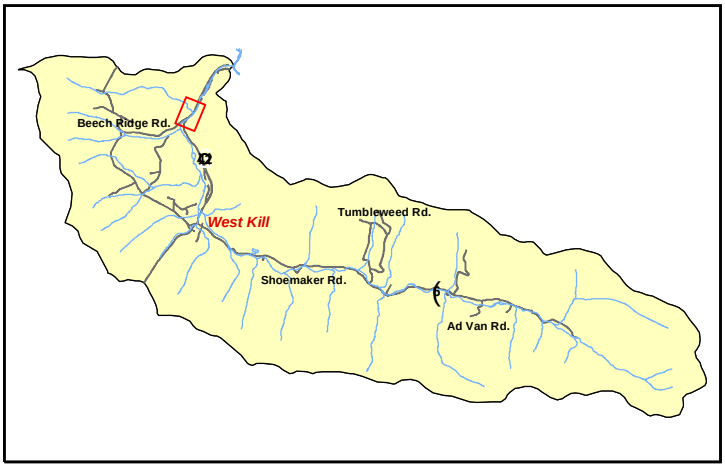


West Kill Management Unit 19

Stream Feature Statistics

32% of stream length is experiencing erosion
6% of stream length has been stabilized
9.0 acres of inadequate vegetation within the 300 ft. buffer
447 ft. of stream is within 50 ft. of the road
0 houses located within the 100-year floodplain boundary

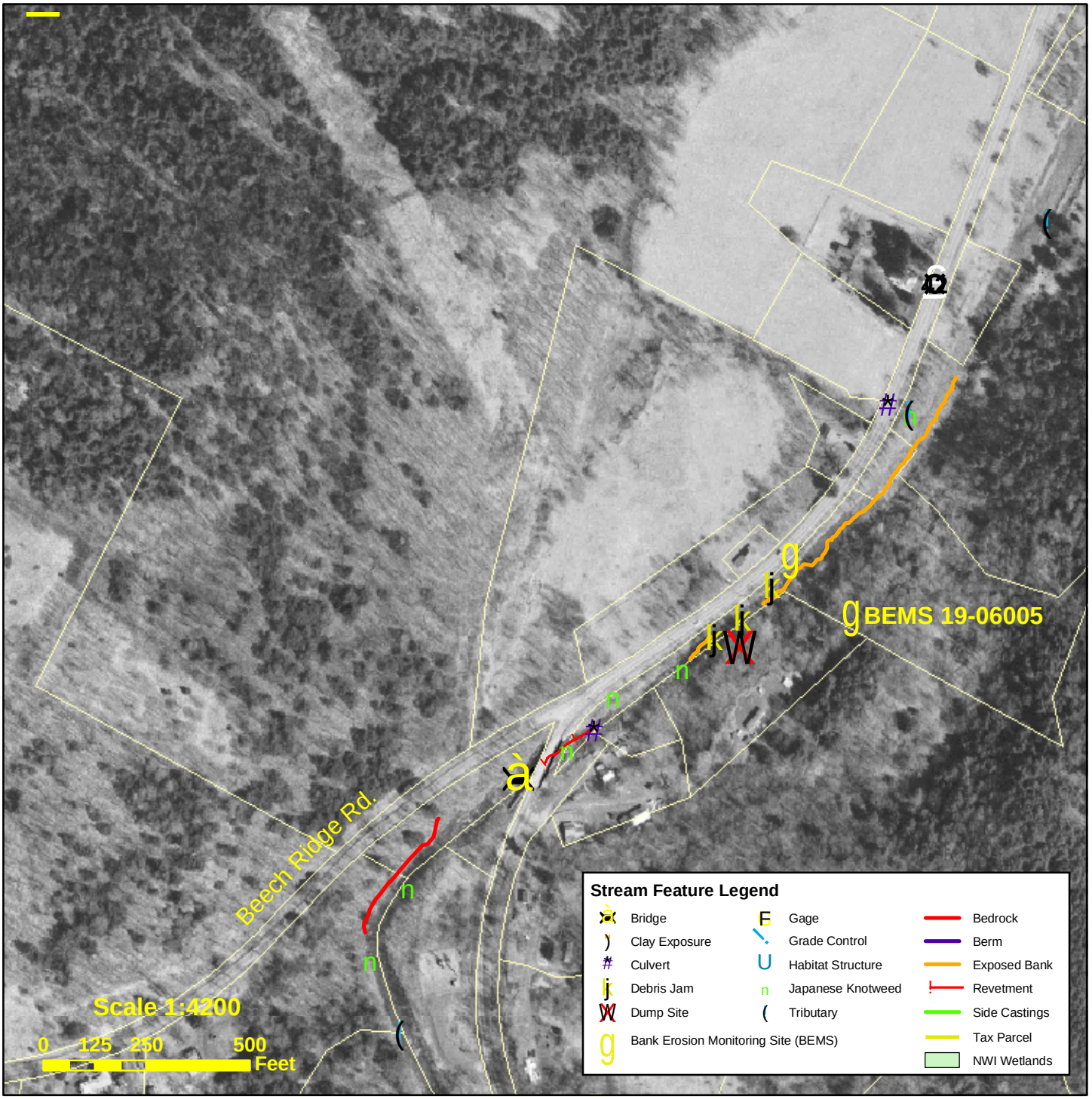


Figure 4.19.1 2004 aerial photography with stream feature inventory and tax parcels

Management Unit 19

Between Station 7402 and Station 4778

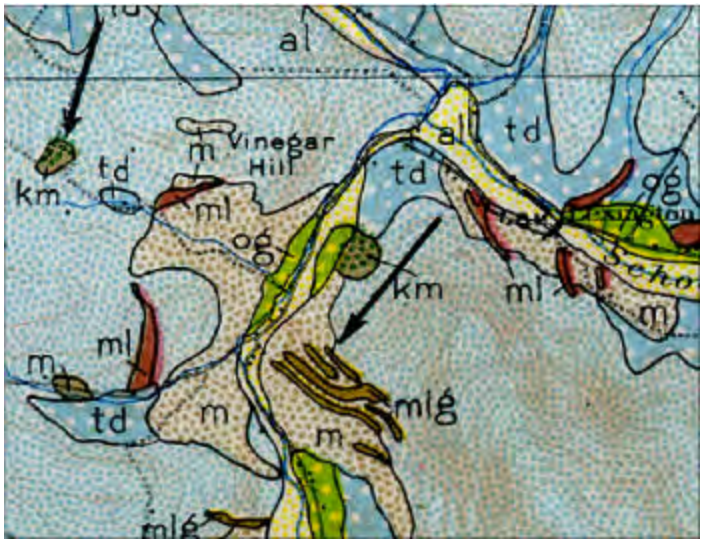
Management Unit Description

This management unit begins at Station 7402, just upstream of the State Route 42 bridge, continuing approximately 2624 ft. to where the floodplain opens up just downstream of the confluence of Roarback Brook (Station 4778). The drainage area ranges from 28.7 mi^2 at the top of the management unit to 30.7 mi^2 at the bottom of the unit. The valley slope is 0.83%.

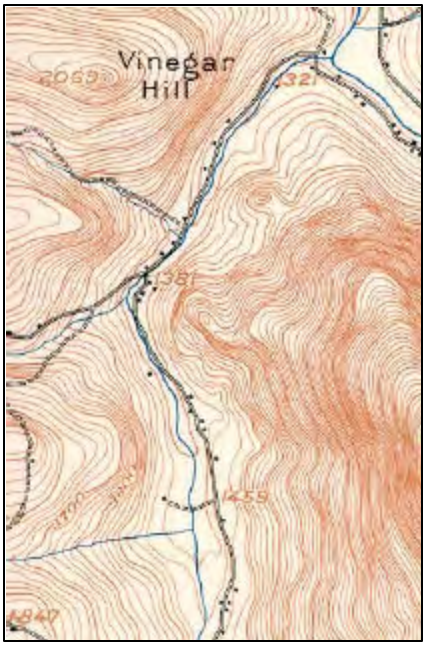
Summary of Recommendations Management Unit 19	
Intervention Level	Full Restoration
Stream Morphology	Restore sediment transport continuity.
Riparian Vegetation	Revegetate failing banks. Japanese knotweed eradication program.
Infrastructure	Interplant stable revetment; replace failing rip-rap with natural channel design treatments.
Aquatic Habitat	Watershed-wide study.
Flood Related Threats	Full restoration of erosion and infrastructure threats.
Water Quality	Isolate clay exposures.
Further Assessment	Investigate areal extent of lacustrine clay lens. Geotechnical assessment of failure mechanisms at BEMS 19-06005.

Historic Conditions

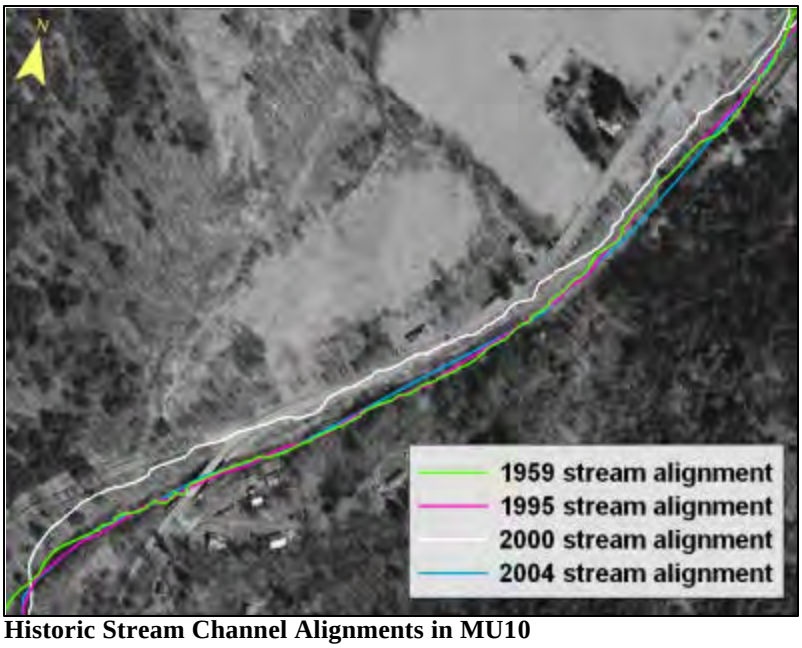
As the glaciers retreated about 12,000 years ago, they left their "tracks" in the Catskills. See Section 2.4, Geology of the West Kill Creek, for a description of these deposits.



Excerpt from Rich, 1935



USGS 1903 topographic map, excerpt



Historic Stream Channel Alignments in MU10

As seen from the historical stream alignments, the channel alignment has not changed significantly 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.

According to available NYS DEC records there was one stream disturbance permit issued in this management unit following the flood of 1996. Records indicate that this permit was issued to James Mayerhoefer, but did not indicate the extent of work performed.

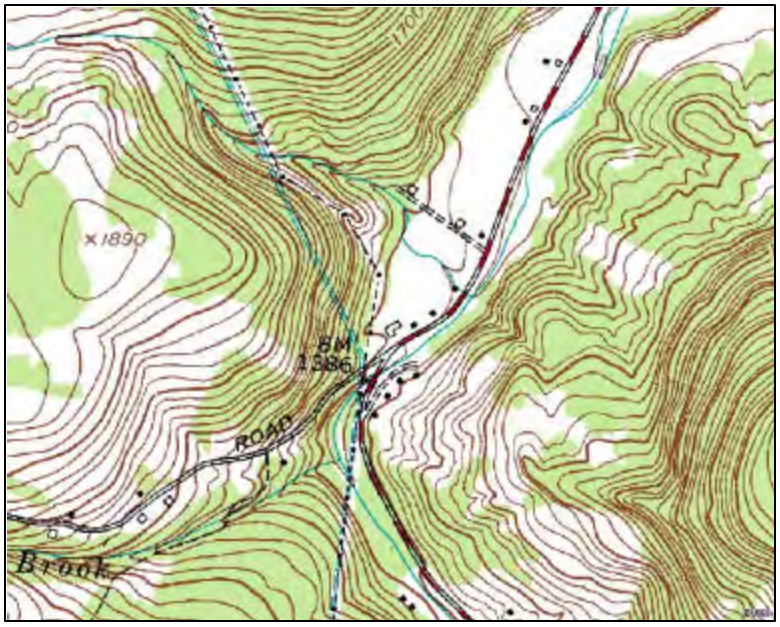
Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 32% (849 ft.) of the stream exhibited signs of active erosion along 2,624 ft. of total channel length (Fig. 1). Revetment has been installed on 6% (161 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 4.19.2. "Left" and "right" references are oriented looking downstream, photos are also oriented looking downstream unless otherwise noted. 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 from USGS topographic map, West Kill quad

In Management Unit 19, the West Kill begins by crossing to the east under State Route 42 at a pinch point in valley morphology. Downstream of the bridge, despite a general opening of the valley in the Vinegar Hill flats, the channel is tightly confined between the valley wall on the southeast, and the road embankment on the northwest and remains in this entrenched condition for the remainder of the management unit.

Stream morphology, or shape (i.e., slope, width and depth) remains the same throughout this unit, with relatively uniform morphologic characteristics, and is classified as a single F3 *stream type* (See Section 3.2 for description of stream types).

Cross-sections and Rosgen stream type classification in MU19

Three monumented cross-sections (Stations 6970, 6464, and 5266) document 2,624 ft. of F3 stream type, which encompasses this entire management unit. The channel slope decreases upstream to downstream, from to 1.83% at a monumented cross-section just downstream of the culvert outfall that carries drainage from Beech Ridge Road, to 0.85% near the downstream end of the unit. The dominant bed material remains cobble throughout the entire unit.


Knotweed on left bench

Management Unit 19 begins as the channel is turned sharply to the right by bedrock in the left bank and bed. The riparian buffer on the left is healthy, but on the right is narrow and somewhat disturbed in the vicinity of the power transformer station. During the 2005 inventory, two stands of Japanese knotweed (*Fallopia japonica*), an invasive, exotic shrub species that can grow rapidly to crowd out more appropriate streamside vegetation, were observed here on right and left banks, at this bend; by 2005 the number had increased to seven stands. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended. A culvert high on the left bank outfalls over the slope, and carries road drainage from Beech Ridge Road, which meets NYS Route 42 just downstream of the bridge.


Knotweed stand, right


NYS Route 42 bridge, looking upstream

The channel bed is armored with abundant boulders upstream, under and downstream of the NYS Route 42 bridge (#10252000) (see Inset H, Fig. 4.19.2). The abutments and concrete wingwalls are in good condition and despite the skewed angle of the crossing, the span appears sufficient to pass flood flows with little obstruction. There is some evidence of scour on the left and right abutments, and recent addition of dumped rip-rap scour protection on the right. This is the first evidence of possible channel incision in MU19.

Abutment scour protection

Downstream of the bridge on the right, a residence sits adjacent to the channel on a terrace that confines the channel on the right (see Inset D, Figure 4.19.2). The lawn is mown to the edge of the bank. The terrace bank is covered with a mixture of disturbed herbaceous vegetation and dumped revetment comprised of rock riprap and construction debris. The owner of the residence reports channel incision.

Grassed swale at residence

A grassed stormwater swale draining the area around the residence empties into the channel just downstream of the right bridge wingwall. The swale appears to be functioning to trap fine sediment.

Terrace bank, with Japanese knotweed

The NYS Route 42 road embankment confines the channel on the left. Several small stands of Japanese knotweed were documented on the right bank.

Culvert outfall over dumped rip-rap

A galvanized culvert, perched, and with no headwall, but with good outfall protection, also drains the residential area on the right.

Knotweed, left, on road embankment

Continuing downstream, several additional occurrences of knotweed, on both banks, were observed during the 2004 Stream Feature Inventory; the number of stands observed in the 2005 Inventory had increased notably throughout this unit, especially in the power line right-of-way on the NYS Route 42 road embankment.

Knotweed, right

Bank Erosion, left

Downstream of the residence, the riparian buffer improves on the right, as the terrace transitions into a continuous hillslope. Minor erosion of this hillslope (77 ft.) was observed. The increased channel confinement here is producing toe scour at higher flows, resulting in the introduction of some trees and clay-rich soil. The site was not monumented as a Bank Erosion Monitoring Site, but the second stream morphology classification cross-section runs through this eroding bank. The channel slope here has dropped to 1.1%.

Woody debris at base of slope

Woody debris along eroding bank

At the downstream end of this erosion, and higher up on this hillslope, a dumpsite was observed, containing old cars, metal and mechanical debris. It did not appear active. Appliances, trash and other refuse often contain metals, lubricants and various chemicals that can be detrimental to water quality. The dumpsite also degrades the aesthetic quality of this reach. Removal of the trash and appliances is recommended in order to protect water quality and limit further soil contamination.

Dumpsite on hillslope

Aggradation upstream of debris

Continuing downstream, aggradation of the bed was observed, likely the result of flow obstruction by a major debris jam comprised of abundant large woody material -- trees and rootballs -- introduced into the stream from large failing banks just downstream (See Insets C, G and B, Figure 4.19.2).

Debris jam at toe of large landslide

This debris jam is a major blockage at the toe of a large landslide on the right. The trees in the channel are creating a severe obstruction at all flows, and represent a serious threat to stability of the channel and the NYS Route 42 embankment. This 772 ft. long erosion site has been monumented as a Bank Erosion Monitoring Site (BEMS Station 19-06005). In a prioritization of twenty-one BEMS sites throughout the West Kill watershed (see Section 3.3, Watershed Inventory and Assessment), this site ranked High Priority, and in fact, is the highest priority site in the watershed. The *thalweg*, or deepest part of the stream channel flows up against the failing hillslope, which is being undermined by toe erosion, leaving large sections of the stream bank unvegetated. The hillslope, which has multiple scarps, is stratified, with numerous sand lenses exposed by the erosion through which groundwater piping was observed. These exposed *lodgement till* soils have a high silt and clay content, contributing sediment through both *wet and dry ravel* and yielding a significant suspended sediment and bed load during high flows. 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.

The conditions at this site present low potential for self-recovery. Full restoration of the site is recommended, necessarily preceded by a geotechnical assessment of the hillslope failure mechanisms. The restoration would likely involve installation of rock vanes to direct stream flows away from the banks, stabilization of at least the lower portion of the bank, and revegetation of the bank face. Because the instability problems at this site are related to sediment transport discontinuities in MU20, a comprehensive, integrated analysis and treatment of MU 19 and MU20 is recommended. In-depth survey and engineering design would be required to plan a stream restoration project at this site.

Downstream of the eroding bank, the channel grade flattens further, to 0.9%, as documented by the third monumented cross-section just downstream of the eroding bank. Entrenchment becomes extreme at this point; the reach, however, is aggrading due to the reduction in slope and the excess sediment supply introduced by the landslide. As NYS

Aggrading reach downstream of erosion

Lateral bar, left

Route 42 bends to the left, a lateral bar develops on the left, sparsely vegetated with sedges and willows.

Roarback Brook confluence

Culvert under NYS Route 42

Continuing downstream, Roarback Brook (1.7 mi.^{2}) enters across the bar on the left, having passed through a large concrete culvert, controlled with a concrete culvert bottom, under NYS Route 42. This grade control sill extends for some distance beyond the box opening at the downstream end, and the tributary channel then plunges 1.5' into a scour pool, presenting a possible barrier to fish migration into the tributary. A stand of Japanese knotweed was observed at the confluence.

Downstream of the tributary confluence, on the right bank, a stacked stone abutment for a relic cable bridge crossing remains. Across the channel, a spring has been piped, possibly from a cistern back in the floodplain.

Bridge Abutment

Piped spring

Downstream of the spring, a small, unnamed tributary enters from the right, across a perched but well vegetated floodplain. Aggradation continues through the downstream end of the management unit. Entrenchment diminishes as the channel reconnects with its floodplain right and left, the channel begins to widen and the slope continues to drop.

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).

Sediment transport in the upstream half of MU19 is strongly influenced by the encroachment of NYS Route 42 on the channel. While grade is probably controlled at the beginning of the unit by bedrock, the entrenchment of the channel between an unstable valley wall on the east and the highway on the west is creating conditions for incision and/or lateral erosion below the Route 42 bridge. The large landslide in the middle of the unit is partly the result of these over-effective conditions at high flows.

The downstream half of the unit, by contrast, exhibits aggradational conditions, created by the transition to a valley morphology that permits connectivity between the channel and floodplain, the reduction in slope, and the sediment inputs introduced by the landslide. These conditions have a low potential for self-recovery, as additional aggradation is likely to exacerbate the erosion of the toe of the landslide, resulting in the introduction of even more sediment into the stream.

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 4.10.3). Japanese knotweed occurrences were documented as part of the

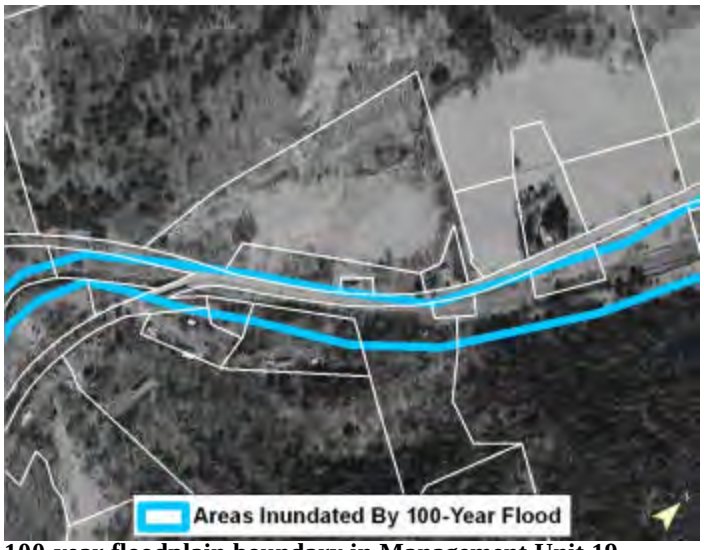
stream feature inventory conducted during the summer of 2004, with additional occurrences identified in 2005.

In this management unit, the predominant vegetation type within the 300 ft. riparian buffer is Forest (50%) followed by Herbaceous (20%). *Impervious* area (6%) within this buffer is primarily the Greene County Route 6, along with private residences and associated roads. Five occurrences of Japanese knotweed were documented in this management unit during the 2004 inventory; that number increased to sixteen occurrences in 2005. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended.
There are no 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).

Areas identified as having herbaceous (non-woody) cover may 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, potential riparian improvement planting sites were identified through a watershed-wide remote evaluation of current riparian vegetation conditions in a critical buffer zone extending approximately 75 ft. from the centerline of the stream (Fig 4.10.4). These are sites where plantings of trees and shrubs on and near stream banks would likely reduce the threat of serious bank erosion, and can improve aquatic habitat as well. In some cases, these sites 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 the biological integrity of the stream and floodplain. Twenty-four potential planting sites were identified in MU10.

In many cases, these sites can not be effectively treated with riparian enhancement alone, and full restoration efforts would include bank and/or channel restoration components in addition to vegetative buffer plantings. However, the risk to bank stability can be minimized by maintaining mature trees along the stream margin. The risks and benefits associated with management of streamside vegetation will depend partly on the current channel conditions, and local channel surveys are recommended at each site.

Flood Threats



100-year floodplain boundary in Management Unit 19

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. There are no houses in the 100-year floodplain in this management unit. 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.

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

Thirty-two percent (849 ft.) of the stream in this unit is experiencing major erosion, and 6% (161 ft.) has been stabilized. The management unit is generally unstable, and there is one Bank Erosion Monitoring Site (BEMS #19-6005), which serves to document a total of 772 ft. of bank erosion in the middle of the management unit. Because this site poses a serious water quality concern, infrastructure is threatened, and is not likely to self-recover readily, it ranked as a High Priority, and Full Restoration is recommended at the site.

Infrastructure

Six percent of the stream in this management unit has been treated with some form of revetment. While there are no immediate threats to roadways or bridges in this management unit, the severity of the landslide and debris jam in the middle of the unit has a significant potential to destabilize the NYS Route 42 embankment. It is recommended that a comprehensive restoration design be developed that incorporates stabilization of the roadway as a primary objective.

Aquatic Habitat

It is recommended that a habitat study be conducted on the West Kill Creek, with particular attention paid to possible physical and 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.

If restoration is implemented here, before/after habitat assessment should be considered for the restoration site.

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 two significant clay exposures documented in this management unit. Full restoration at this site should attempt to isolate this clay exposure from bed scour. Investigation of the areal extent of the clay in bed and banks should be conducted prior to design.

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 are two stormwater culverts in this management unit, and 17% of the stream (447 ft.) lies within 50 ft. of a road.

Nutrient and pathogen loading from failing septic systems or livestock manure is another potential source of water pollution. Leaking septic systems can contaminate water making it unhealthy for swimming or wading. There are no houses located in close proximity to the stream channel in this management unit.

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.

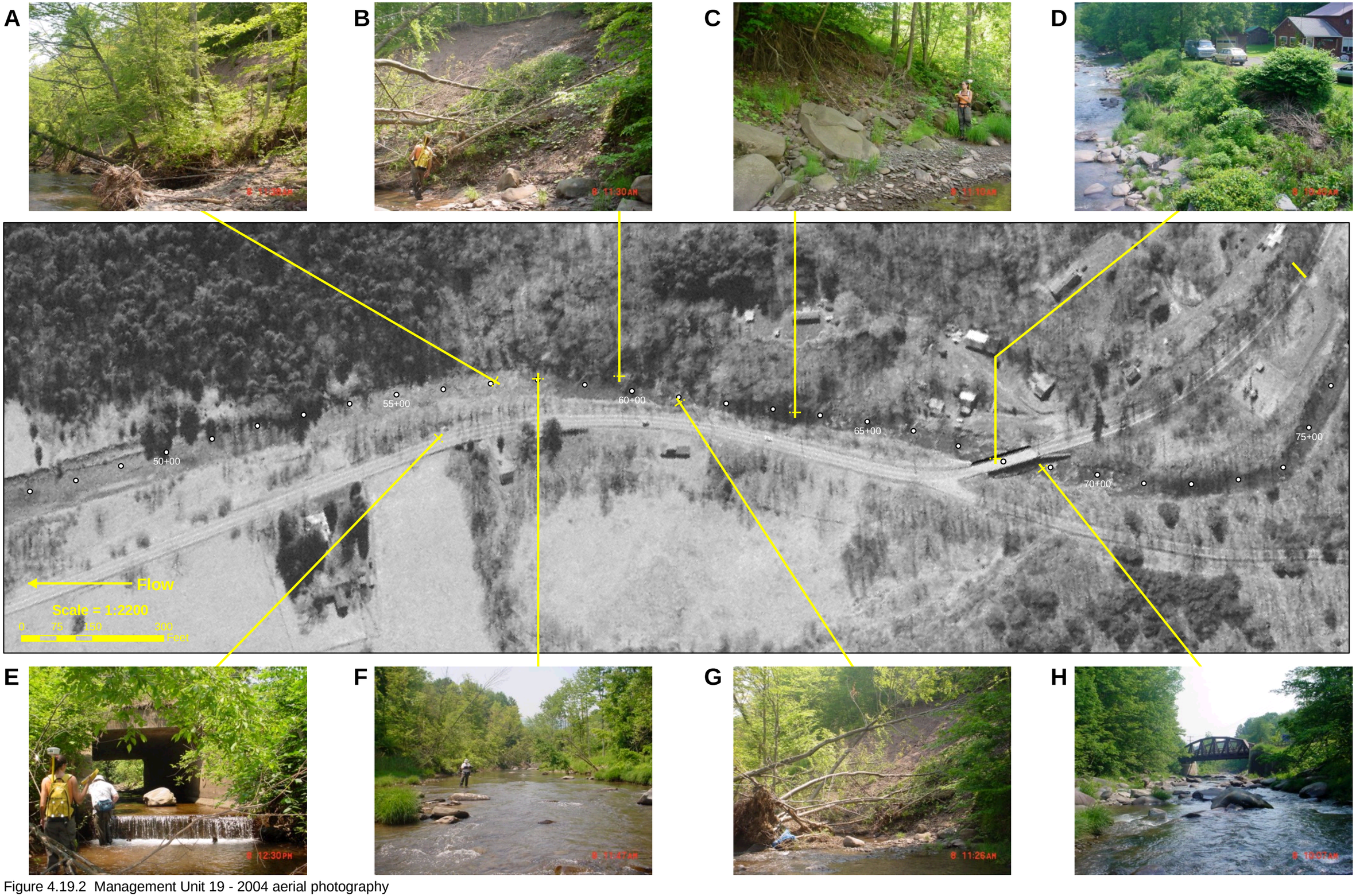


Figure 4.19.2 Management Unit 19 - 2004 aerial photography