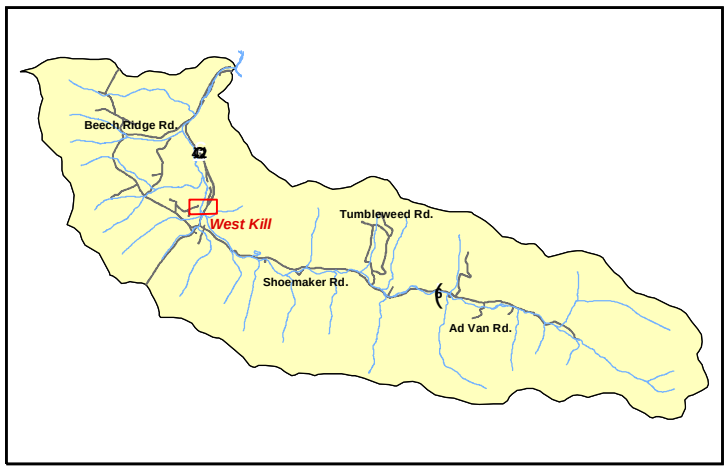


West Kill Management Unit 16

Stream Feature Statistics

54% of stream length is experiencing erosion
52% of stream length has been stabilized
4.4 acres of inadequate vegetation within the 300 ft. buffer
0 ft. of stream is within 50 ft. of the road
0 houses located within the 100-year floodplain boundary

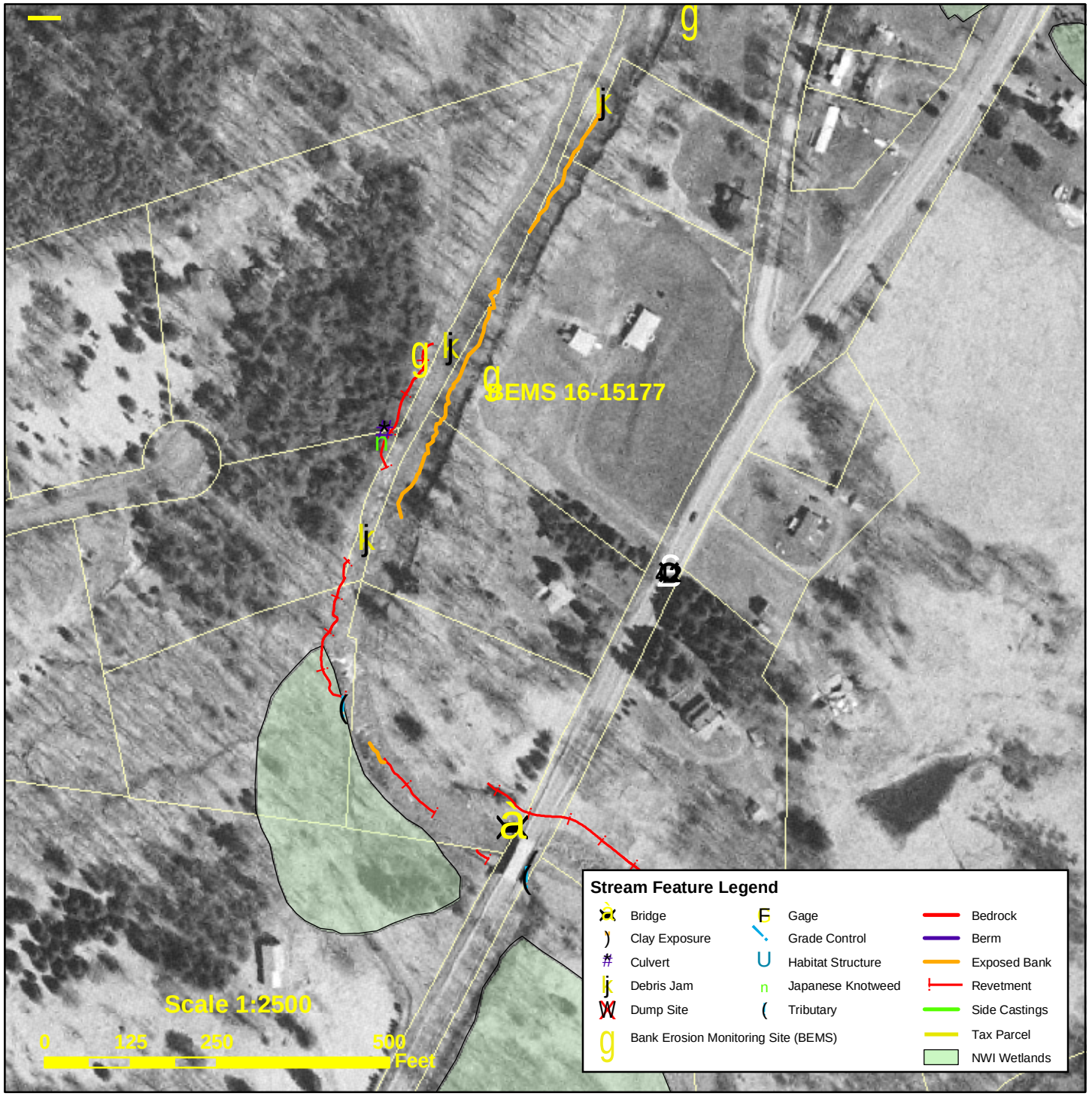


Figure 4.16.1 2004 aerial photography with stream feature inventory and tax parcels

Management Unit 16

Between Station 16010 and Station 14742

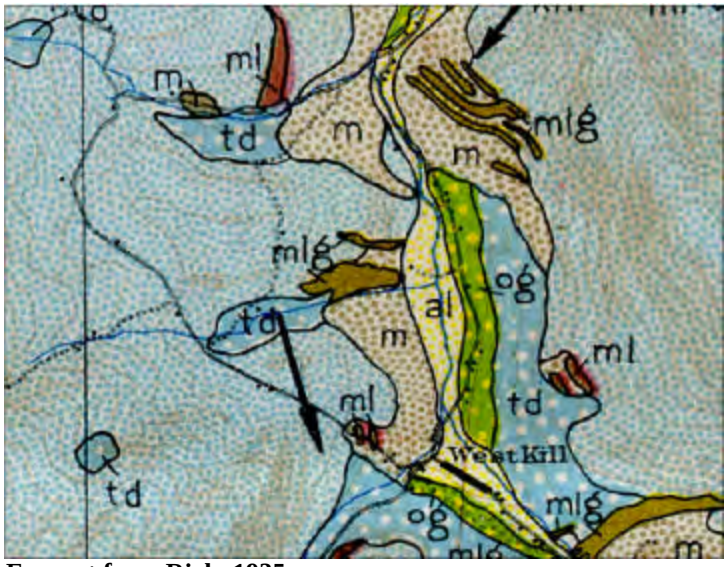
Management Unit Description

This management unit begins at the SR 42 bridge crossing, continuing approximately 1268 ft. to the end of the unit. The drainage area ranges from 22.8 mi^2 at the top of the management unit to 23.5 mi^2 at the bottom of the unit. The valley slope is 1.65%.

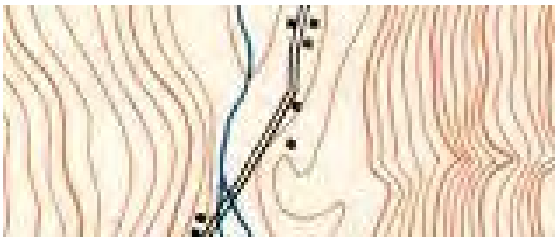
Summary of Recommendations Management Unit 16	
Intervention Level	Assisted Self-Recovery
Stream Morphology	Vegetative treatments in aggradational reaches to promote reduced width-depth ratios.
Riparian Vegetation	Enhancement of the riparian buffer along residential lawn area, vegetative toe treatments at BEMS 16-15177, Knotweed eradication program.
Infrastructure	Improvement of floodplain drainage at the NYS route 42 bridge.
Aquatic Habitat	Watershed wide study
Flood Related Threats	None
Water Quality	None
Further Assessment	None

Historic Conditions

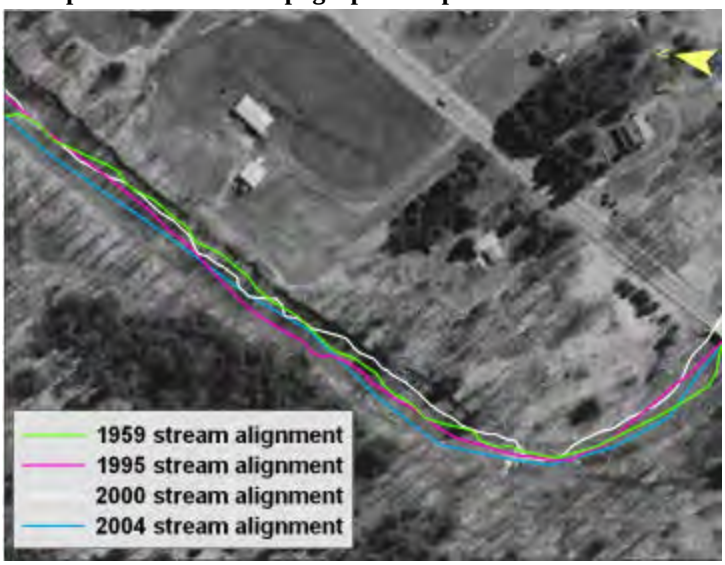
As the glaciers retreated about 12,000 years ago, they left their "tracks" in the Catskills. See Section 2.4 Geology of the West Kill Creek, for a description of these deposits.



Excerpt from Rich, 1935



Excerpt of 1903 USGS topographic map MU16



Historic Stream Channel Alignments in MU16

As seen from the historical stream alignments, the channel alignment has remained fairly consistent over the years. The minor differences between the historical alignments are more likely to be artifacts of nuances in the correlation of the photographs than evidence of actual channel migration. Channel migration in this unit is undetectable at this scale of inquiry.

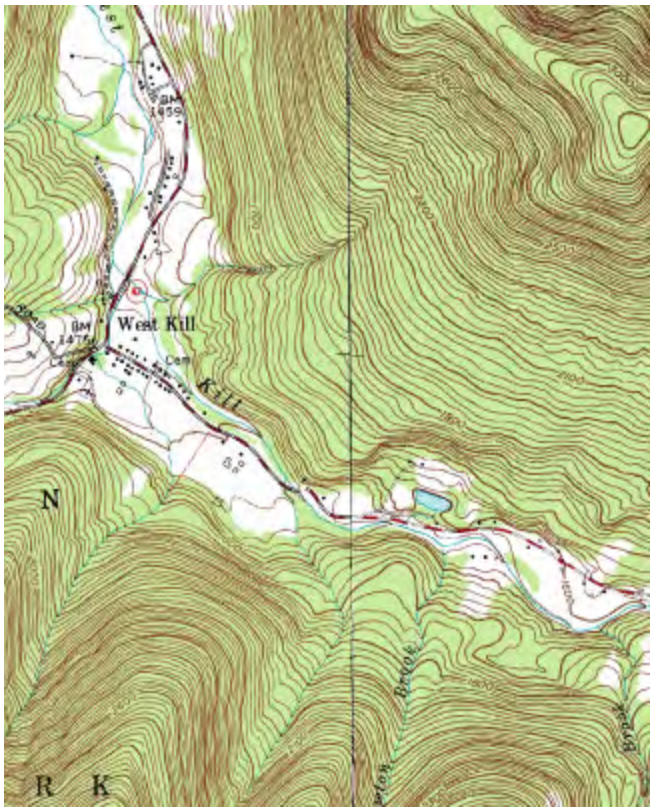
Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 54% (681 ft.) of the stream exhibited signs of active erosion along 1268 ft. of total channel length (Fig. 4.12.1). Revetment has been installed on a remarkably large 52% (656 ft.) of the stream. No berms were identified in this management unit at the time of the stream feature inventory.

Stream Morphology

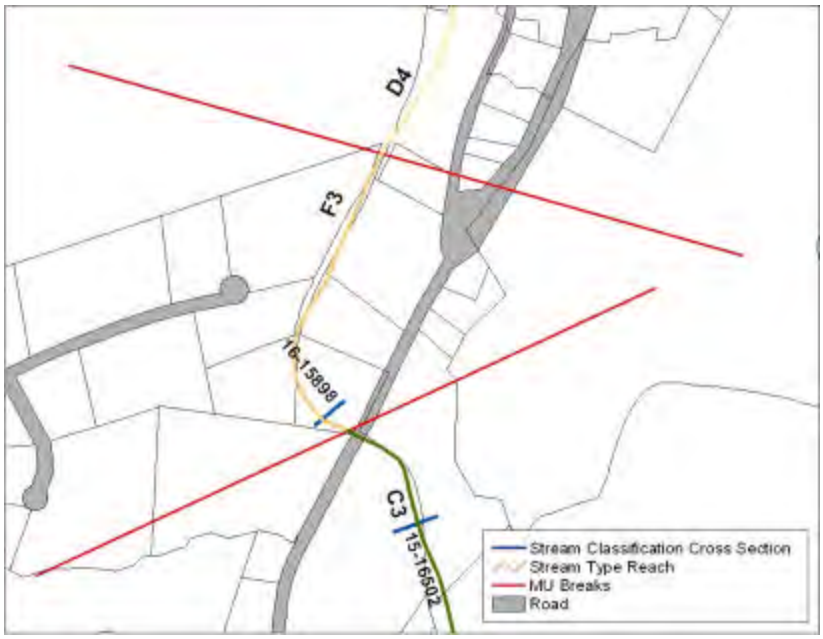
The following description of stream morphology references insets in the foldout Figure 4.16.2. "Left" and "right" references are oriented looking downstream. Stationing references, however, proceed upstream, in feet, from an origin (Station 0) at the confluence with the Schoharie Creek at Lexington. Italicized terms are defined in the glossary. This characterization is the result of surveys conducted in 2004 and 2005.



Excerpt of 1980 USGS topographic map

The channel in this management unit is confined along much of its length between the valley wall to the west and a high alluvial terrace to the east. While upstream reaches appear to be transporting sediment effectively, aggradation and overwidened channel conditions in the downstream reaches result in widespread erosion and revetment. As the confinement reduces in the downstream reaches, aggradation becomes more problematic due to the excess sediment load contributed by the eroding banks in the unit and from reaches upstream. Width-depth ratios expressed here are high and inefficient, resulting in channel that has inadequate capacity to convey the existing sediment load.

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 3.2 for description of stream types).



Management Unit #16 consists entirely of a 1268 ft. reach of F3 stream type. The stream type is documented by a monumented cross-section at Station 15898. The channel is *entrenched*, or confined within the stream banks during high flood events. The channel slope is 1.1 % and the bed material is dominated by cobble.

Cross-sections and Rosgen stream types in MU16

NYS Route 42 bridge

Looking upstream

Looking downstream

NYS Route 42 bridge (Inset D, Fig. 4.16.2) marks the upstream limit of Management Unit 16. The alignment of this bridge is poor, creating a sharp bend to the left as the channel approaches the bridge opening and a sharp bend to the right as the channel departs from the bridge. The sharp bend in combination with poor floodplain drainage through the NYS route 42 road fill results in backwater and aggradation upstream. Recommendations at this site include modification of the stream approach to the bridge, and installation of flood plain drains under NYS Route 42.

Rip-rap, left and right

Downstream of the bridge, a short (23 ft.) installation of rip rap lies on the left bank, providing nominal scour protection to the bridge abutment. Rip-rap is also found on the right bank, extending from Management Unit 15, protecting the right bridge abutment.

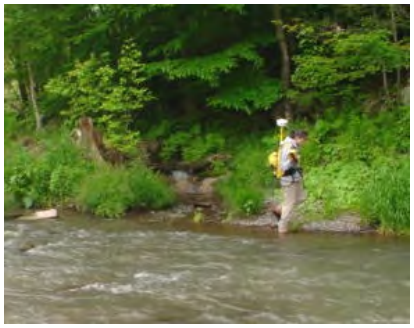
Remnants of log cribbing (Inset H, Fig. 4.16.2) are noted along 111 ft. of the left bank, starting near Station 15920. The revetment is in very poor condition, with only a few logs and the cobble backfill remaining.

Log cribbing, left

Bank erosion, left

Erosion begins as the cribbing ends, and continues for 38 ft. along the left bank. The erosion is fairly minor, but is actively undermining mature trees on the terrace. This erosion was not monumented as a Bank Erosion Monitoring Site.

An unnamed tributary joins the West Kill from the left near Station 15720. The mouth of the tributary is well connected and densely vegetated.



Tributary, left

Rip-rap, left

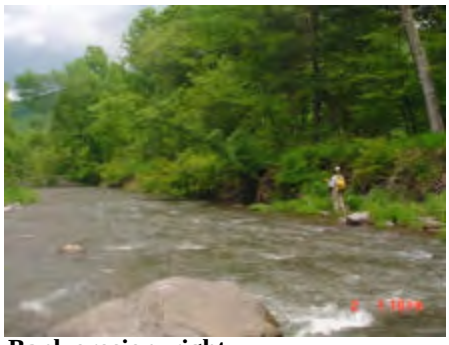
Rip-rap (Inset G, Fig. 4.16.2) is installed along 237 ft. of the left bank, starting immediately downstream of the tributary. The treatment is extremely old, and appears to be made of native stone collected from adjacent uplands. A gravel road lies on the terrace beyond the rip-rap.

Rip-rap, left

Debris jam

A debris jam is found near Station 15470. Large woody debris lies at stream left and right. The logs are aligned parallel to flow, against the banks, creating a minimal obstruction, and providing some measure of bank protection.

Debris jam



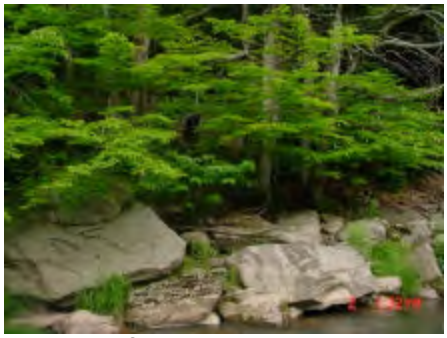
Bank erosion, right

Bank erosion (Inset C, Fig. 4.16.2) begins on the right bank near Station 15425, extending 416 ft. downstream. Dense shrubby vegetation obscures the near-vertical bank face. Woody vegetation on the terrace is undercut, and becoming entrained as debris load. The riparian buffer beyond the erosion consists of a narrow strip of shrub and herbaceous vegetation, giving way to lawn just a few feet from the top of the bank. Erosion of the right bank has been monumented as a Bank Erosion Monitoring Site (BEMS Station 16-15177). In a prioritization of twenty-one BEMS sites throughout the West Kill watershed (see Section 3.3, Watershed Inventory and Assessment), this site ranked Low Priority. Vegetative toe treatments are recommended for this site to improve bank stability and reduce sediment yield resulting in aggradation downstream. Riparian buffer enhancement is recommended for the lawn area at the top of the terrace. The risk to bank stability can be minimized by maintaining mature trees along the stream margin, including a critical buffer zone extending approximately 75 ft. from the centerline of the stream (Fig. 4.16.4).

Rip Rap, left

Rip-rap (Inset F, Fig.4.16.2) has again been installed to protect 208 ft. of the left bank at the toe of the embankment of the gravel road. The rip-rap is very old, but in good condition.

A culvert drains the gravel road and outfalls onto the rip-rap. The culvert is perched, but the rip-rap provides adequate outfall protection.



Culvert, left

During the 2004 inventory, one stand of Japanese knotweed (*Fallopia japonica*), an invasive, exotic shrub species that can grow rapidly to crowd out more appropriate streamside vegetation, was observed at the outfall of the culvert. A program for eradication of Japanese knotweed throughout the West Kill valley is recommended.

Debris Jam

Trees fallen from the undercut right bank form a debris jam at the downstream end of the rip-rap. The trees create a flow obstruction throughout the range of flows, and are promoting scour of the left bank downstream of the rip-rap.


Aggradation

Aggradation (Inset E, Fig. 4.16.2) is apparent downstream of the eroded right bank. The aggradation results in cutting at the left and right banks, entraining small amounts of debris. The aggradation is likely to be associated with excess sediment load supplied by the eroding bank. In stream plantings of ecologically appropriate shrub and herbaceous species is recommended for this site, in combination with reduction of local sediment inputs, to promote development of a narrower, deeper bankfull channel with the capacity to convey the delivered sediment.

As the channel becomes more connected with the terraces at the left and right, erosion compromises 227 ft. of the right bank. Woody vegetation is being undermined and falling into the stream from the top of the terrace, resulting in another debris jam (Inset A, Fig. 4.16.2) formed at the downstream end of the erosion.


Debris Jam, right


Bank Erosion, right, looking upstream

Despite dense, shrubby vegetation on the face of the bank, the recovery potential of this bank is low due to the active aggradational processes here and inadequate width of the buffer on the terrace beyond the erosion. This erosion was not monumented as a Bank Erosion Monitoring Site.

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).

Extensive terrace erosion in middle reaches of the unit results in active aggradation in the downstream reaches of the unit. Erosion active along the aggradational reaches is unlikely to self-correct as toe scour will persist while the channel widens. In stream plantings are recommended to promote a more efficient sediment transport condition.

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. Mowed lawn does not provide adequate erosion protection on stream banks because it typically 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, which are adapted to our regional climate and soil conditions and typically require less maintenance following planting and establishment.

Some plant species that are not native can create difficulties for stream management, particularly if they are invasive. Japanese knotweed (*Fallopia japonica*), 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 2005 and field inventories (Fig. 4.12.3). Japanese knotweed occurrences were documented as part of the stream feature inventory conducted during the summer of 2004, with additional occurrences identified in 2005.

In this management unit, the predominant vegetation type within the 300 ft. riparian buffer is Forest (58 %) followed by Herbaceous (21 %). *Impervious* area (4%) within this unit's buffer is primarily the Greene County Route 6, along with private residences and associated roads. No occurrences of Japanese knotweed were documented in this management unit during the 2004 or 2005 stream inventories.

National Wetland Inventory wetlands in MU16

There are 2 wetlands within this management unit mapped in the National Wetland Inventory (see Section 2.5, Wetlands and Floodplains for more information on the National Wetland Inventory and wetlands in the West Kill watershed). 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). The larger wetland, which is 1.6 acres in size, is classified *palustrine, forested, broadleaf deciduous, temporarily flooded* (PFO1A). The smaller wetland is 0.3 acres and is designated as *palustrine, unconsolidated bottom, semipermanently flooded, excavated* (PUBFx). as *palustrine, unconsolidated bottom, permanently flooded, diked/impounded* (PUBHh).

Areas of herbaceous (non-woody) cover present opportunities to improve the riparian buffer with tree plantings, to promote a more mature vegetation community along the streambank and in the floodplain. In November 2005, suitable riparian improvement planting sites were identified through a watershed-wide remote evaluation of current riparian buffer conditions and existing stream channel morphology. 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 long-term stream channel stability, 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 many cases, these sites can not be effectively treated with riparian enhancement alone, and full restoration efforts would include channel restoration components in addition to vegetative treatments.

Nine potential planting sites were documented within this management unit (Fig. 4.16.4).

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 35 feet will increase the buffer functionality and improve stream bank stability while still allowing a significant lawn area.

Flood Threats

100-year floodplain boundary in Management Unit 16

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. The NYS DEC Bureau of Flood Protection is currently developing new floodplain maps for the West Kill

on the basis of recent surveys. These maps should be completed for the West Kill watershed in 2006.

According to this existing floodplain maps, there are no houses located within the 100-year floodplain boundary in this management. The 100-year floodplain is that area predicted to be inundated by floods of a magnitude that is expected to occur once in any 100 year period, on the basis of a statistical analysis of the local flood record. Most communities regulate the type of development that can occur in areas subject to these flood risks. The current NFIP maps are available for review at the Greene County Soil & Water Conservation District office.

Bank Erosion

Many of the stream banks within the management unit are considered stable, but 54% (681 ft.) of the stream is experiencing major erosion. The notably high percentage of stream length that has been revetted indicates a history of instability.

There is one Bank Erosion Monitoring sites in MU16 (BEMS 16-15177). Recommendations at this site include vegetative toe stabilization measures to reduce sediment loading from this bank.

Infrastructure

Fifty-two percent of the stream length in this management unit has been treated with some form of revetment which is generally in good condition and not threatened by flood flow.

Aquatic Habitat

It is recommended that a habitat study be conducted on the West Kill Creek, with particular attention paid to possible temperature barriers in aggrading sections, to the frequency of disturbance of the bed due to incision at numerous points in the system, and to embeddedness resulting from excessive entrainment of fine sediment.

Habitat was fairly good throughout this management unit, with abundant woody debris, and ample shallow margins serving as rearing habitat. However several reaches appear somewhat impaired, with inadequate canopy cover, low diversity of bedform and introduction of fine sediment from eroding banks.

Water Quality

Clay exposures and sediment from stream bank and channel erosion pose a potential threat to water quality in West Kill Creek. Clay and sediment inputs into a stream may increase *turbidity* and act as a carrier for other pollutants and pathogens. There were no significant clay exposures identified in the 2004 or 2005 stream inventories,

Stormwater runoff can also have a considerable impact on water quality. When it rains, water falls on roadways and flows untreated directly into West Kill Creek. The cumulative impact of oil, grease, sediment, salt, litter and other unseen pollutants found in road runoff can significantly degrade water quality. There is one stormwater culvert in 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 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. No homeowners in this management unit made use of this program to replace or repair a septic system.

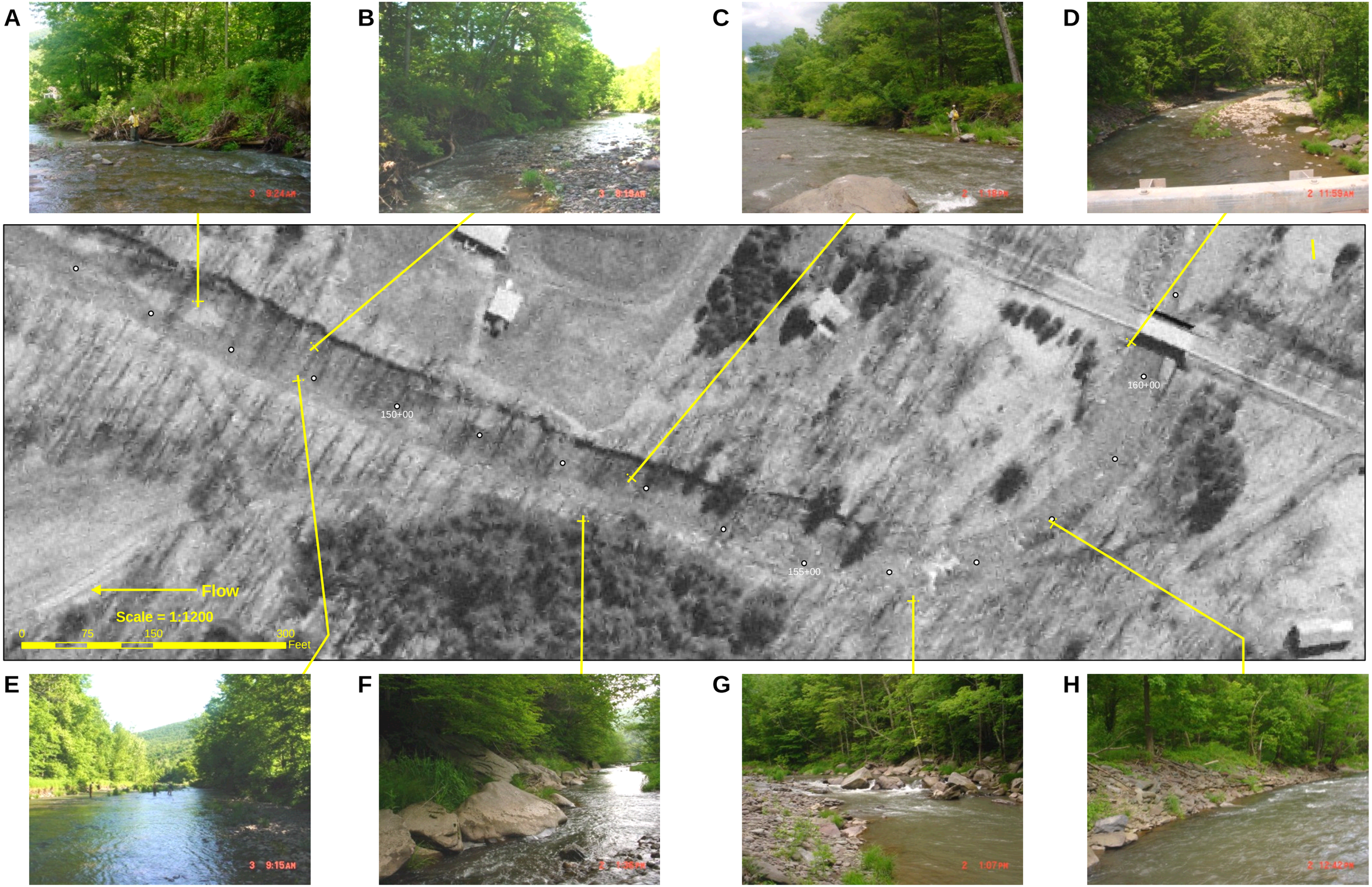


Figure 4.16.2 Management Unit 16 - 2004 aerial photography