# Management Unit 17

Ulster County Town of Shandaken

Silver Hollow Road Bridge to between XS 172 and XS 173

## Management Unit Description

This management unit begins just below the Silver Hollow Road Bridge in Chichester and continues approximately 2,135 ft. to between XS 172 and XS 173. The drainage area ranges from 26.5 $mi^2$ at the top of the management unit to 26.9 $mi^2$ at the bottom of the unit. The valley slope is quite steep at 3% and stream water surface slope is 1.8%.

This unit presents a number of management challenges. Infrastructure encroachment and valley confinement have resulted in a history of bank stabilization and channel realignment efforts, currently leading to channel incision and large hillslope failures in several locations. 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 restoring sediment transport continuity by establishing grade control, stable channel dimension and alignment, as well as enhancing riparian vegetation.

| Summary of Recommendations<br>Management Unit 17 | |
|---|---|
| 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 | Riparian plantings at two identified sites (PS #46-47) |
| Infrastructure | Joint plant rip-rap on road embankment along Rt. 214 |
| Habitat | Improve overhead cover, riffle/pool feature 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 | Consider options in feasibility study for overexcavation of channel invert in reaches with clay exposures as a component of channel restoration<br>Stabilize hillslope failures at both bank erosion sites |
| Further Assessments | Geotechnical assessment of bank erosion monitoring site #23 and #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 glacial *lodgement till* along the upstream reaches of this management unit, and of glacial lake clay along this entire section of the stream corridor, exposed in the stream bank or bed, or beneath a thin layer of alluvial deposits in the stream bed (See Section 2.4, Geology of the Stony Clove Creek, for a description of these deposits).

The Silver Hollow Road Bridge, at the top of the unit, had been constructed at least by 1875, as it is shown on the Beers’ Atlas of Ulster County (Fig. 2). The bridge has been replaced several times over the years, most recently in 1983. How the hydraulics of the earlier bridges may have historically affected the morphology of the channel in the reaches downstream is obscured by the most recent bridge maintenance.


**Figure 2 Excerpt from Beers 1875 Atlas of Ulster County**

The Village of Chichester, built up around a furniture factory established by Frank and Lemuel Chichester in 1870, already had over 500 residents by the end of that year, according to the 1870 census (Chichester Historical Society and Ladies Auxillary, 2001). The factory was first water-run, then steam. The steam mill failed completely in 1884, but was reopened and continued operation into the 1920s. Figure 3 is an inset included in Beers 1875 Atlas of Ulster County, depicting the Village of Chichester, and shows the pond used to service the factory.


**Figure 3 Chichester Village**
**Inset from F.W Beers’ 1875 Atlas of Ulster County**

It is difficult to know when or how much modification of the stream channel and banks occurred in the process of settlement and development of the village, but it can be assumed that the construction and maintenance of the sluiceways for the factory, as well as the roads, bridges and rail lines, had a significant effect on this unit.

**Figure 4  View of Chichester looking southeast, up the Stony Clove Creek**
**Courtesy of the Gale Collection**

**Figure 5   1910 flood at the crossing to the lumber storage on the south floodplain flat, Chichester**
**Courtesy of the Gale Collection**

Note in Figure 4, the location of the creek just south of the factory, and the bridge crossing to the floodplain flat where lumber was stored on the south floodplain of the stream.  The stream is extremely wide under this bridge. The railroad embankment can be seen in the distance as the tracks head up valley.  This same bridge crossing is seen in the photograph in Figure 5, taken during the Flood of 1910.  Figure 6 views the scene from the railroad tracks, looking north across the creek.

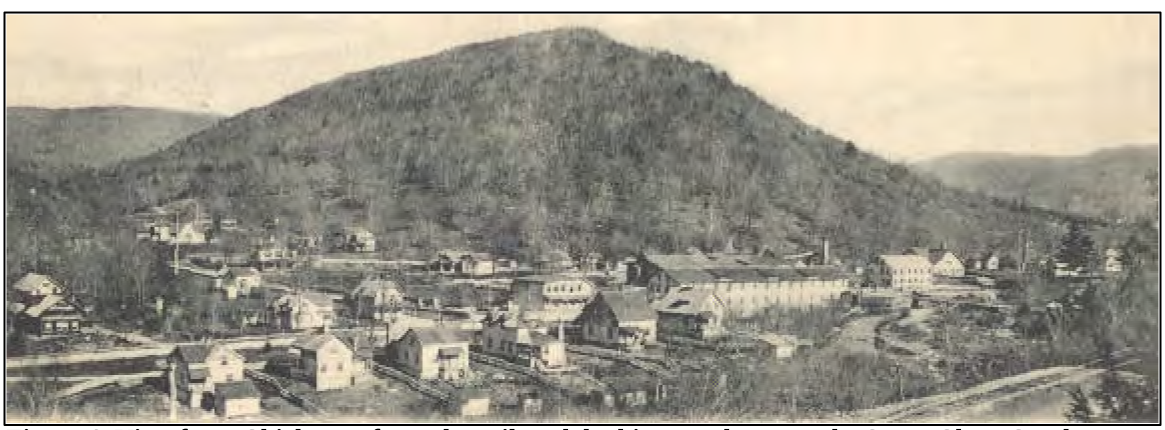


**Figure 6  View from Chichester from the railroad, looking north across the Stony Clove Creek**
**Courtesy of the Gale Collection**

The channel was diverted to the south side of this flat sometime between 1959 and 1965, straightening and steepening the bottom reaches of this unit and the top of the next management unit downstream.

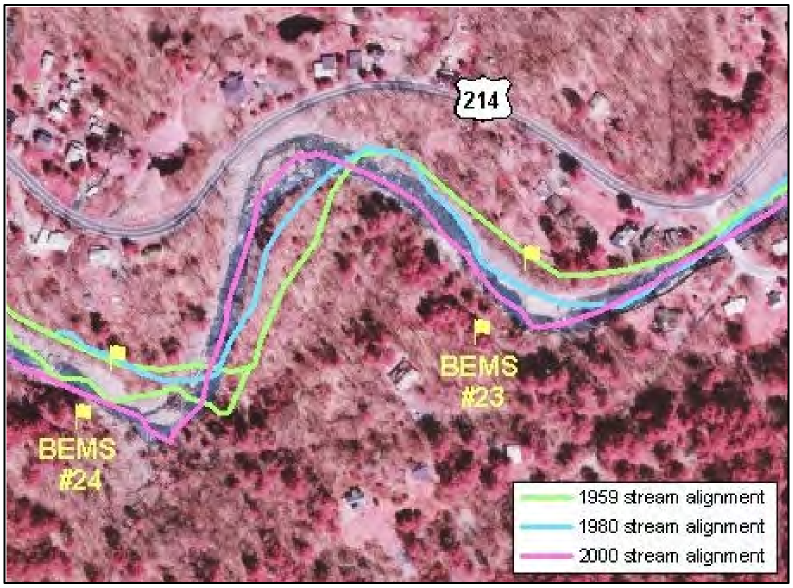



**Figure 7 Historic channel alignments in Management Unit 17**

As seen from the historical stream alignments this management unit has experienced significant channel migration and manipulation in recent years (Fig. 7). At the top of the management unit the stream channel has migrated approximately 125 ft. This shift has forced the stream against the left stream bank resulting in severe erosion and clay exposures at bank erosion monitoring site #23. In the middle of the unit the stream channel has migrated approximately120ft, in a classic pattern of down-valley meander migration. This shift has forced the stream against the right stream bank, threatening the stability of NYS Route 214. Following a road washout during the January 1996 floods, the NYS DOT installed rip-rap at this location in to protect the road from erosion. At the bottom of the unit the stream channel has migrated approximately 100 ft. This shift has forced the stream against the left stream bank resulting in severe erosion and clay exposures bank erosion monitoring site #24.

**Figure 8 1996 flood damage at Hoffman property**

At the Hoffman residential property located on the left stream bank just below Silver Hollow Bridge, severe stream bank erosion occurred during the 1996 flood event (Fig. 8). In efforts to protect the house and property, the landowner installed a 220 ft. long stacked rock wall.

The photos below, looking downstream from the Silver Hollow Bridge, illustrate the difference between low and high flow conditions (Fig. 9).

**Figure 9 Stony Clove Creek below Silver Hollow Bridge low flow vs. high flow condtions**

During the January 1996 flood event, floodwaters damaged the road embankment along NYS Rt. 214 and caused serious stream bank erosion (Fig. 10). After this flood event, rip-rap was installed by the NYS Department of Transportation (DOT) to stabilize the stream bank.

**Figure 10 NYS Route 214 washout from 1996 flood**

According to available NYS DEC records at least two stream disturbance permits have been issued in this management unit. In September 1998 a permit was issued to Katsuji Asada to stabilize 45 ft. of erosion on the left stream bank at bank erosion site #23 with large stones and gravel taken selectively from the adjacent gravel bar. In July 1999, the Hoffmans received a permit to install 220 ft. of rip-rap wall to prevent further bank erosion and to restore a portion of the embankment, as discussed above.

## Stream Channel and Floodplain Current Conditions

### Revetment, Berms and Erosion

The 2001 stream feature inventory revealed that 25% (1,086 ft.) of the stream banks exhibited signs of active erosion along 2,135 ft. of total channel length (Fig. 1). There are two large eroding areas total approximately 27,975 $ft^2$. Revetment has been installed on 16% (699 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 25. “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. 11), creating small reaches with differing morphologic characteristics, which are classified as different *stream types* (See Section 3.1 for stream type descriptions).

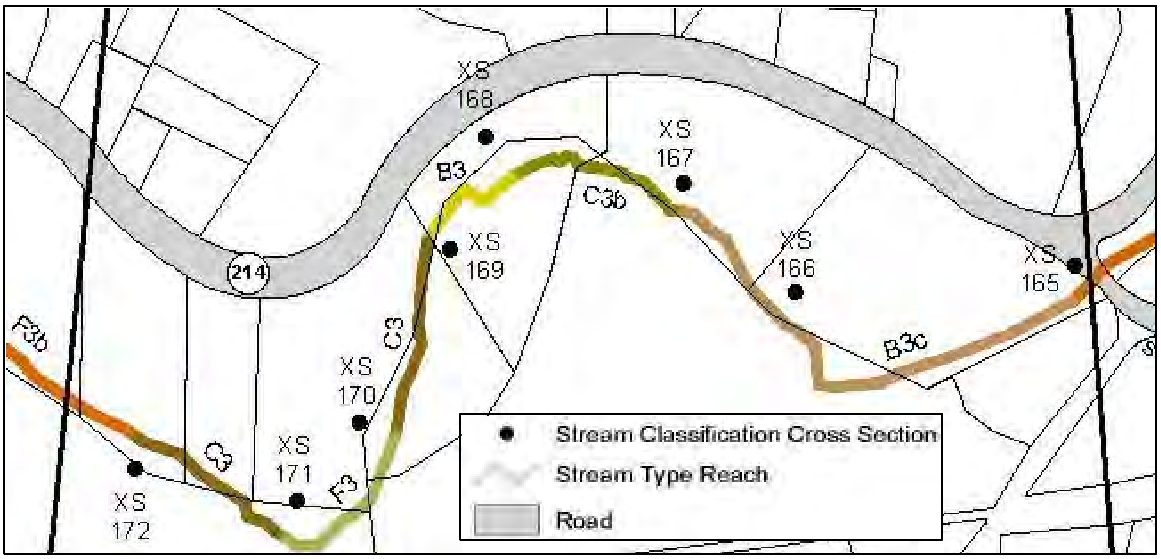



**Figure 11 Cross-sections and Rosgen stream types for Management Unit 17**

Infrastructure and valley form confinement control the channel planform at several locations in this management unit. Meander truncation has resulted in several hillslope failures and migrating headcuts. The headcuts threaten to exacerbate the hillslope failures and undermine revetment at both public infrastructure and private residences. While entrenchment is only slight or moderate through most of the unit, channel incision has confined more frequent, small flood events. This condition, if not mitigated, will result in more significant bed degradation and associated bank loss.

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. Lake-bottom silts and clays are more cohesive than lodgement tills, but once exposed in banks, are slow to revegetate. These fine-grained clays can produce significant volumes of suspended sediment and turbidity when scoured in stream beds and banks by tumbling cobble and boulders.

Management unit #17 begins just below the Silver Hollow Bridge (Inset D). As the Stony Clove Creek emerges from underneath the bridge, the first 48 ft. of F3b stream is *entrenched*, or confined within the stream banks during high flow events, with a steep 2.7% slope. Bed material is dominated by cobble.

A 220 ft. stacked rock wall runs along the left stream bank (Inset H). Several houses sit along the right bank; one of the houses maintains an access path to the stream.

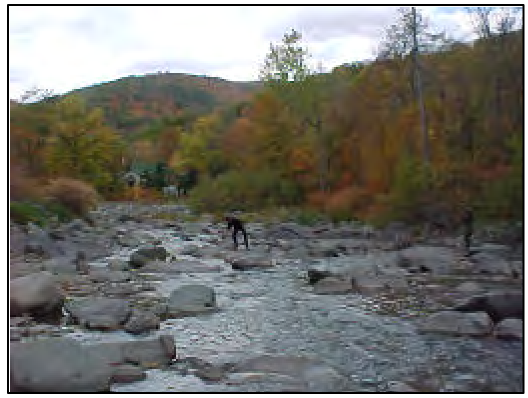


**Figure 12 Cross-section 167**
**Stream type B3c**

As entrenchment moderates and slope decreases to 1.3%, stream type changes to B3c for the next 752 ft (Fig. 12). Approximately 300 ft. into this stream section, the valley wall forces the stream to bend sharply to the right, as the *thalweg*, or deepest part of the stream channel, flows into a deep, clay-bottomed pool directly against the left stream bank (Inset C).

**Figure 13 Bank Erosion Site 23**

Bank erosion monitoring site #23 is located along this eroding bank, and is approximately 332 ft. long, with a total area of 18,858 ft.$^2$. qualifying it as the third largest eroding area along the Stony Clove Creek (Fig.13).

The Bank Erodibility Hazard Index (*BEHI*) score for this site is ranked “Very High”, the second highest prioritization category in terms of its vulnerability to erosion due to the threat to water quality.

Large sections of the hillside have no vegetation, and several severe *scarps* provide evidence of extensive *rotational failure planes* on the hillslope above the channel (Inset G). During high flows, the channel morphology and clay-rich bed and banks set up the conditions for severe *toe erosion* along this stream bank (Inset C). As the toe of the left bank is scoured down through clay lenses, the hillslope slips along the failure planes. Consequently, at high flows large amounts of clay are introduced into the stream as *suspended sediment*. Just below the pool at this bank failure there is a 2 ft. high *headcut* (downstream of cross-section 166) which, if allowed to migrate upstream, could further destabilize the failing bank by lowering the streambed elevation and increasing the potential for additional slippage.

For the next 278 ft. reach the channel widens into a C3b stream type, and entrenchment decreases significantly as the channel regains connection with its floodplain (Fig.14). Floodplains provide overflow capacity for high flows. Channel slope increases to 3%, and bed material coarsens again to large cobble.

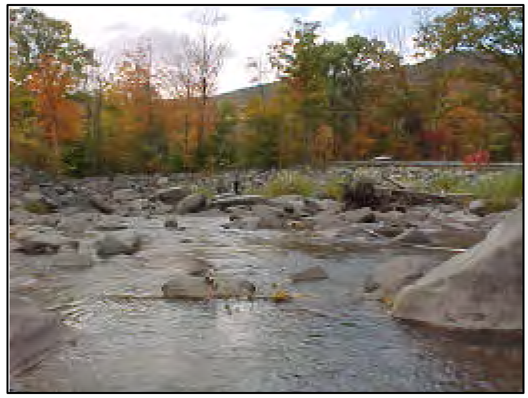


**Figure 14 Cross-section 168**
**Stream type C3b**

The channel bends to the left, confined by the NYS Route 214 road embankment and revetment along the right stream bank. The stream continues with the same steep slope and bed material coarsens with the addition of boulders added into the channel when the revetment was placed.

**Figure 15 Cross-section 169**
**Stream type B3**

Entrenchment increases as the channel turns to the left, narrowing and deepening to become a B3 stream type for the next 162 ft. reach (Fig. 15). The left stream bank is experiencing moderate erosion into exposures of clay at the toe (Inset F).

Coming out of this reach, the channel straightens and flattens, with slope decreasing to 1% as stream type changes to C3 for 288 ft. (Fig. 15). Entrenchment moderates as the channel moves away from the road and regains connection with its floodplain. The bed material becomes dramatically finer as the channel departs from the armored road embankment. Clay is exposed on the right stream bank here (Inset A).

**Figure 16 Cross-section 170**
**Stream type C3**

**Figure 17 Cross-section 171**
**Stream type F3**

Proceeding downstream, both stream banks increase in height as the stream takes another sharp bend to the right, turned by the valley wall beyond the left stream bank. This 250 ft. reach is an F3 stream type (Fig.17). The stream widens significantly, steepens slightly to 1.9% slope and the bed material becomes finer. The thalweg flows against a failing high left stream bank.

Like the previous erosion site, this hillslope is being undermined by toe erosion and exhibits several failure plane scarps, with mass wasting of large volumes of glacial till accompanied by mature trees and shrubs. As this large woody material is mobilized, it poses a threat to infrastructure downstream. The soil has a high silt and clay content, and the site contributes significantly to suspended sediment loading.

Bank erosion monitoring site #24 (Inset E) begins at this reach and extends into the next. Covering an area close to 20,000 ft.[2], this is the largest erosion site on the Stony Clove.

The BEHI score of site #24 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 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 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 #17 include installing a series of rock vane 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, including geotechnical assessment of the rotational failures. Providing opportunities for activities such as fishing and kayaking should be considered as a secondary objective of the project.

Narrowing and deepening as it comes out of the turn, the stream drops over a 3 ft. high headcut. As the channel straightens and entrenchment moderates, stream type changes to C3 for the next 257 ft. reach (Fig.18). An abandoned channel, still evident in the floodplain on the right, carries water during flood flows.

**Figure 18 Cross-section 172**
**Stream type C3**

The high, unvegetated left bank, composed of lodgement till, continues through this reach and extends into the next, contributing sediment through both *wet and dry ravel.*

At the bottom of the management unit, the channel has incised and is cut off from its floodplain again, becoming an F3 stream type for the last 100 ft. of this management unit.

## 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).

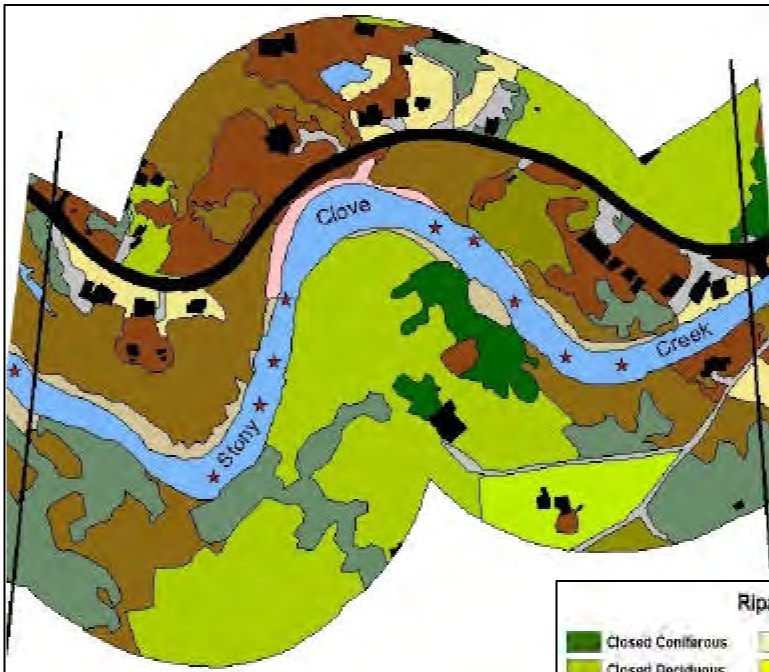
It would appear from the historical evidence and our morphology assessment that this management unit has been modified significantly over the years, and that in general, the channel length has been shortened, and therefore steepened. The morphology of this management unit, in conjunction with the surficial geology, indicate that for several reaches within the unit, excess *shear stress* has probably in the recent past been causing the channel bed to degrade, as evidenced by the several headcuts in the unit. This lowering of the channel bed has destabilized the toe of the two high banks, which are in turn contributing excess sediment –both suspended and bedload- to the stream. It is likely that, during high flows, the cobble pavement is being scoured to the glacial lake clay subpavement that underlies much of the channel through the unit.

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



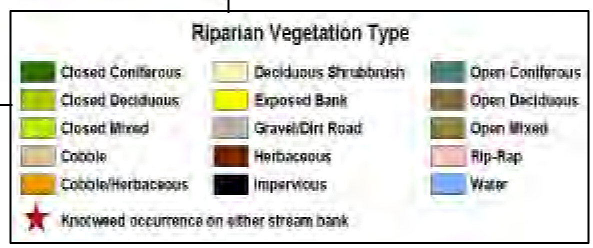




**Figure 19 Riparian vegetation map for Management Unit 17**

The predominant vegetation type within the 300 ft. riparian buffer is forested (71%) followed by herbaceous (14%) and deciduous shrubbrush (3%). Areas of herbaceous (non-woody) cover present opportunities to improve the riparian buffer with plantings of more flood-resistant species. *Impervious* area (8%) within this unit's buffer is primarily the NYS Route 214 roadway and 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. 20). 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. Two appropriate planting sites were documented within this management unit.

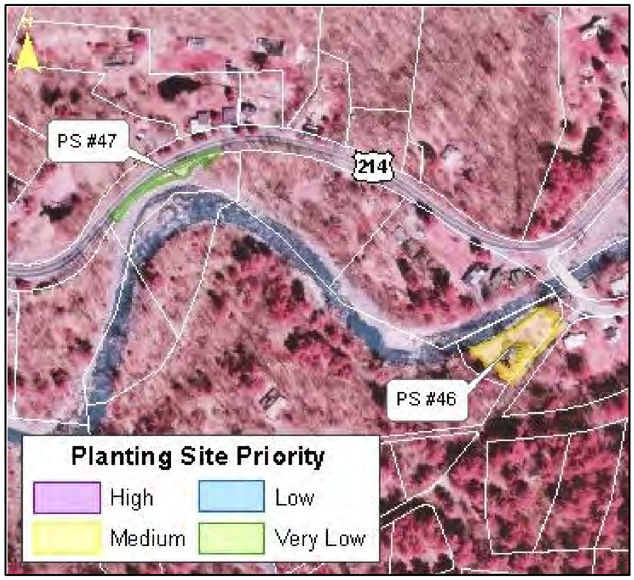



**Figure 20 Planting sites location map for Management Unit 17**

**Figure 21 Planting Site #46**

Planting site #46 is located on the left stream bank just downstream from the Silver Hollow bridge on the Hoffman property (Fig. 21). On this site there is a stacked rock wall, with several shrubs and mowed grass to the edge of the stream bank.

To increase stream buffer functionality, additional plantings of native trees and shrubs along the stream bank and upland area are recommended. Increasing the stream buffer width by at least 20 feet will improve stream bank stability while still allowing for a lawn area. It is also recommended to interplant native willow and sedge species through the stacked rock and along the toe of this stream bank. This planting will help to strengthen the revetment, while enhancing aquatic habitat.

Planting site #47 is located on the right stream bank along the rip-rap on NYS Route 214 (Inset B).

Inserting plant materials into the soil between rip-rap rocks, or *joint planting*, is recommended (Fig. 22). Joint planting will strengthen and increase the longevity of this rip-rap, while adding aesthetic and habitat value. The planting of the rip-rap here would require coordination with the NYS DOT, as they are responsible for the maintenance of the rip-rap.

**Figure 22 Planting Site #47**

## 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 23 100-year floodplain boundary map in Management Unit 17**

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 maps, there is one house located within 100-year floodplain boundary in this management unit (Fig. 23). The current NFIP maps are available for review at the Greene and Ulster County Soil & Water Conservation District offices.

### Bank Erosion

At the top of the unit, the house behind the stacked rock wall on the left bank is vulnerable to erosion from high floods if the revetment is undermined by bed degradation. The two large bank failures described above, bank erosion monitoring sites #23 and #24, together constitute severe flood hazards for reaches downstream, with the potential for landslides and the associated introduction of mature trees into the stream during large floods. These trees can create debris jams at bridges or mid-channel bars and result in catastrophic channel shifts, redirecting flows across roads and private property.

### Infrastructure

Potential upstream migration of headcuts through the revetted reach at NYS Route 214 represents another flood-related threat. Channel incision would undermine the toe of the revetment, leaving the embankment vulnerable to failure. A utility pole near the revetment could also be undermined. This highway is the primary north-south conduit for emergency service traffic in the area.

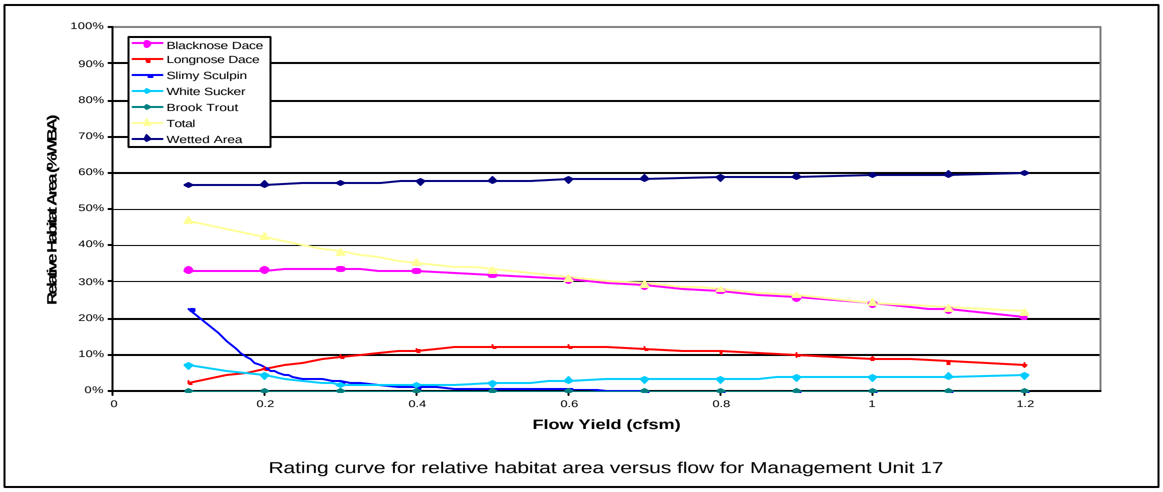
## **Aquatic Habitat**

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 #17 is characterized by significant amounts of rip-rap and boulders, with some shallow margins (Fig. 24). It is slower and somewhat shallower than management unit #16. *Wetted area* covers only 60% of the bankfull wetted area at all investigated flows. At the high end of the investigated flow range, this unit is dominated by rapids and ruffles. The amount of suitable habitat for the target community is generally low. Blacknose dace are favored, but their habitat declines as flow increases. Slimy sculpin have mostly low quality habitat, along with longnose dace, which have more suitable habitat than in the unit upstream. Habitat for white sucker is very low and for brook trout nearly absent. Interestingly, rainbow and brown trout have more high quality habitat in this unit than anywhere else in the Stony Clove mainstem, owing perhaps to the deep pools scoured into the clay subpavement.

Because a significant amount of suspended sediment is introduced into the stream from clay exposures in the bed and banks, this management unit is likely producing *embeddedness* downstream. Embeddedness results when fine sediment fills the spaces in gravel beds, reducing the amount of water flowing through these spaces, and reducing the viability of fish eggs that may be layed in them.

There may also be a thermal barrier in the middle of the management unit during summer low flows in the vicinity of the Route 214 embankment and revetment. The orientation of the stream and lack of canopy cover at this location allows for significant mid-day heating of the road, the rock rip-rap and expansive lateral bars in this area. The hillslope failures and bed instability throughout the management unit probably produce a chaotic disturbance regime in the channel substrate. Studies indicate that this may have negative consequences for macroinvertebrate community dynamics. (See Section 6.6 general recommendations for aquatic habitat improvement)



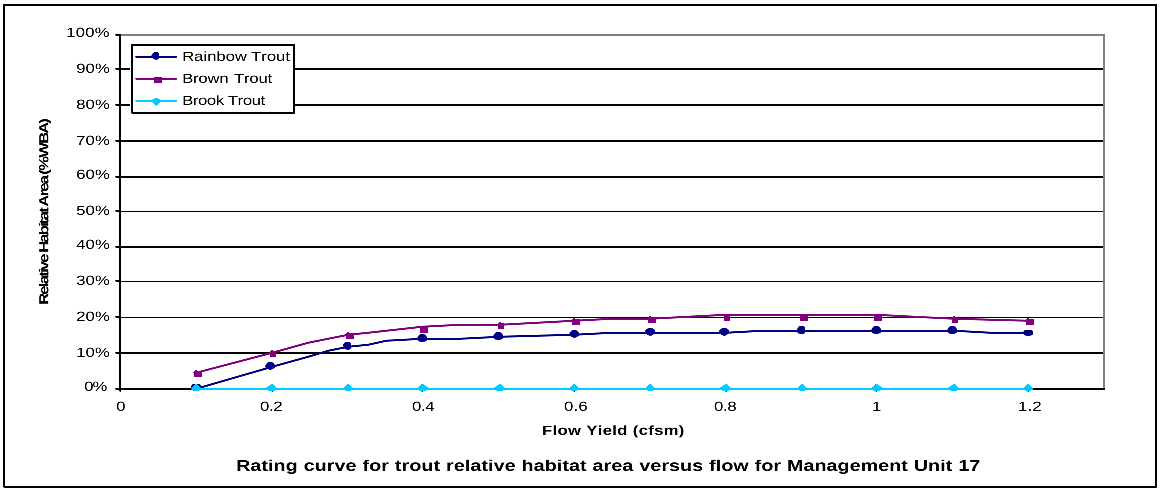




**Figure 24 Habitat rating curve for Management Unit 17**

## 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. Numerous significant clay exposures were identified in this management unit at the time of the stream feature inventory.

This management unit includes a section of the Stony Clove Creek that was identified by the NYC DEP Division of Water Quality Control as contributing a disproportionately large supply of suspended sediment into the Stony Clove Creek. It is not clear whether the source is principally from the stream bed or the banks, but both are certainly sources.

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 is one stormwater culvert at the upstream end of this management unit.

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 has made use of this program to replace or repair a septic system.