Reach 5b (Kane Bridge to Red Falls)

Reach 5b begins at the private bridge accessing the Kane property and runs nearly 5,700 feet to the waterfall known as "Red Falls" **(Map VI-6)**. The reach is located in the Towns of Ashland and Prattsville and is referred to as the "Red Falls" site. The contributing drainage area ranges from 68.1mi^2 at Kane's bridge to 68.6 mi^2 with no tributaries entering the reach. A USGS stream gaging station is located at the bottom of the reach, and has been recording real-time and peak flow data since October 1997. Reach 5b lies in Valley Zone I **(Figure V-11),** which has an average valley slope of 1.2%. The valley morphology is dominated by the presence of a large terminal moraine in the middle of the reach, and steep side slopes. The presence of the terminal moraine results in extreme entrenchment.

Current land-use/land-cover is predominately forest with very limited development within the reach. As discussed in the history section of this SMP, at one time the Red Falls reach was site of dense development, with several large mills and their attendant facilities. The adjoining properties have numerous old foundations, the remains of a diversion channel and old stone walls, some of which factor into the current instability problems.

Stream Morphology/Stability

Reach 5b has been the focus of extensive study by the GCSWCD and NYCDEP since 1998. In general, the reach has been characterized as extremely unstable, and it has been prioritized based on its water quality impacts. High eroding banks, large clay exposures and active planform adjustments are some of the factors involved. The Phase I Inventory and Assessment identified reach 5b as one of the most unstable sections in the watershed, with 38% of the reach experiencing some form of erosion. Over 97,000ft^2 of exposed streambank was measured in the 5,700 foot long reach, which equates to over 17 ft^2 of exposed streambank for every linear foot of channel. Evidence of mass wasting was present along several large sections of the reach **(Figure VI-83)**, with eroding banks exceeding 50 feet in height.

Figure VI-82: Mass wasting of high terraces along reach 5b present a significant water quality concern

A detailed Phase III/IV assessment was started at Red Falls in August 1997. Initially, eight erosion monitoring pins (toe pins) were installed in selected areas where the stream bed meets the channel bottom. Profiles of the bank perpendicular to the channel flow were surveyed starting at the top of each pin and carried beyond the top of the bank. In August of 1998, 13 permanent cross sections were installed, with 8 of those cross sections overlapping the existing monitoring pins. The monitoring reach includes 3200 feet of stream profile. Between 1998 and 2001 the cross sections have been surveyed annually, and the GCSWCD has conducted channel and point bar sediment analysis. In the fall of 2000, a topographic survey was completed for the entire site representing an area of approximately 41 acres which includes the stream channel, floodplain, control points and relevant features with in the project area.

A review of historic aerial photographs from 1959 to present revealed that the same sections currently experiencing problems have been active for at least 41 years. Active erosion at the upstream edge of the moraine, as well as just above the falls is clearly visible as far back as 1959. In addition to the Phase I inventory, the impact of reach 5b on water quality was also shown when NYCDEP evaluated turbidity and TSS data collected during storm events on the Batavia Kill. Analysis of several storms between 1995 and 2000 showed strong signs that the reach appears to be a significant contributor to both turbidity and TSS. The assessment of water quality implications from the Red Falls reach are discussed in greater detail in Section V-A: Water Quality Assessment.

The primary factor influencing stream stability in reach 1b is the natural constriction of the valley. As seen in **Figure VI-83**, the remains of a large glacial moraine across the valley floor leaves very limited *beltwidth* for the stream channel. The moraine shows extensive signs of folding of the clay layers, indicating that the moraine was acted on by multiple glaciers. In several sections of the reach, the moraine impinges on the active channel completely detaching the channel from its floodplain.

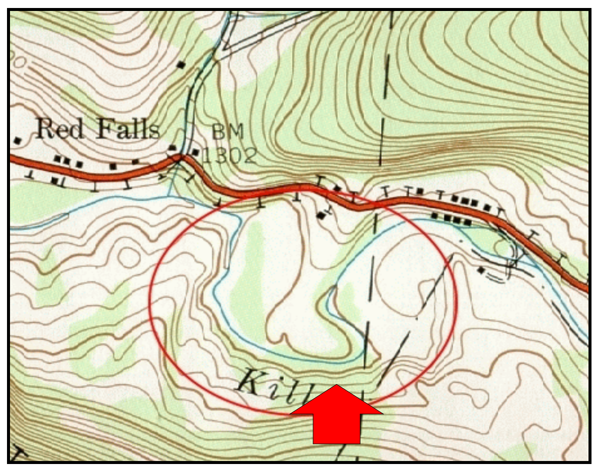

Figure VI-83: Terminal moraine and natural valley topography strongly influence entrenchment in reach 5b.

Figure VI-84 compares a valley cross section well above the Red Falls reach, to a typical valley cross section within the reach. Note the "U" shaped valley above, with a broader valley floor that allows for floodplain development. Conversely, the valley morphology at the Red Falls reach is characterized by a deep "V" shape in which the channel is confined.

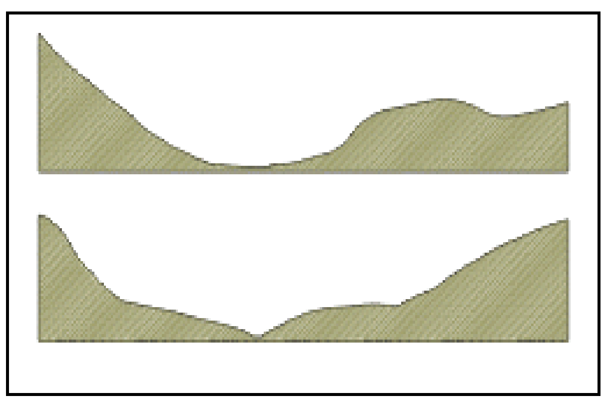
Figure VI-84: Valley cross sections from 1000' above Red Falls (top) to a cross section in reach 5b

The Red Falls reach contains several different stream types resulting, in part, from the bedrock channel located near both the top and bottom of the reach and the heavy influence of the entrenched to moderately entrenched morphology. At the top of the reach **(Figure VI-90)** the stream classifies as a C3 stream type, with a large flood plain along the west streambank. The right side of the stream channel runs along the upstream race of the glacial moraine which is approximately 40 feet in height and is comprised primarily of glacial clays and silt. At the lower end of the moraine, the channel has exhibited a tremendous amount of mass wasting during the monitoring period **(Figure VI-90a photo G, Figure VI-90b photo D,F,J)**. Monitoring cross sections located at the bottom of this area show the erosion measured between 1997 and 2000 **(Figure VI-85)**. It was estimated that the slope failure experienced nearly 50,180 cubic feet of erosion during an eight month period.

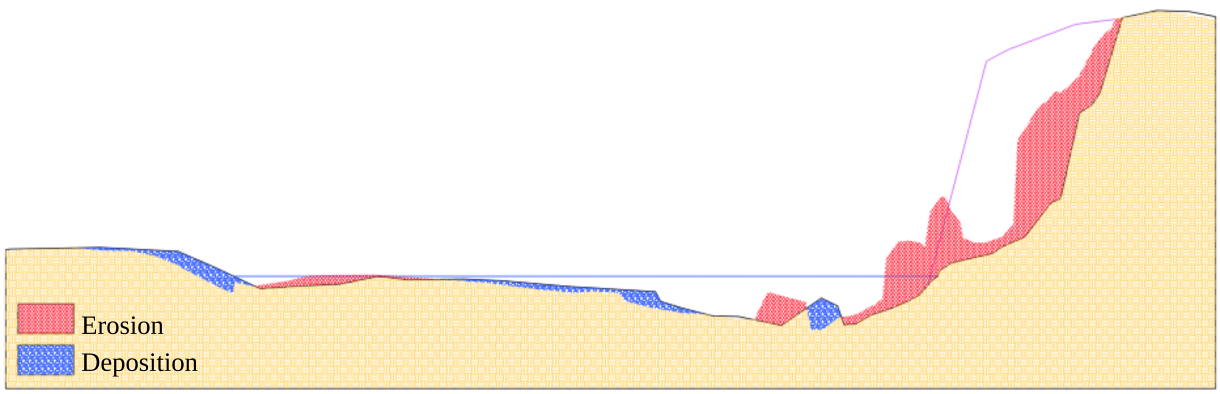

Figure VI-85: Overlay of cross section #2 at Red Falls site 1997 to 2000. Single thin line represents bank profile frm 1997 data collection.

Severe erosion had previously been located upstream of the current failure, in the first meander bend below the Kane bridge. In the late 1980's, NYSDOT completed a major stabilization project on this bend, installing over 500 feet of heavy rock rip-rap on the right bank **(Figure VI-90a photo A,E)**. It is presumed that the stream responded to the rip-rap by transferring erosional forces downstream to the current location.

Immediately downstream of the slope failure, the Batavia Kill extreme entrenchment as it passes over a bedrock sill and quickly becomes confined in a bedrock channel. The stream planform makes a 90 degree turn, and the stream type changes sharply from a C4 stream above the moraine, to an F1 bedrock controlled channel **(Figure VI-90b photo H)**. Approximately 100 feet later the bedrock is no longer present in the stream bottom, and the channel transitions to an F4 stream type. Conditions of extreme entrenchment continue downstream for approximately 2500 feet, with the channel confined by a combination of natural topography, channel degradation and man-made features.

A significant section of the entrenched section of the reach contains a large stone wall running approximately 600 feet on the right streambank. The wall may have been a feature of the old mills or it may have been to protect the mills from flooding. In either case, it now cuts off the Batavia Kill's access to its adjoining floodplain **(Figure VI-86)**. Inspections of reach 5b after the September 1999 flood event revealed no signs that streamflow had accessed the majority of the floodplain during and after the flood event. By preventing the stream flow from entering the flood plain during floods, the main channel experiences increased velocity and shear stress which is contributing to the channel's downcutting. Further degradation of the channel only worsens the entrenchment condition, accelerating the process over time.

Figure VI-86: Large stone wall along right streambank increases channel entrenchment.

Proceeding down the reach, the Batavia Kill divides into two separate channels, with a fairly large central island. The left channel appears from the 1959 and 1980 aerials to have been the primary channel with the area where the right channel is located showing long term instability. In 1997, the GCSWCD noted that the right channel appeared to be a recently developed cut-off chute. The right channel has a steeper slope, and is characterized by a cobble and boulder streambed structure. A monitoring cross section located on the upper end of the divided channel has indicated that erosion is increasing the size of the right channel, with the left channel experiencing minor aggradation **(Figure VI-87)**.

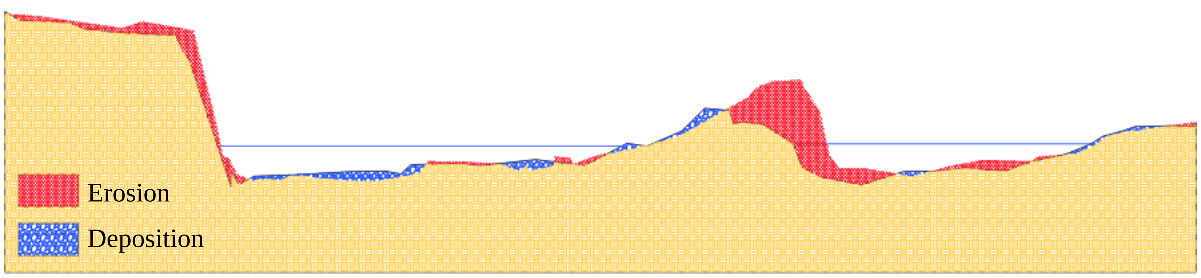

Figure VI-87: Monitoring cross section (#8) at upper end of divided stream channel. Note severe erosion of central island by the right hand channel. (1998-2000).

The left channel, which appears to be the main *thalweg* dating back to the 1959 aerial photo, runs along a glacial moraine which exceeds 54 feet in height **(Figure VI-90b photo A,E,G,H)**. The banks in this area are composed of highly erodible material with minimal streambank protection. Mass wasting through this area has been observed by GCSWCD, dating back to 1997 and evidence of this instability is seen as far as 1959. Historical aerial photographs **(Figure VI-88)** were used to compare channel conditions and planform adjustments of the reach between 1959 and 2000.

Noted on the 1959 aerial photograph was severe bank erosion located on the left bank just above the bottom of the reach. This erosion has continued to migrate nearly 150 feet toward the north west in the past 41 years, with 23,650 ft^2 of erosional loss. The magnitude of the erosion from this single stretch of stream channel is well represented by monitoring cross section #10 located at the slope failure area. As seen in **Figure VI-89**, between 1997 and 2000, tremendous areas of streambank materials were lost to erosion.

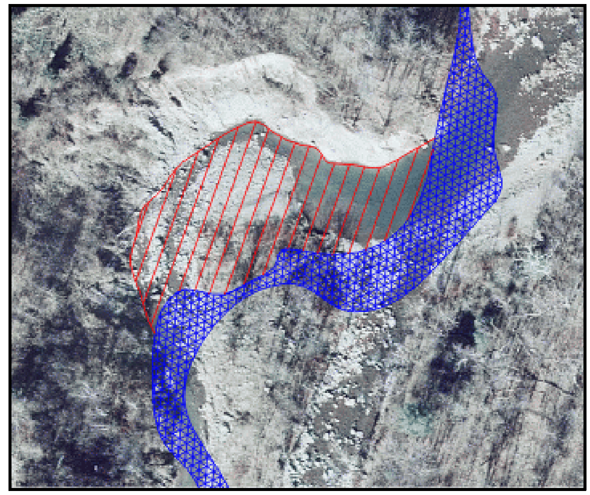

Figure VI-88: Stream channel migration between 1959 (blue) and 2000 (photo). Red is eroded area.

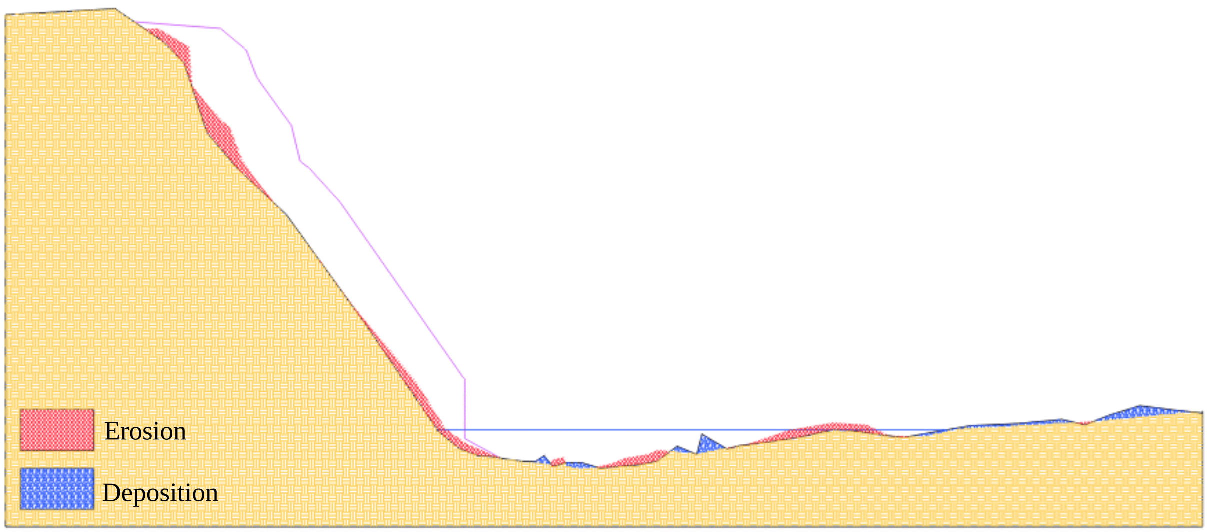

Figure VI-89: Soil erosional losses at Red Falls cross section #10 between 1997 and 2000. The thin line represents the 1997 bank and bed profile. Red is erosion, blue is deposition. View is looking downstream.

By calibrating historical aerial photographs to a topographic survey of the reach, the GCSWCD was able to develop a fairly accurate estimate of soil loss from the eroding banks near the bottom of the reach. Sediment loss was estimated by comparing the area between water surface boundaries and top of banks, and then multiplying by the average eroded bank height. This resulted in an estimate of nearly 1,182,500 ft^3 of material loss. To put that in perspective, imagine 2,190 large dump truck loads of material eroded from a single, isolated reach.

As the channel approaches the bottom of the reach, the channel planform makes a 90 degree turn, and immediately transitions into a bedrock controlled channel before ending at a steep cascade (“Red Falls”). The lower section of the reach is currently stable, with the right bank and stream bottom controlled by bedrock.

Riparian Vegetation

While the predominant land cover in the Big Hollow reach is forest, the riparian condition is in poor condition. A review of the broader stream corridor between 1959 and present reveals that a significant portion of the reach has seen a dramatic transition from open fields to forest cover over the past 41 years. This change can be attributed to the loss of farming activities within the reach. Regardless of the reforestation of the overall corridor, as seen in **Figure VI-90b photo A,D,F,G,H,J**, extreme instability conditions have far surpassed the ability of riparian vegetation to provide stability. The reach has become so unstable that riparian vegetation is no longer an important factor in reach stability, and vegetation alone could not be used to regain bank stability.

Water Quality

The primary water quality issue at the Red Falls reach is the impact on turbidity and TSS from the clay exposures exacerbated by extreme instability. The water quality impacts related to the reach have been throughly discussed in Section V-A Water Quality Assessment.

Infrastructure

There are no infrastructure concerns in reach 5b.

Habitat

Habitat conditions at the Red Falls reach could be characterized as fair to poor. While the large deep scour holes may provide thermal refugia, the extreme instability make habitat conditions variable. Poor riparian vegetation does not provide critical shading and accelerated stream erosion processes frequently disturb the streambed and streambanks.

Flooding Issues

The GCSWCD is aware of no specific flooding concerns.

Reach 5b Summary

The Red Falls reach exhibits signs of extreme instability and a significant impact on water quality in the watershed. The channel is highly entrenched due to glacial moraines and a narrow valley cross section. The GCSWCD and NYCDEP have identified the reach as a top priority for restoration based on water quality monitoring, and will initiate restoration activities in 2004.

Table VI-19: Management Recommendations Reach 5b.

Reach 5b: Kane's Bridge to Red Falls.	
Intervention Level	Full Restoration - Entire reach
Stream Morphology	Stream morphology in reach 5b is dominated by entrenchment within a glacial moraine and steep valley side slopes. Stream erosion is highly accelerated and has ben documented by NYCDEP as a major water quality problem. The GCSWCD and NYCDEP have prioritized the reach for restoration. The restoration project design will address localized entrenchment as well as addressing drainage on the high slopes and protecting the high slopes from erosion at the toe of the slopes. Establishing a stable channel will be a challenge at this location, and a totally natural channel design strategy may not be possible. The GCSWCD is conducting further assessment of the site and will be developing a restoration design in 2003 and planned for construction in 2004.
Riparian Vegetation	The riparian condition in the immediate stream corridor is in poor condition due to the severe streambank failure. Restoration of a stable stream form will be necessary before any riparian plantings are undertaken.
Water Quality	Primary impact is from *turbidity* and *TSS* associated with extreme streambank failure. Water quality impacts would be mitigated by restoration of the reach. ***See Section V-A Water Quality Assessment***.
Infrastructure	No specific problems noted. Any future rehabilitation or other work on NY Route 23 must be done so as to avoid any further modification of the channel.
Habitat	Fair to poor condition. Habitat will be addressed in the restoration design.
Further Assessment	Continue to monitor reach stability in preparation for restoration.

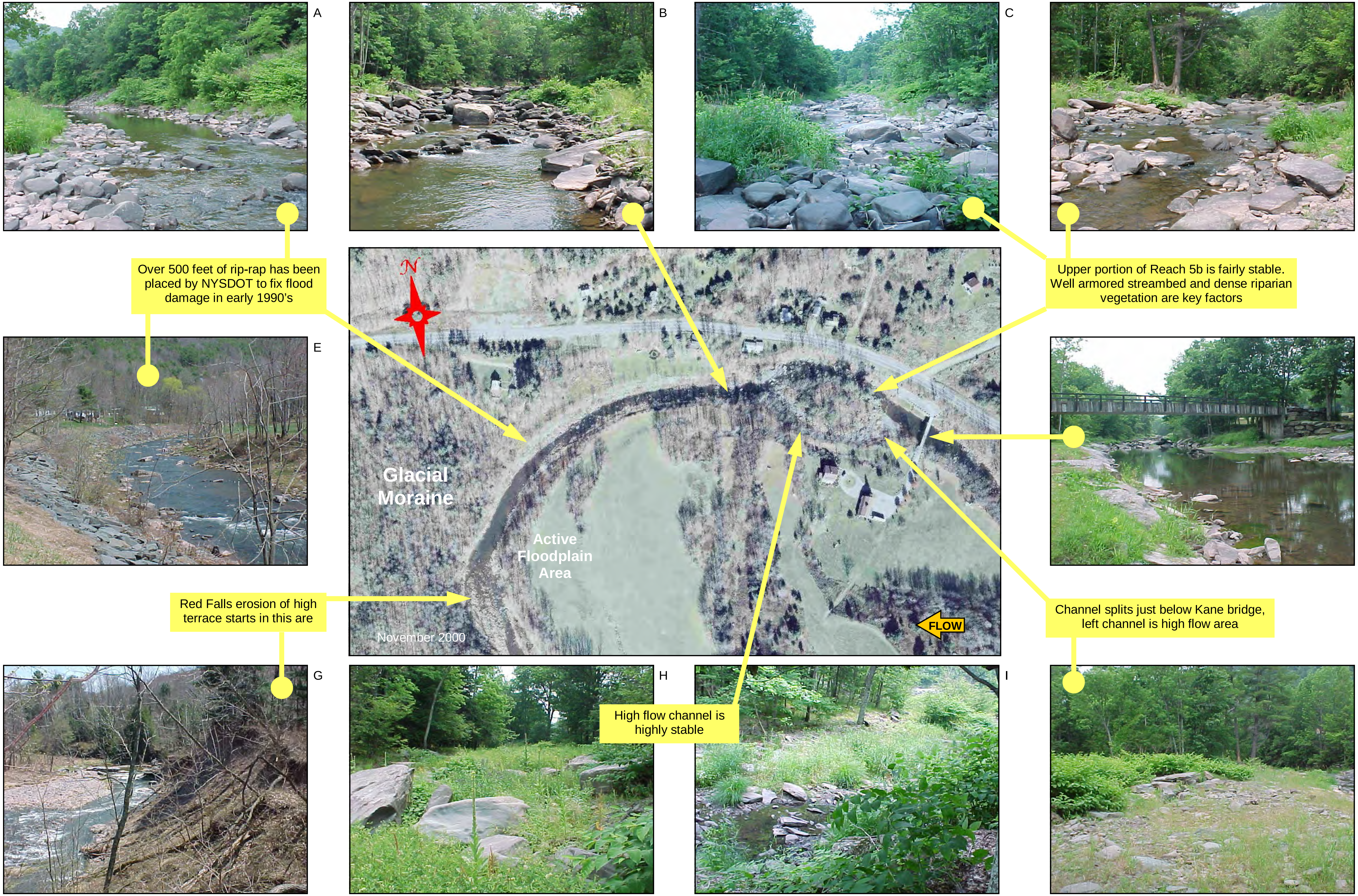

Figure VI-84a: Reach 5b-Upper

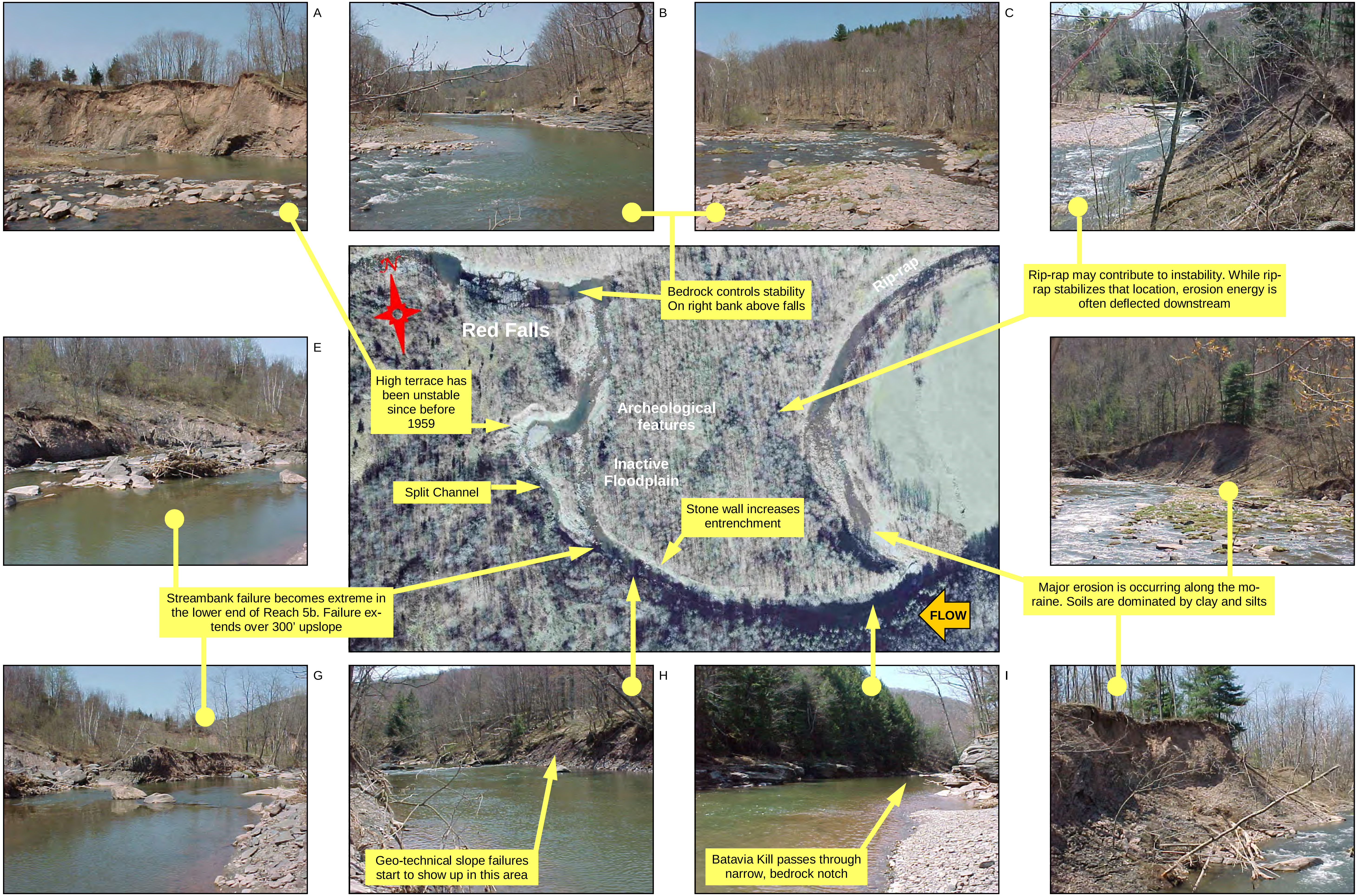

Figure 84b: Reach 5b-lower "Red Falls"