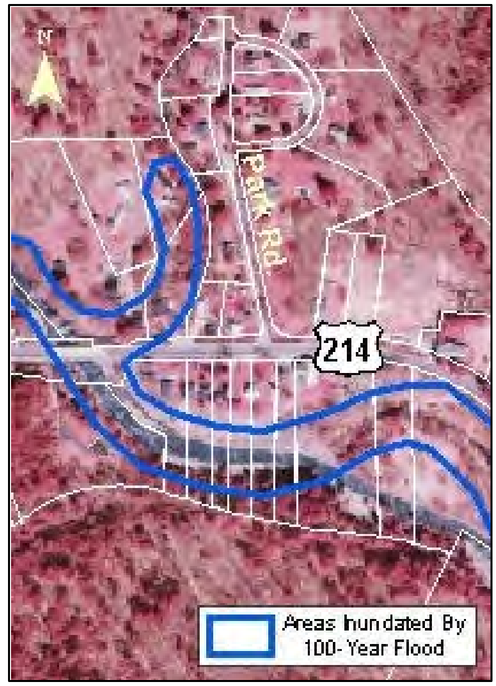


Figure 15 100-year floodplain boundary in Management Unit 18

According to NFIP maps, there are two houses located within the 100-year floodplain boundary in this management unit (Fig. 15). The current NFIP maps are available for review at the Greene and Ulster County Soil & Water Conservation District offices.

Bank Erosion

Most of the stream banks within the management unit are considered unstable, and 25% of the stream banks are experiencing major erosion. The erosion (Inset H), located at the top of the management unit, is a continuation of bank erosion monitoring site #24. This is a large failure contributing significant amounts of fine soil and clay, as well as mature trees, to the creek. This failure could constitute a severe flood hazard for downstream reaches due to the potential for trees to be introduced into the stream from the eroding stream bank during large floods. These trees can create debris jams at bridges or mid-channel bars and may shift the flow pattern of the stream across roads and residential properties.

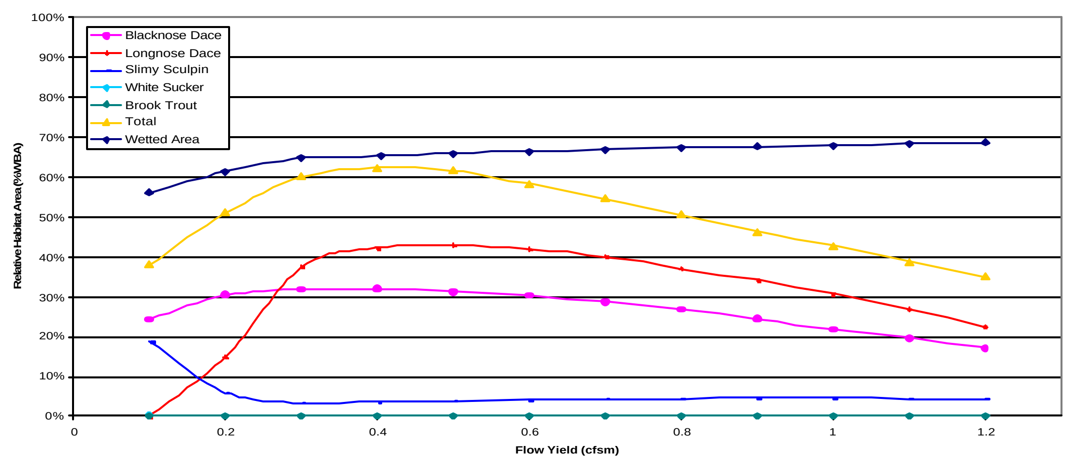
Infrastructure

38% of the stream banks in this management unit have been treated with some form of revetment. However, there are no immediate threats to roadways in this management unit. Failure of the log cribbing (Inset F) on the left stream bank at the end of the management unit poses a threat to a residential property. The condition of this revetment has rapidly declined in recent years, and retrofit is planned for the near future. Modifications to this revetment should include a toe treatment that extends deeper than anticipated stream bed scour depths. Vegetative applications on the face of the revetment and upper bank would increase the strength and longevity of these measures while enhancing the habitat function and aesthetic value of the treatment.

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 #18 has many boulders and some shallow margins. With the exception of the furthest upstream reach, it is somewhat shallower, but faster, than management unit #17. *Wetted area* covers only 55%-70% of the bankfull wetted area through the investigated range of flows, with an inflection point near 0.3 cfsm. This unit is comprised primarily of rapids and runs that turn into ruffles and rapids at higher flows. The overall habitat increases with total wetted area until around 0.3 cfsm, beyond which, habitat steadily declines (Fig. 16). The highest habitat levels in this unit are for longnose dace, followed by blacknose dace. All other species have sparse suitable habitat. Consistent with the results from most other management units, adult brown and rainbow trout have limited amounts of low-quality habitat available. (See general recommendations for aquatic habitat improvement in Section 6.6)



Rating curve for relative habitat area versus flow for Management Unit 18

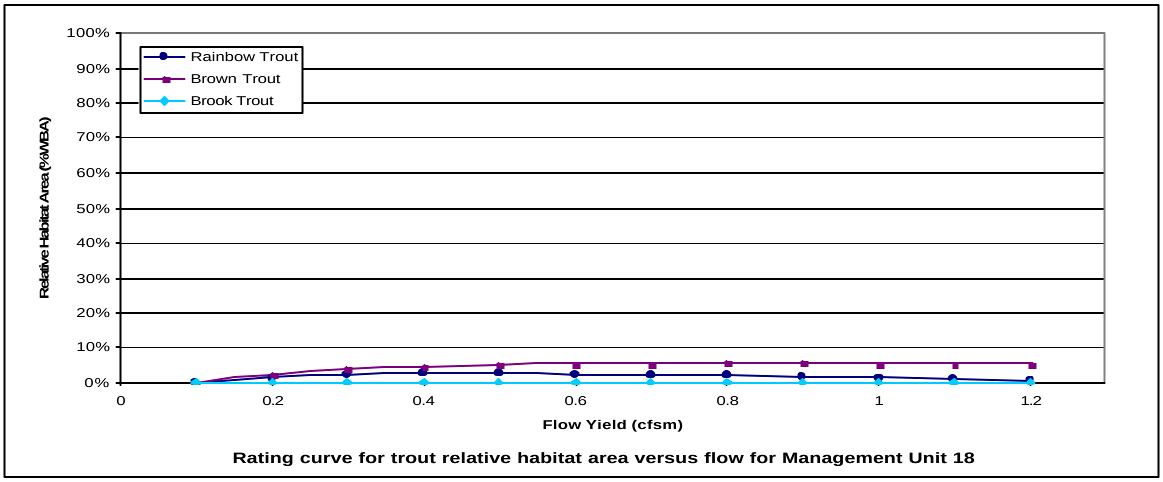


Figure 16 MesoHABSIM habitat rating curves for Management Unit 18

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.

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. There are no stormwater culverts in this management unit, although there is some direct input from the NYS Route 214 roadway over the Chichester Bridge.

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 numerous 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). No homeowners in this management unit made use of this program to replace or repair a septic system.