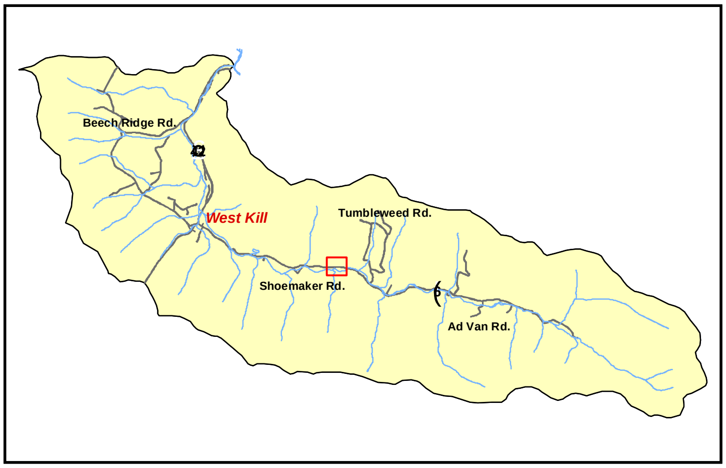
West Kill Management Unit 10



Stream Feature Statistics

31% of stream length is experiencing erosion
26% of stream length has been stabilized
8.6 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

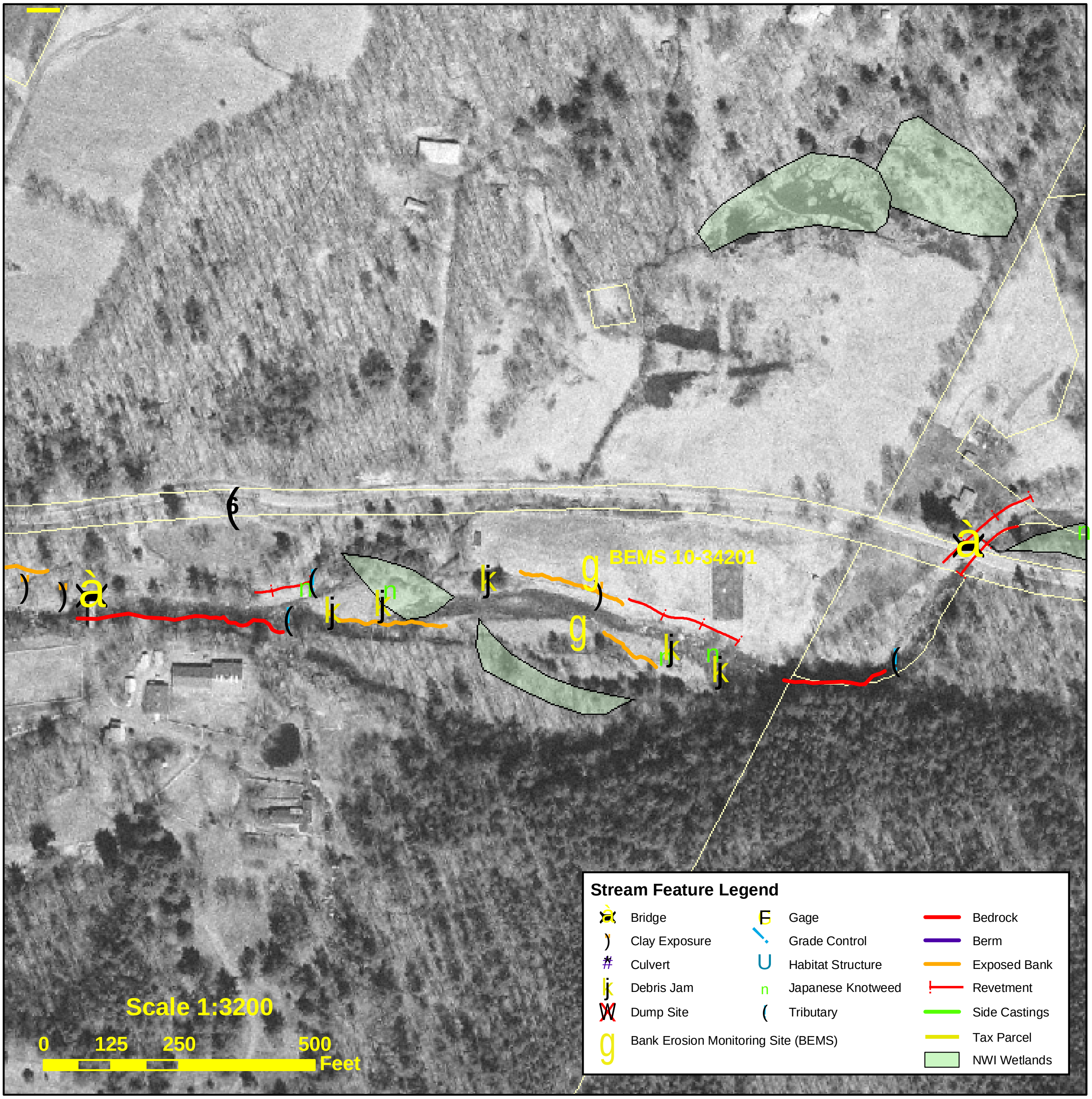


Figure 4.10.1 2004 aerial photography with stream feature inventory and tax parcels

Management Unit 10

Between Station 32092 and Station 30263

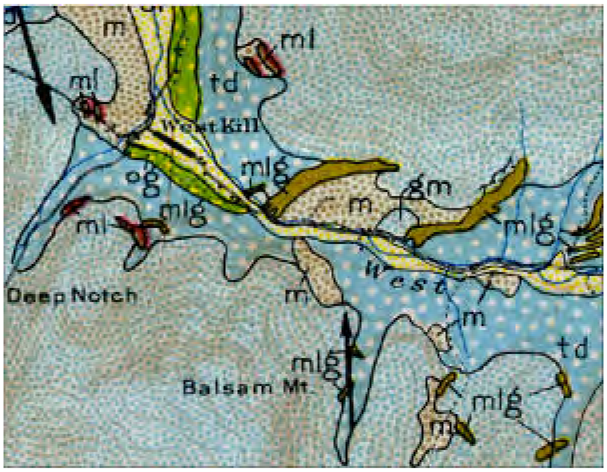
Management Unit Description

This management unit begins just downstream of the County Route 6 bridge at Station 30263, continuing approximately 1829 ft. to the private bridge crossing at RCH Farms (Station 30263). The drainage area ranges from 14.5 mi^2 at the top of the management unit to 15.6 mi^2 at the bottom of the unit. The valley slope is 1.65%.

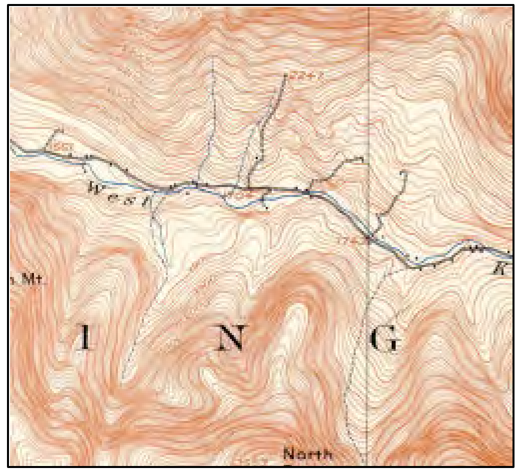
Summary of Recommendations Management Unit 10	
Intervention Level	Full Restoration at bank erosion sites in the middle of the management unit.
Stream Morphology	Design of channel morphology to improve sediment transport effectiveness.
Riparian Vegetation	Reestablishment of vegetative buffer along pasture.
Infrastructure	Interplant stable revetment; replace failing riprap with natural channel design treatments.
Aquatic Habitat	Watershed-wide study.
Flood Related Threats	Mitigate erosion threats.
Water Quality	Isolate clay exposures; improve buffer at pasture.
Further Assessment	Investigate areal extent of lacustrine clay lens.

Historic Conditions

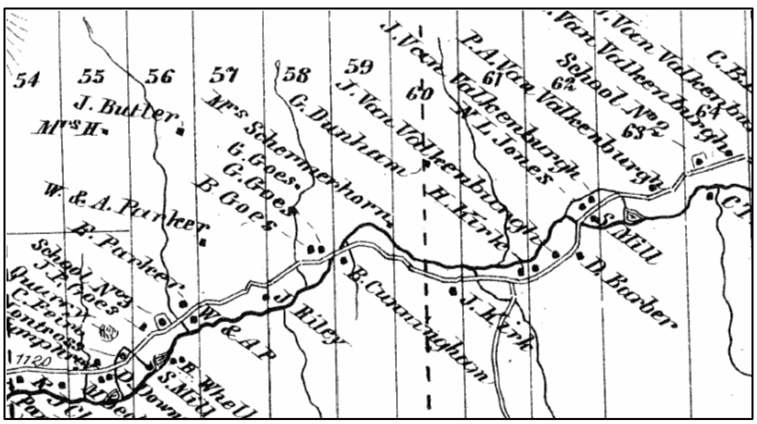
As the glaciers retreated about 12,000 years ago, they left their “tracks” in the Catskills. See Section 2.4, Geology of the West Kill Creek, for a description of these deposits.



Excerpt from Rich, 1935

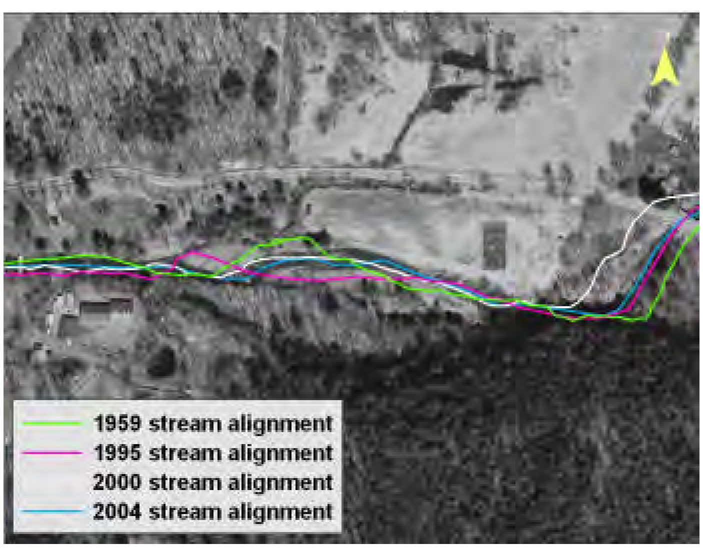


USGS 1903 topographic map, excerpt



F.W. Beers 1867 Atlas of Greene County, New York, excerpt from the Town of Lexington

Both the 1867 Beers map and USGS topography from 1903 indicate that the channel may have turned less severely near the beginning of the unit than it does currently. This interpretation is supported by indications of relic channels in aerial photography, below.



Historic Stream Channel Alignments in MU10

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

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 RCH stables, but did not indicate the extent of work performed.

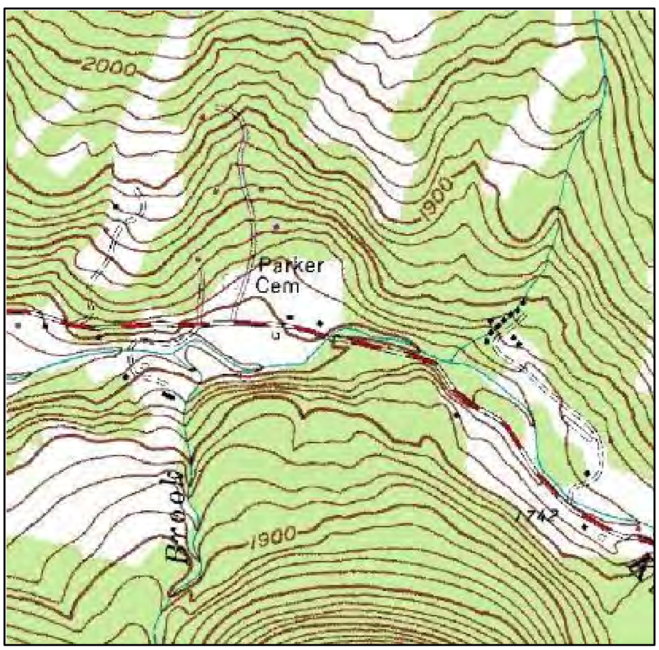
<u>**Stream Channel and Floodplain Current Conditions**</u>

Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 31% (558 ft.) of the stream exhibited signs of active erosion along 1829 ft. of total channel length. Revetment has been installed on 26% (482 ft.) of the stream length. No berms were identified in this management unit at the time of the stream feature inventory, although there is some evidence of floodplain grading.

Stream Morphology

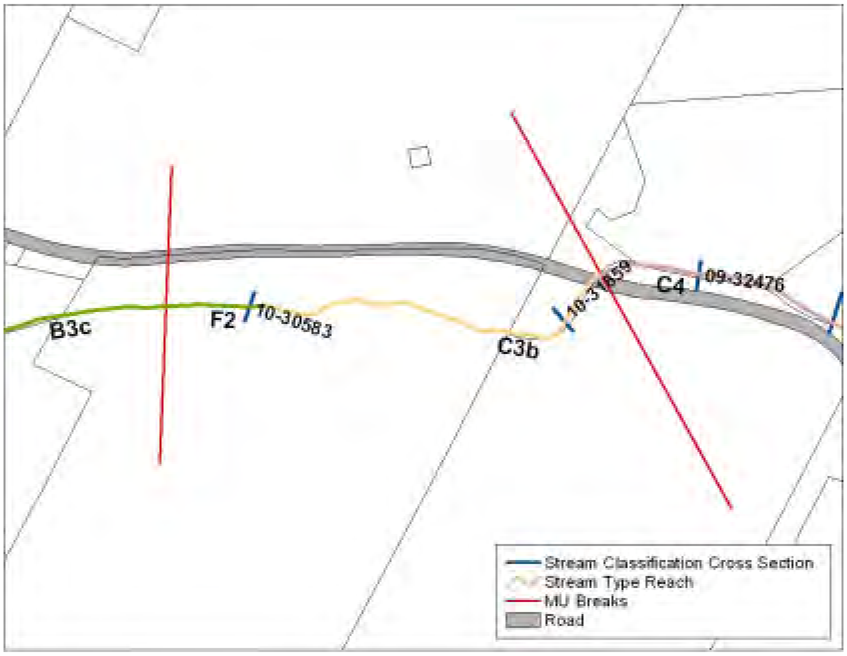
The following description of stream morphology references insets in the foldout Figure 4.9.2. "Left" and "right" references are oriented looking downstream. Stationing references proceed upstream, in feet, from an origin (Station 0) at the confluence with the Schoharie Creek at Lexington. Italicized terms are defined in the glossary. This characterization is the result of surveys conducted in 2004 and 2005.



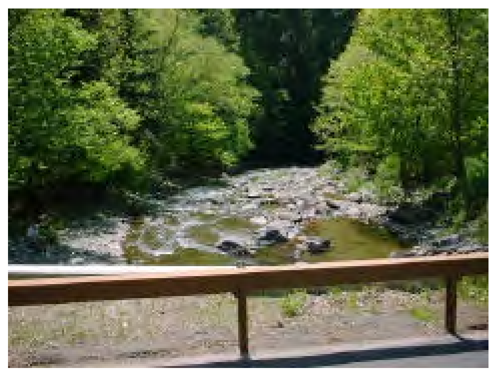
Excerpt of 1980 USGS topographic map

In Management Unit 10, the West Kill begins by crossing to the south under County Route 6, as the valley opens back up again. As it reaches the south valley wall, the channel is turned back to the right, and is vertically controlled by a bedrock sill. The channel morphology here is largely controlled by the next valley pinch point, where a private bridge crosses at the end of the management unit, and where a bedrock sill again provides vertical control. The significant drainage of Hagadore Brook confluences just upstream of this bridge; it appears that some of its sediment load may be deposited as it crosses the relatively broad flat of a high terrace (elev. 1800-1900 ft.). The West Kill channel moves between aggradational conditions at the upstream end, to effective sediment transport through the bridge.

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).



Cross-sections and Rosgen stream types in Management Unit 10

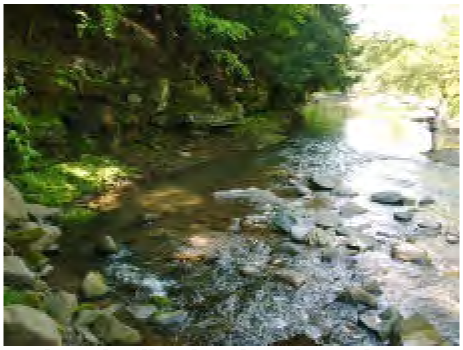


County Rte. 6 bridge, looking downstream

Management Unit 10 begins with a 1442 ft. reach of C3b streamtype as documented by a monumented cross-section at Station 31859. Downstream of the bridge, the slope increases significantly to 2.4%, and the dominant material in the channel transitions from gravel to cobble. A healthy riparian buffer protects streambank stability on the left here, and should be preserved. Higher flows have floodplain access on both banks. The riparian vegetation on the right is less mature, and should be allowed to grow into maturity. The channel flows up against the rip-rap protecting the downstream, right embankment and bridge approach, the toe of which is stabilized with sheet piling (see Inset D, Fig. 4.10.2).

Tributary, left

A small tributary enters from the left through the forested buffer, over a somewhat perched floodplain, with good outfall protection. During the 2005 inventory, a number of clusters of Japanese knotweed, an invasive, exotic shrub species that can grow rapidly to crowd out more beneficial streamside vegetation, were observed here on the left bank. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended. The streambed includes abundant small boulders here.

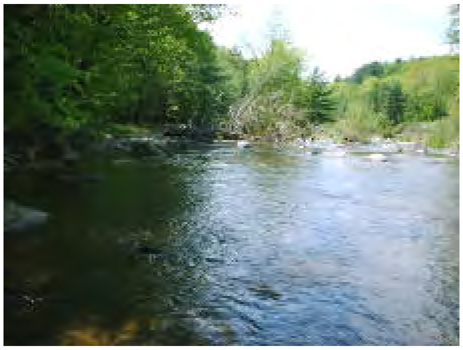


Bed Rock sill at bend in channel

As the channel meets the base of the valley wall, it is turned to the right by a bedrock bank and bed on the left; it is likely that bedrock provides grade control across the entire channel width, as sub-pavement under the cobble bed, but it could not be confirmed on the right.

Aggradation

Downstream of the bend, evidence of aggradation in the streambed was observed, and the channel slope begins to flatten again. As the channel makes a gentle bend back to the left, a mid-channel bar is developing. In a stable sediment regime, this typically would be a point bar, with an overflow channel on the left and the main channel to the right. Several jams of woody debris, however, were documented on the bar, which appear to obstruct bankfull and higher flows, impeding sediment transport, causing aggradation and directing flows right and left. Several occurrences of Japanese knotweed were also documented on the bar, to the left of the main channel. The valley wall on the left remains forested, but the low terrace on the left has patchy mature vegetation, and a pasture on the right has essentially no buffer protection.



Debris Jam

Proceeding downstream, the right bank and horse pasture beyond it has been protected by 221 ft. of placed rip-rap. Willows and sedges have intergrown the rip-rap, providing additional stability at the upstream end (see Inset D, Fig. 4.10.2).

Knotweed

Rip Rap

Downstream, however, the toe of the installation has failed, apparently the result of a *headcut* passing up the reach. Evidence of bed degradation is also seen downstream.

Debris Jam

Moving downstream, bankfull channel width increases, and the mid-channel bar deposits push the erosional force of the stream at higher flows to the right and left. On the left side of the mid-channel bar, a low terrace exhibits approximately 122 ft. of cut bank (see Inset G, Fig. 4.10.2), with mature trees leaning over and falling into the left channel thread, from the poorly vegetated floodplain. This bank cutting is the result of excessive floodplain connection, aggradation and lateral channel migration.

This erosion was not significant enough to warrant a separate monumented monitoring cross-section, but is part of the larger erosion site documented at Station 31201, just downstream.

Knotweed on bar

Bank Erosion, 2004

On the right, the main thread of the channel closely parallels the fenced horse pasture, devoid of any mature vegetative buffer. Approximately 206 ft. of erosion on the right bank has been monumented as a Bank Erosion Monitoring Site BEMS #10-31201 (see Inset B, Fig. 4.10.2). In a prioritization of twenty-one BEMS sites throughout the West Kill watershed (see Section 3.3, Watershed Inventory and Assessment), this site ranked as a High Priority. The *thalweg*, or deepest part of the stream channel flows up against the bank, which is being undermined by toe scour, leaving most of the stream bank unvegetated. Previously placed rip-rap has also apparently been destabilized by extreme near bank shear stress. The bank retreat as a result of high flows in the spring of 2005 has exposed extensive clay deposits in the bed, and destroyed 180 ft. of horse fencing.

Worsening streambank erosion in 2005

The *alluvial* and *lacustrine* soils in the bank and bed have a high silt and clay content, yielding a significant suspended sediment 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. Because the bankfull channel appears to be widening here, it is recommend that an additional monumented classification cross-section be added between Stations 31100 and 31400, if an appropriate location can be found.

Full restoration is recommended at this site. Ideally, this would involve establishment of a well-vegetated bench on the right at the base of the pastured terrace, rock vanes to direct stream flows away from the bank, revegetation of the bank face and bench with bioengineering stabilization, establishment of a vegetated buffer on both the right and left, and possibly a decrease in bankfull channel width and increase in sinuosity. In-depth survey and design would be required to plan a stream restoration project at this site.


Aggradation downstream of erosion

The channel bends back to the left at the downstream end of the erosion, and aggradation is observed again, caused by increased entrenchment and the narrowing of the bankfull channel further downstream. Channel narrowing, whether due to encroachment by road embankments, bridge abutments or valley pinch points, can cause backwatering, slowing down streamflows, and result in a building up of the streambed, as seen here. As the stream bed aggrades, woody debris can become immobilized and accumulate, which also is observed here along the right bank. This debris jam creates an obstruction at all flows; it does, however, provide some habitat cover.


Debris Jam


Bank Erosion, left

The aggradation described above is putting pressure on both right and left banks, undercutting 230 ft. of the terrace on the left, and undermining trees which have fallen across the channel. These fallen trees further obstruct flows and exacerbate the aggradational trends.

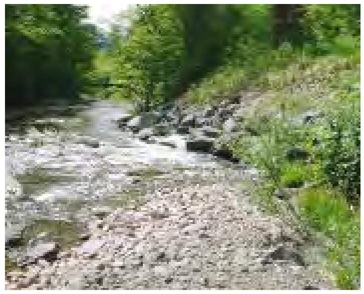

Undermined trees, left

On the right, a small stand of Japanese knotweed was documented near the confluence of a small, unnamed tributary entering from the right, across a well-vegetated and well-connected floodplain. Entrenchment increases, and a monumented cross-section (Station 30583) documents the transition to a 387 ft. of F2 stream type. The slope diminishes to 0.76%, yet the dominant bed material transitions to boulders. Just downstream of the tributary confluence, large quarried rock rip rap has been stacked


Japanese knotweed

and dumped on the right bank, to stabilize the RCH driveway embankment. The installation appears to further narrow the channel, and likely aggravates the associated aggradation upstream.

Large, stacked revetment at mouth of tributary

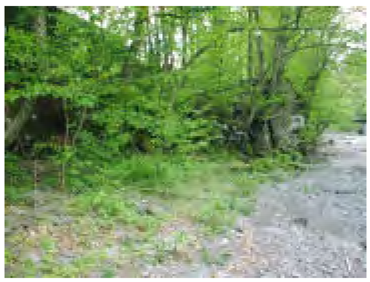


Rip Rap, right, narrowing the channel

Hagadore Brook confluence, left, perched

Bedrock bank, left, with trees on lateral bar

Laid stone masonry wall

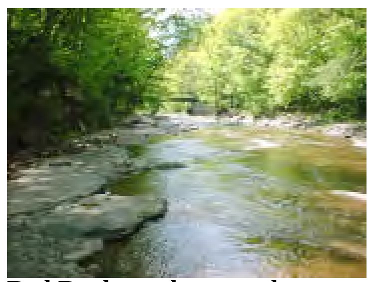


Bedrock bank, left, encroaching on channel

Tributary confluence, right

A major tributary, Hagadore Brook (0.7mi.^{2}) confluences from the left over a bedrock ledge, forming a waterfall and then crossing a narrow lateral bar. Downstream of the tributary confluence, the bedrock bank on the left encroaches on the stream, transitioning to a laid stone wall.

On the approach to the bridge crossing at RCH stables, the bedrock on the left extends into and across the bed, providing grade control. At the bridge itself, the abutments narrow the channel considerably. As described earlier, this undersized bridge opening causes water to back up upstream of the bridge, reducing stream velocity, which results in sediment deposition. In such settings, higher stage floodwaters may seek conveyance through alternative paths, forming new channels around the bridge constriction. No such paths exist here, however, due to the extent of entrenchment and revetment. Additional *floodplain drainage*, using culverts set at the floodplain elevation under the right bridge approach, may help mitigate this problem. Alternatively, when the landowner eventually must replace or renovate the bridge, lengthening the bridge span should be considered to further reduce backwatering here and aggradation upstream.



Bed Rock grade control

RCH bridge, new abutments

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 MU10 is, like in the previous unit, strongly influenced by valley morphology. The valley pinch point at Station 30263, used as a convenient place to locate a bridge crossing that further confines flood flows, results in the generally aggradational conditions upstream. These reaches are bookended by vertical and, in places on the left, lateral bedrock controls. This leaves the right bank as the deformable boundary in several places; bank erosion is the result.

Extensive mid-channel bars generally indicate ineffective sediment transport. Bedrock grade control near the upstream and downstream ends of the unit provides a limit on incision, or the lowering of the elevation of the channel. The result is a low channel slope, and the reach becomes a location where sediment delivered from upstream is stored. Sediment storage areas benefit the general health of the stream system by limiting bedload delivered to downstream reaches during large storm events. Sediment sinks such as this throughout the watershed should be identified and preserved where adjacent land uses permit. Mature riparian vegetation will be important in such settings to limit the extent of lateral channel migration and bank erosion.

However, where the deposition of sediment forces the channel toward the right bank, local incision results. Lacustrine clay exposures in the bed on the right have been exposed in these reaches. These exposures point to the possibility that, during the end of the last glacial period, an ice jam at the valley pinch point may have impounded glacial meltwater upstream, leading to the lakebed deposits. These clay beds were subsequently overlain with deep alluvial deposits of cobble, gravel, and sands, indicating another period of ineffective sediment transport before the present channel incised into this material.

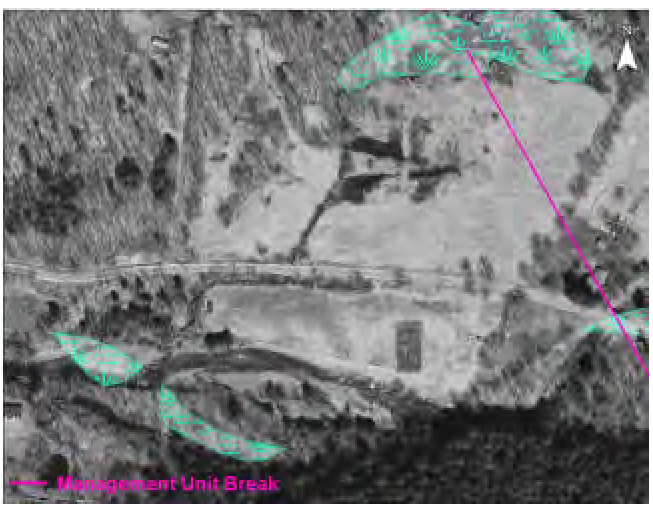
Riparian Vegetation

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 (54%) followed by Herbaceous (27%). *Impervious* area (4%) within this buffer is primarily the Greene County Route 6, along with private residences and associated roads. Four occurrences of Japanese knotweed were documented in this management unit during the 2004 inventory; that number increased to seven occurrences in 2005. A program of eradication of Japanese knotweed throughout the West Kill valley is recommended.



National Wetland Inventory wetlands in MU10

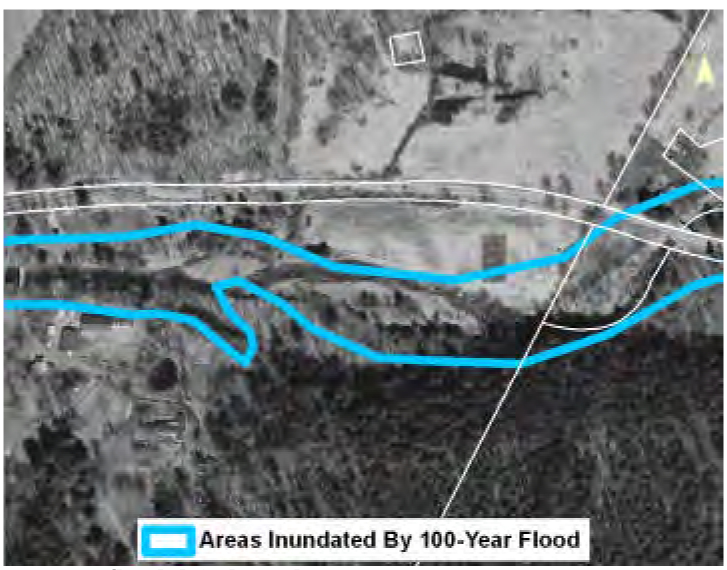
There are three wetlands within this management unit mapped in the National Wetland Inventory (see Section 2.5, Wetlands and Floodplains for more information on the National Wetland Inventory and wetlands in the West Kill watershed). Wetlands are important features in the landscape that provide numerous 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 most upstream wetland, which measures 0.8 acres in size, is designated *palustrine, unconsolidated bottom, semipermanently flooded, diked/impounded* (PUBFh). Moving downstream, there are two wetlands both measuring 0.3 acres in size, and designated *riverine, upper perennial, unconsolidated shore, temporarily flooded* (R3USA).

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 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

Inundation



100 year floodplain boundary, MU10

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 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-one percent (558 ft.) of the stream length in this unit is experiencing minor erosion, and 26% (482 ft.) has been stabilized. This and the variability of the historic alignments would indicate that the management unit should be considered generally unstable, and there is one Bank Erosion Monitoring Site (BEMS #10-31201). This monitoring station serves to document a total of 206 ft. of bank erosion in the middle of the management unit. Because this site poses a water quality concern and infrastructure is threatened, and is not likely to self-correct readily, it ranked as a High Priority, and Full Restoration is recommended at the site.

Infrastructure

Twenty-six percent of the stream length in this management unit has been treated with some form of revetment. This does not include previously placed riprap that has evidently been lost to erosion. While there are no immanent threats to roadways or bridges in this management unit, the revetment has been compromised to some degree in numerous places, including along the driveway, and 180 ft. of pasture fencing has been destroyed. It is recommended that plantings of ecologically appropriate trees and shrubs should be interplanted with the existing dumped rip rap to increase bank stability and improve buffer function. This planting should be performed after completion redesign and construction of channel and floodplain morphology.

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, 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 was one significant clay exposure 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 lens should be undertaken 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 no stormwater culverts in this management unit, and only 3% of the stream (50 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 horse pasture represents a potential source of both nutrients and pathogens, and restoration should include planting of a riparian buffer to better isolate the pasture from the stream.

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.

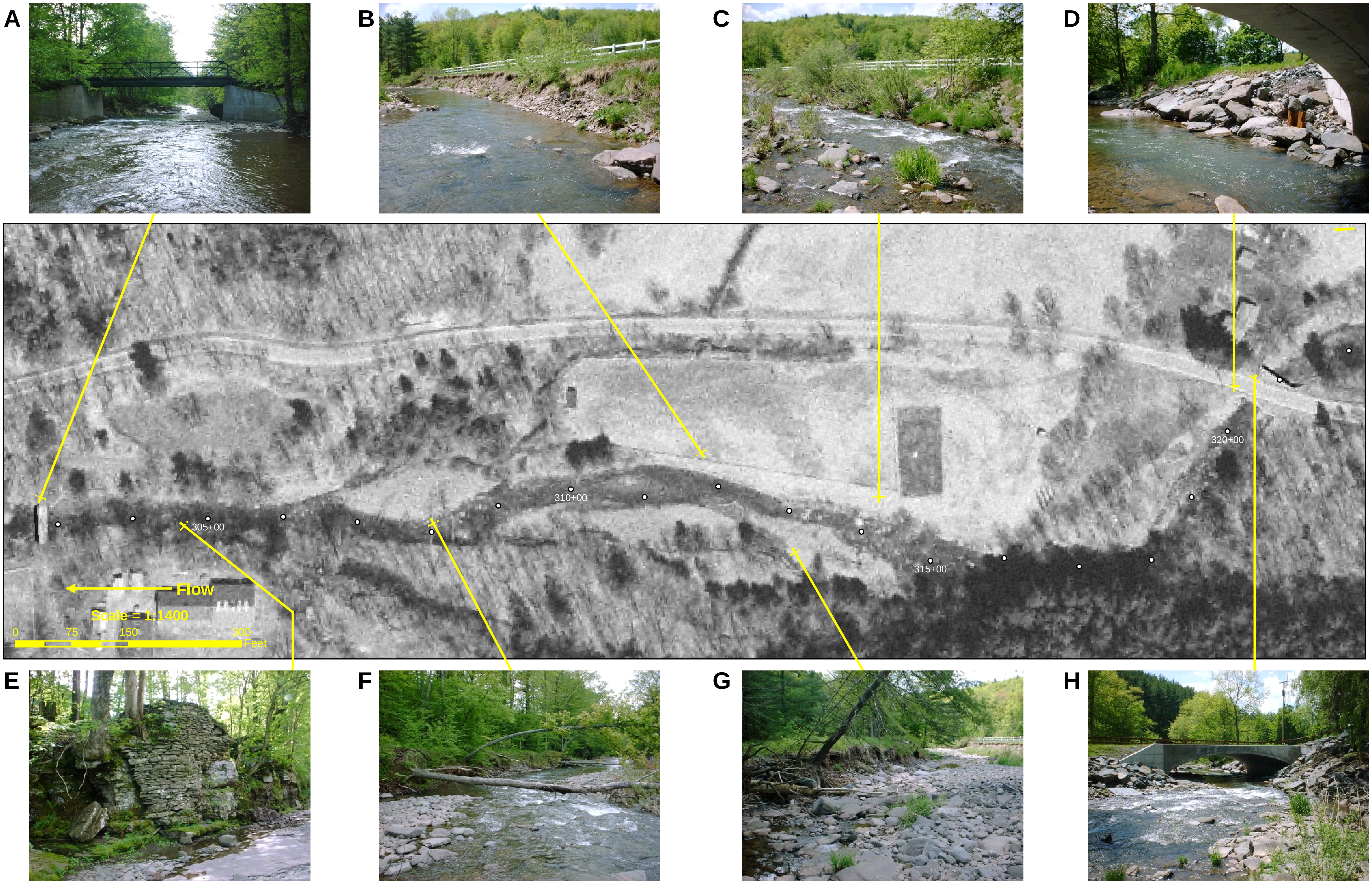


Figure 4.10.2 Management Unit 10 - 2004 aerial photography