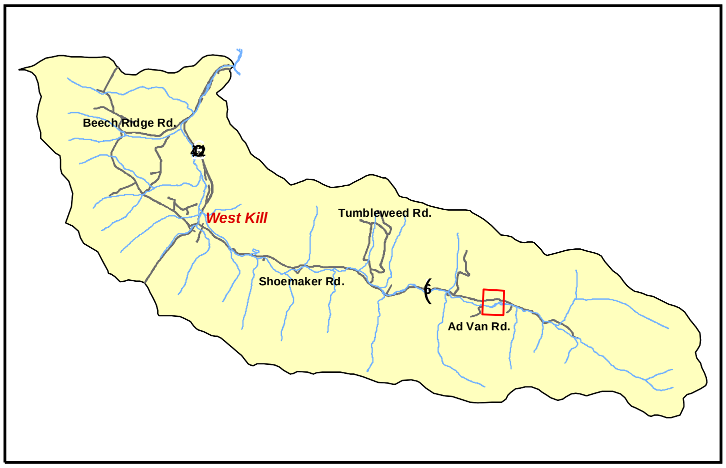


West Kill Management Unit 4

Stream Feature Statistics

12% of stream length is experiencing erosion
11% of stream length has been stabilized
12.3 acres of inadequate vegetation within the 300 ft. buffer
13 ft. of stream is within 50 ft. of the road
0 houses located within the 100-year floodplain boundary

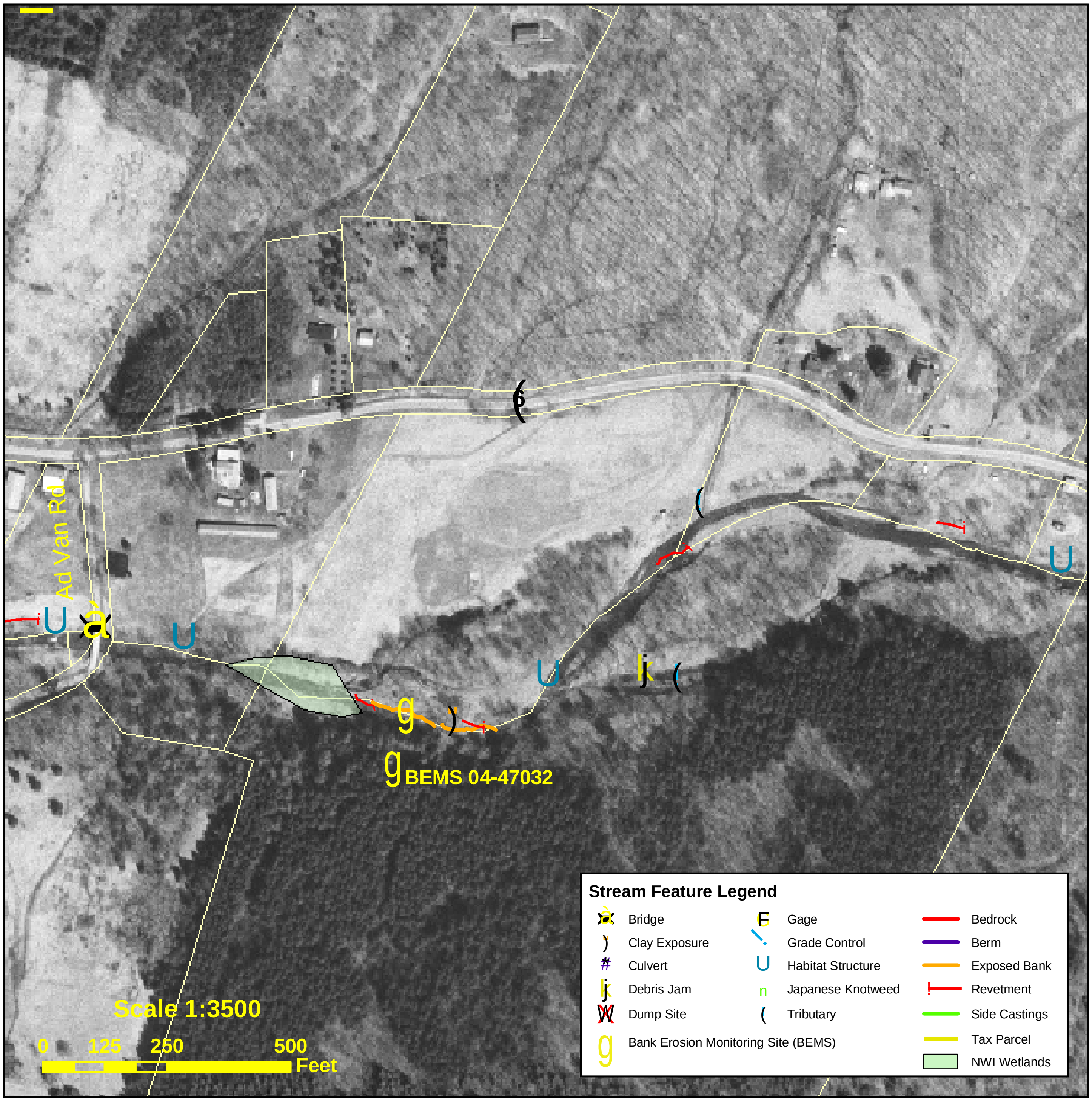


Figure 4.4.1 2004 aerial photography with stream feature inventory and tax parcels

Management Unit 4

Between Station 48476 and Station 46365

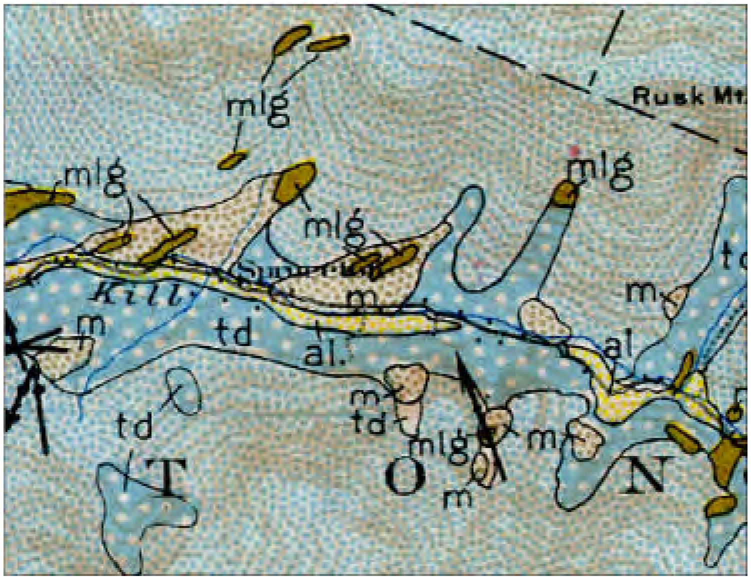
Management Unit Description

This management unit begins just downstream of the NYSDEC habitat structure at the end of Management Unit 3, continuing approximately 2,111 ft. to the Ad Van Road bridge. The drainage area ranges from 6.6 mi^2 at the top of the management unit to 7.4 mi^2 at the bottom of the unit. The valley slope is 1.65%.

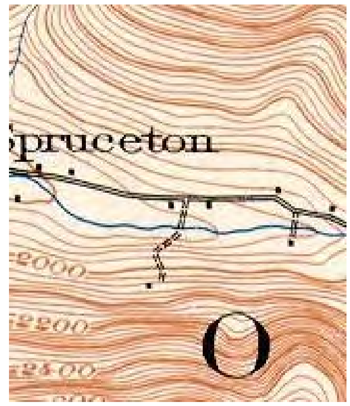
Summary of Recommendations Management Unit 4	
Intervention Level	Passive
Stream Morphology	None
Riparian Vegetation	Potential plantings along upstream aggradational reaches, Increase in buffer width in downstream reaches, right
Infrastructure	None
Aquatic Habitat	Watershed-wide study Investigate aggradational reaches for potential temperature and physical barriers
Flood Related Threats	None
Water Quality	Investigate fine sediment and nutrient enrichment sources
Further Assessment	Geotechnical assessment of BEMS 04-47032

Historic Conditions

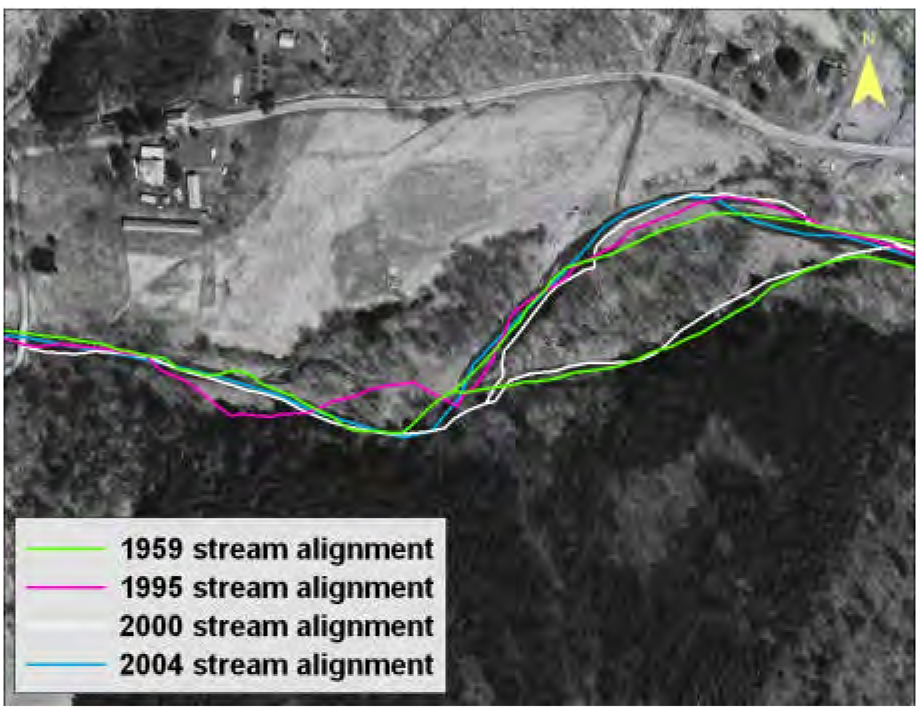
As the glaciers retreated about 12,000 years ago, they left their "tracks" in the Catskills. See Section 2.4, Geology of the West Kill Creek, for a description of these deposits.



Excerpt from Rich, 1935



Excerpt of 1903 USGS topographic map MU4



Historic Stream Channel Alignments in MU4

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

Managing a West Kill tributary, circa. 1950

Looking up the valley, the aerial photo shows a braided portion of channel in MU4, evident as far back as our earliest photography (1959). Braiding is not evident on the USGS 1903 topographic map.

Erosion after the January 1996 flood

Flood repair, Ben Barcone's property

According to available NYS DEC records there was one stream disturbance permit issued in this management unit following the flood of 1996, to stabilize 50 ft. of streambank with revetment.

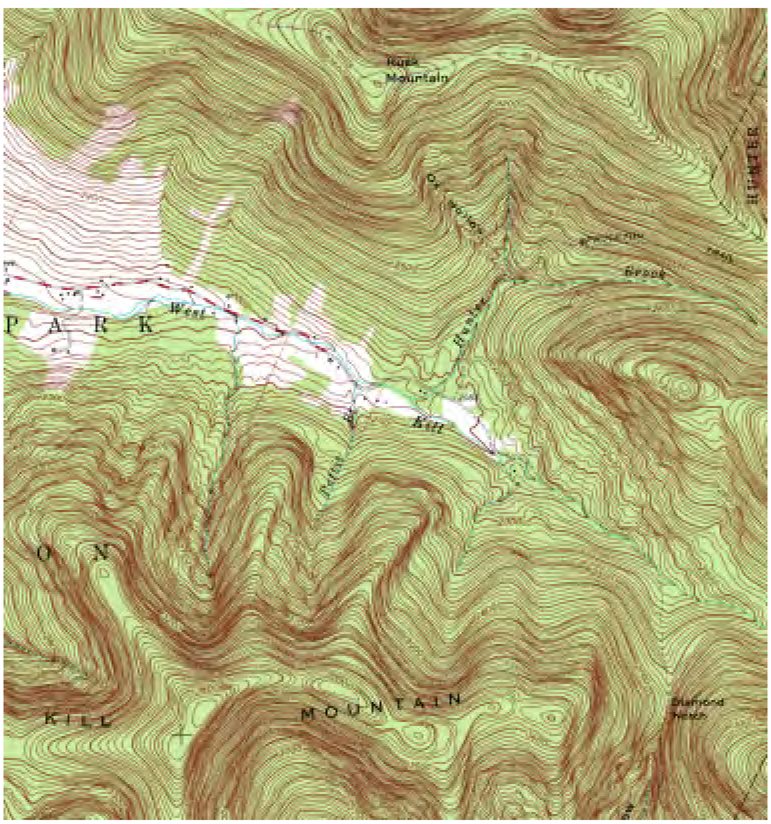
Stream Channel and Floodplain Current Conditions

Revetment, Berms and Erosion

The 2004 stream feature inventory revealed that 12% (258 ft.) of the stream length exhibited signs of active erosion along 2,111 ft. of total channel length (Fig. 4.4.1). Revetment has been installed on 11 % (237 ft.) of the stream length, including both rip-rap and log cribbing. No berms were identified in this management unit at the time of the stream feature inventory.

Stream Morphology

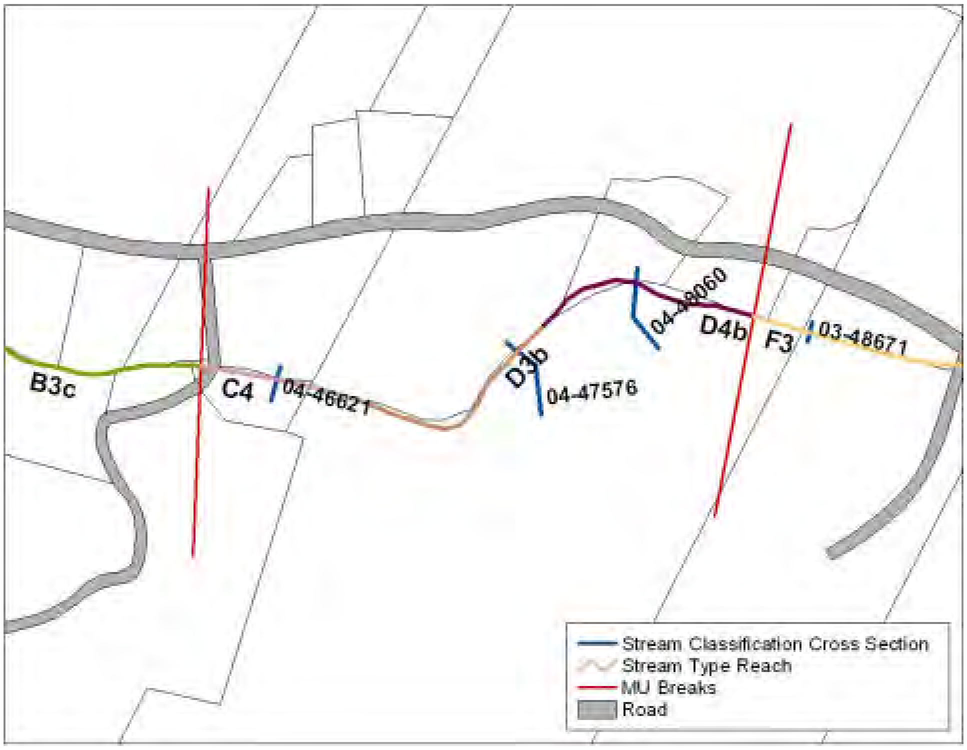
The following description of stream morphology references insets in the foldout Figure 4.4.2. "Left" and "right" references are oriented looking downstream. Stationing references proceed upstream, in feet, from an origin (Station 0) at the confluence with the Schoharie Creek at Lexington. Italicized 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 4, the West Kill bends to the southern edge of the alluvial valley, away from the influence of Spruceton Road. The valley slope here flattens to 1.65%, and the valley floor widens markedly, which in a wild river would result in increased channel sinuosity, a wider beltwidth and consequently, greater tendency and capacity for sediment storage, in contrast to the reaches upstream. The development of a split channel and aggradation in the upper reaches of the unit does create significant bedload storage conditions, but in the lower half of the unit, the channel has a more stable relationship with its floodplain and a reduced sinuosity.

Stream morphology, or shape (i.e., slope, width and depth) changes several times in this unit, 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 4

Management Unit 4 (MU4) begins with a section of what is probably a C4 streamtype. A monumented cross-section near the end of MU3 (Station 48671) documents an F3 streamtype, and the first monumented cross-section in MU4 (Station 48060) documents a 776 ft. reach of D4b streamtype, which currently begins at Station 48476. The transition between these two stream types, as entrenchment drops, likely includes a C4 streamtype, and the addition of a monumented cross-section is recommended (˜ Station 49175).

Rip Rap, right bank

As the channel slope drops, aggradation becomes evident, and a 59 ft. section of rip rap, dumped in place, has been installed on the right bank (Inset H, Fig. 4.4.2). The rip rap is in poor condition, but, protects against possible lateral channel migration in response to the aggradation.


Aggradation, channel split

Continuing downstream, aggradation becomes progressively more severe, eventually resulting in a distinct, two-thread channel divergence, near Station 48250 (Inset D, Fig. 4.4.2). Proceeding down the right channel thread, a monumented cross-section is established at Station 48060, which crosses over the vegetated island and the left thread as well, documenting this 1576 ft. reach of D4b streamtype. This type of channel morphology, typical of aggradational settings, is characterized by multiple, shifting channel threads, excessive bankfull channel widths, low entrenchment, and gravel-dominated streambeds, often with vast gravel deposits. Usually unstable, these stream types are very highly sensitive to disturbance, have poor potential for recovery from their aggradational condition, and exhibit very high sediment supply and streambank erosion potential.


Tributary

A channelized unnamed tributary enters across a mown field on the right. The channel is trapezoidal with laid-back banks, evidence of recent excavation and ongoing maintenance. Its connection is stable.

On the left bank of the right channel thread, the thalweg, or deepest part of the channel, flows against a section of log cribbing (Inset C, Fig. 4.4.2). The cribbing is failing at the downstream end, and is largely buried by gravel deposits, indicating the magnitude of aggradation here.


Log Crib Wall


Mid-channel bar, looking up right thread

Downstream of the cribbing, a mid-channel bar has formed (Inset B, Fig. 4.4.2). The floodplain beyond both banks is forested, with evidence of frequent inundation and historical channel avulsions.

Perched tributary

Backtracking to the divergence and proceeding down the left channel thread, a perched tributary enters from the terrace on the left, with evidence of a headcut up to the terrace edge, but which appears to have stabilized.

Debris jam

Bank scour near convergence

Downstream of the tributary, a mid-channel bar has formed, forcing flows up against the right and left streambanks. Scour of these banks has undermined trees on both banks, creating woody debris obstructions to flows in the left channel thread. A monumented cross-section (Station 47576) documents approximately 800 ft. of D3b stream type. The slope decreases to 2.0%, and the bed becomes dominated by cobble.

Remnants of habitat structure or crib wall

As the threads converge (Station 47400), a remnant habitat structure or crib wall, in very poor condition, is exposed in the streambed. The channel then bends to the right and regains its capacity to transport sediment as slope and entrenchment increase.


Rip rap, left bank


Toe protection only, small headcut at head of rip-rap

At the outside of this meander, the channel flows up against the valley wall, scouring the toe. Rip-rap has been installed at the toe of the bank, but erosion continues at the upstream and downstream ends of the revetment. The bank appears to be sliding over the rip-rap, and scarps are evident on the hillslope. Clay-rich till is exposed in the bed and bank here, and a small headcut at the upstream end of the rip-rap indicates that the channel may be incising. Relic side-channels are observed in the floodplain on the right.


Erosion extending downstream of rip rap


Landslide, with minor toe scour

Downstream of the rip-rap, leaning trees and scarp lines indicate mass wasting of the clay-rich till hillslope. Sliding material has moved vegetation to the stream edge for a short length, but downstream a large section of hillslope is actively eroding. This site is documented as a Bank Erosion Monitoring Site (BEMS 04-47032). 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. The *thalweg*, or deepest part of the stream channel flows up against the hillslope here. The hillslope appears to be mobilized by emergent groundwater and drainage problems, and then is being undermined by toe scour, leaving sections of the stream bank unvegetated. The *glacial till* soils 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. Further investigation of the geotechnical and water quality issues at this site is recommended.

Remnants of log cribbing

The introduction of material from the hillslope has produced a lateral bar downstream of the erosion on the left partially burying remnants of log cribbing, in poor condition. As the reach straightens on approach to the Ad Van Road bridge, a low, wetland terrace develops on the left. A monumented cross-section (Station 46621) documents 535 ft. of C4 stream type. The slope decreases to 1.83%, and the bed becomes dominated by gravel again. A relic channel confluences from the right, and red filamentous algae was observed in the streambed; possible sources of nutrient enrichment should be investigated.

Habitat Structure

Wing deflector and log sill habitat structure

Remnants of a habitat structure, consisting of two channel-constricting wings and a log sill, are found at Station 46580. Habitat structures were historically installed throughout the West Kill mainstem by the New York State Department of Environmental Conservation (NYSDEC), often to create scour pools. These scour pools offer deeper holding habitat, sometimes with associated cover, and the spillways raise the level of dissolved oxygen in the water. The structures, often in the form of a log weir perpendicular to the channel, also provided grade control. Because they provide only minimal lateral control, however, higher flows frequently flank these structures. In some settings, this can promote lateral channel migration, increase width-to-depth ratios and result in bank erosion. This is not observed here, however. In wild streams, these functions – both positive and negative – are performed to a large extent by large woody debris.

A single line of trees buffers the stream from the large mown field on the right.

Ad Van Road bridge

Approaching the end of the management unit, the approaches of the Ad Van Road bridge crossing constrict the floodplain at very high flows, but pass most flows effectively (Inset A, Fig. 4.4.2). Substantial abutment protection was documented, and no abutment scour was observed.

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).

In the upstream half of the unit, multiple channel threads result in inadequate sediment conveyance, and the result is widespread aggradation. The aggrading bed here has resulted in *excess floodplain connectivity*, or floods over its banks too frequently. This condition results in reduced sediment transport capacity, and as such is self-aggravating. The reach becomes a location where sediment from upstream is stored, and may benefit the general health of the stream system by limiting bedload delivered to downstream reaches. 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.

In the middle of the unit, landslides are introducing significant sediment and debris into the stream, resulting in a sediment supply reach. The final reach of the unit appears to be relatively stable, with effective sediment transport.

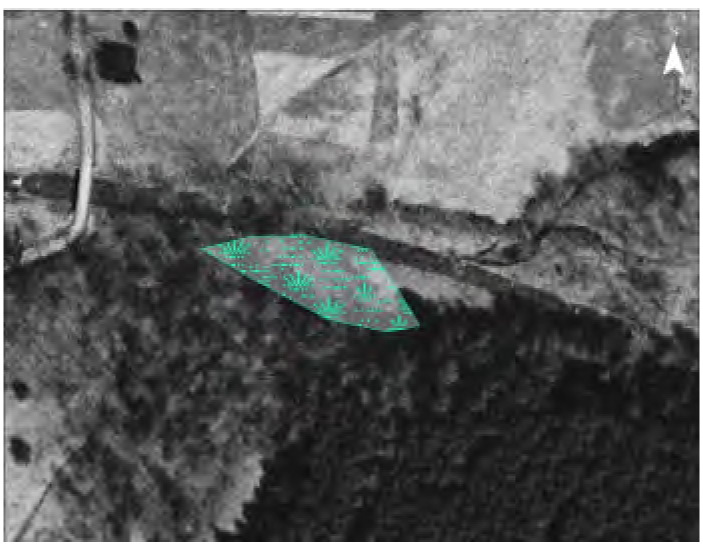
Riparian Vegetation

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. 4.4.3). 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 (51%) followed by Herbaceous (34 %). *Impervious* area (3%) within this unit's buffer is 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 inventory. However, Japanese knotweed does occur downstream, and a program for eradication of Japanese knotweed throughout the West Kill valley is recommended.



National Wetland Inventory wetlands in MU4

There is one wetland within this management unit (Fig. 4.4.1) 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 wetland, just upstream of the Ad Van Road bridge on the left bank, is 0.4 acres in size, and is classified as *riverine, upper perennial unconsolidated shore and temporarily flooded* (R3USA).

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.

Twenty-one possible planting sites were documented within this management unit (Fig. 4.4.4).

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

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 FIRM maps for 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

Most of the stream banks within the management unit are considered stable, although

12% (258 ft.) of the stream length is experiencing major erosion, and 11% has been stabilized.

There is one Bank Erosion Monitoring site in MU4 (BEMS 04-47032), a relatively large failure contributing significant amounts of fine soil and clay, as well as some mature trees, to the creek. This failure could constitute a severe flood hazard for downstream reaches due to the potential for uprooted trees to be introduced into the stream from the eroding stream bank during large floods. These trees can create debris jams at bridges or mid-channel bars and may shift the flow pattern of the stream, threatening roads and residential properties. This site has been treated with rip-rap toe protection, although this revetment does not appear to be adequately addressing suspected geotechnical stability problems at the Bank Erosion Monitoring Site.

Infrastructure

Eleven percent of the stream length in this management unit has been treated with some form of revetment. There are no immediate threats, however, to roadways or bridges in this management unit.

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.

Sub-surface flow, physical and temperature barriers, and inadequate canopy cover are apparent in the upstream aggrading sections, although location near southern valley wall likely means good groundwater inputs and temperature moderation in downstream sections.

The continued deterioration of the NYSDEC habitat structure will reduce erosion threats in their vicinity, and is unlikely to meaningfully reduce the quality of the habitat in the unit.

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, which should be further investigated for its causes and severity.

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. Less than 1% of the stream lies within 50 ft. of a road.

Nutrient 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 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.

Possible nutrient enrichment sources suggested by the presence of red filamentous algae at Station 46900 should be investigated.

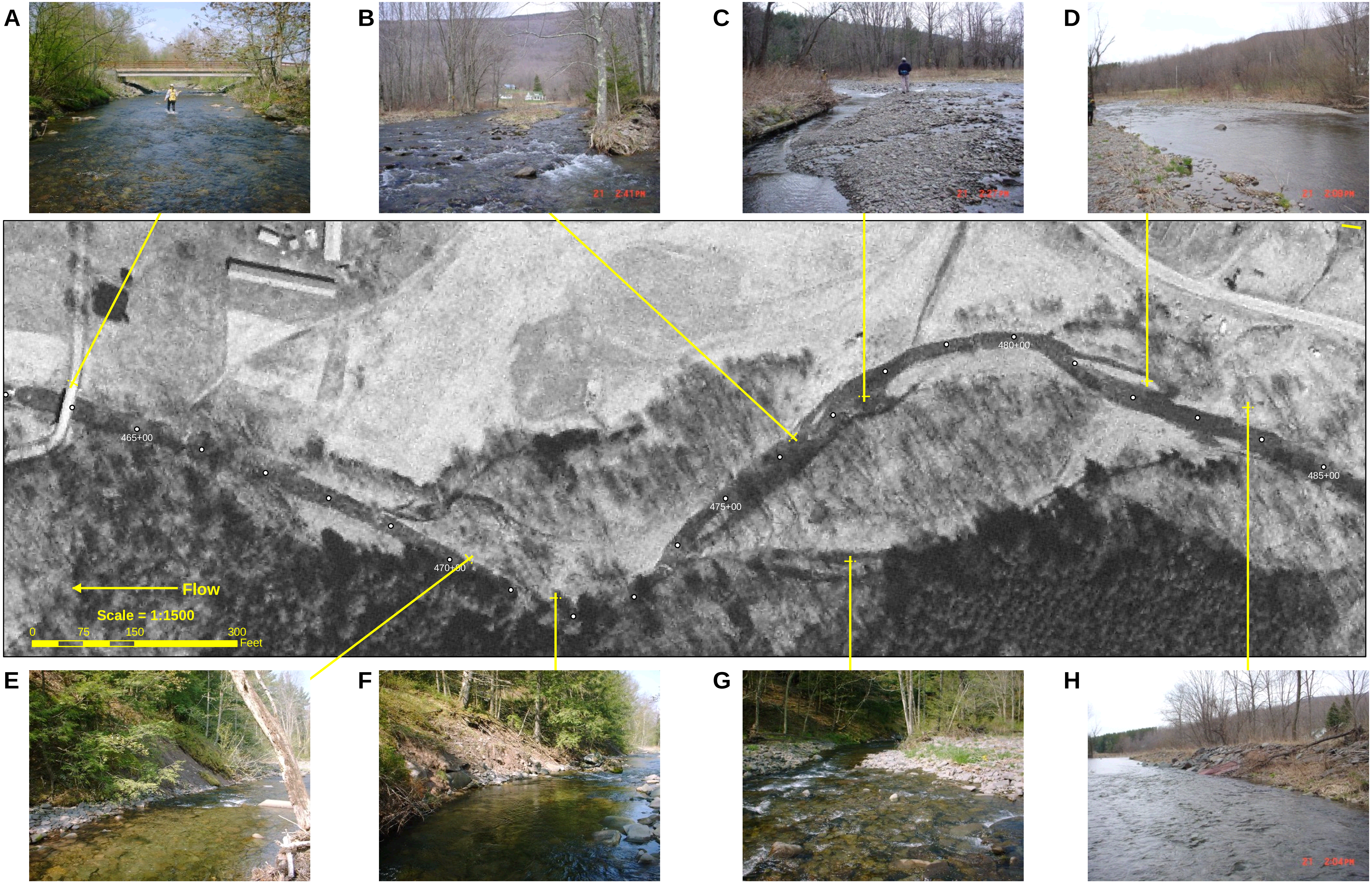


Figure 4.4.2 Management Unit 4 - 2004 aerial photography