Manor Kill Management Unit 3

Town of Conesville – Beaver Hill Rd. (Station 38909) to Station 26995

This management unit begins at Beaver Hill Road, continuing approximately 11,914 ft to Station 26995 in the Town of Conesville.

Stream Feature Statistics

27% of streambanks experiencing erosion
0.54% of streambanks have been stabilized
1.74% of streambanks have been bermed
449.6 feet of clay exposures
179 acres of inadequate vegetation
1,317 feet of road within 300 feet of stream
57.81% of streambanks are proposed for planting

Management Unit 3 location
see Figure 4.0.1 for more detailed map

Summary of Recommendations Management Unit 3	
Intervention Level	Assisted Self-Recovery
Stream Morphology	No recommendations at this time.
Riparian Vegetation	Treat, remove and prevent the spread of Japanese knotweed where feasible. Plant a buffer of trees and shrubs along proposed planting sites and increase width of riparian buffer in appropriate locations.
Infrastructure	When bridge is replaced, construct with the appropriate height and width to allow conveyance of flood flows.
Aquatic Habitat	Watershed Aquatic Habitat Study
Flood Related Threats	No recommendations at this time.
Water Quality	Removal of dump site.
Further Assessment	Consider hydraulic analysis of bridge opening.

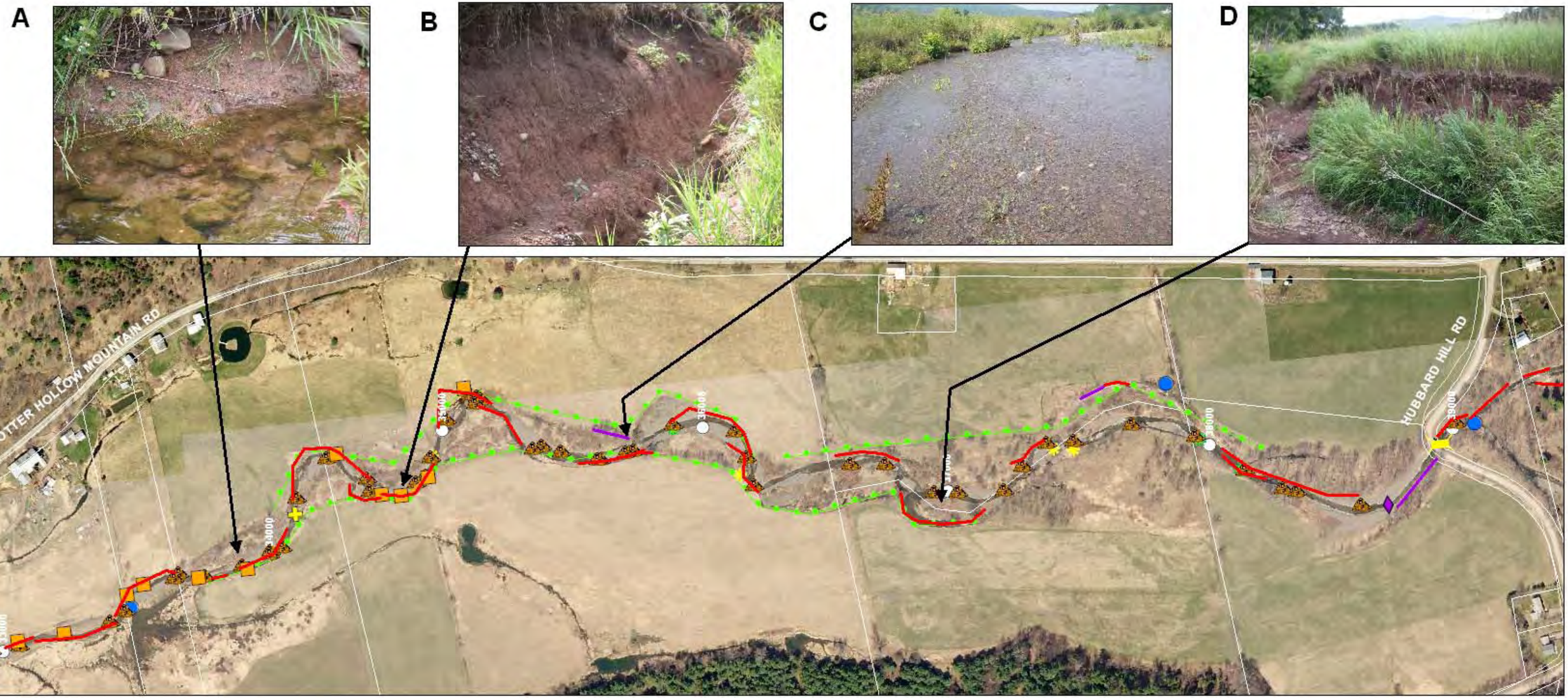


Figure 4.3.1a Management Unit 3 upstream portion - 2006 aerial photography with 2008 stream feature inventory.

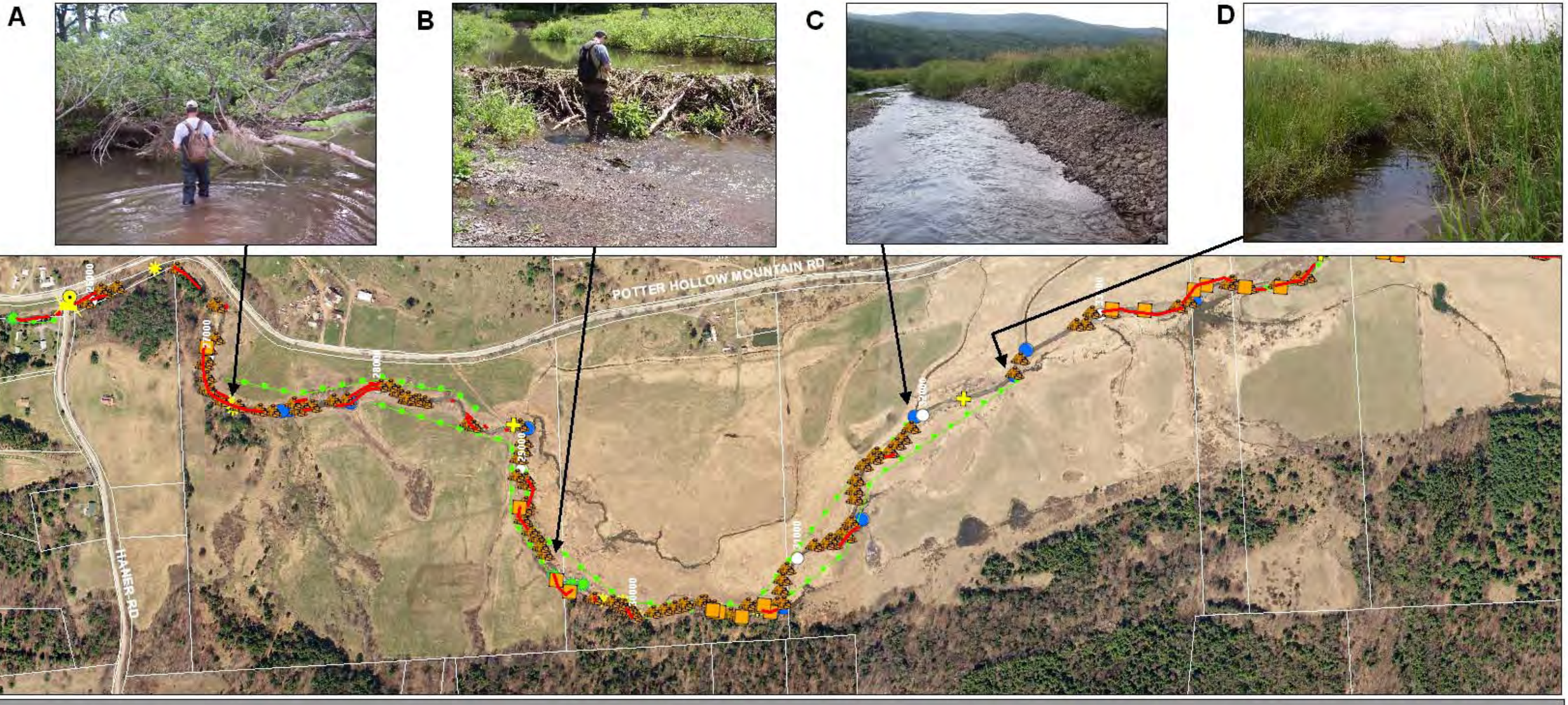
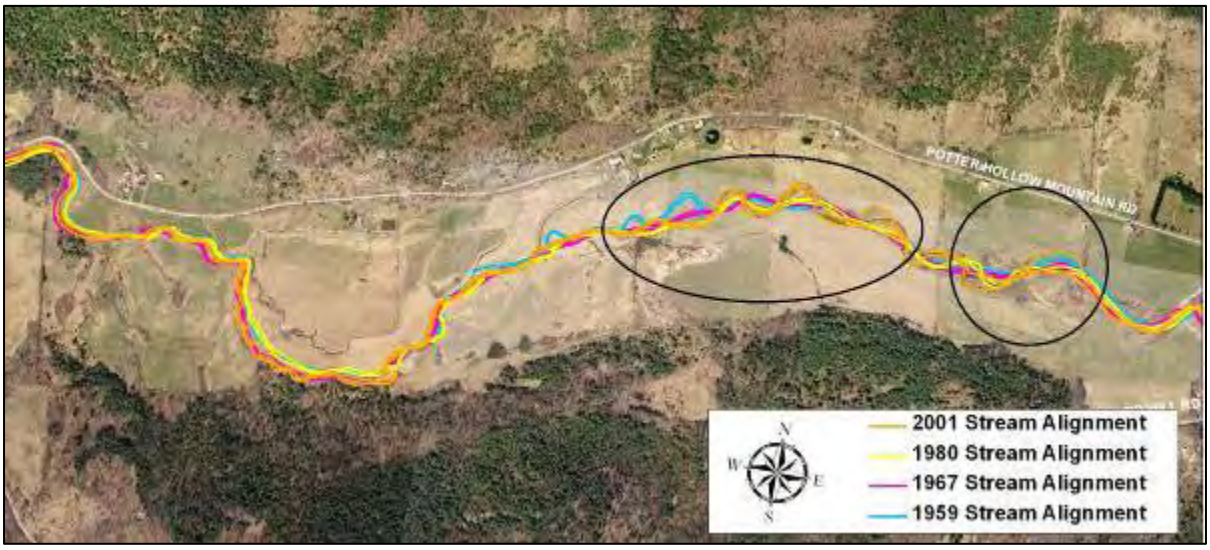


Figure 4.3.1b Management Unit 3 downstream portion - 2006 aerial photography with 2008 stream feature inventory.

Historic Conditions



Historic stream channel alignments overlayed with 2006 aerial photograph

As seen from the historical stream channel alignments (above), the *planform* of the channel has changed significantly over the years along the upstream portion of this management unit; the channel has remained fairly stable through the downstream portion. The stream has experienced lateral migration in several locations over the years. Lateral migration is the movement of a channel across its floodplain, which usually results in extensive bank erosion. The outside banks of meander bends tend to move laterally across the valley floor and down the valley. Historically, the stream channel alignment appears to have been manipulated between 1959 and 1967, resulting in a straightened alignment (pink 1967); since then the stream has increased its sinuosity through lateral migration.

As of 2007, according to available NYS DEC records dating back to 1998, there have been five stream disturbance permits issued in this management unit. Following the 1996 flood, two permits were issued for the repair of flood damage. In 1999, a third permit was issued to repair flood damage. In 1998, a permit was issued to excavate willows along two sites within the Manor Kill and to replant the willows along an eroded channel; this permit was renewed in 1999 (near Station 37600). In 2005, a permit was issued to repair rip rap and flood damages caused by the April 2005 flood.

Stream Channel and Floodplain Current Conditions (2008)

Revetment, Berms and Erosion

The 2008 stream feature inventory revealed that 27% (6,388 ft.) of the streambanks exhibited signs of active erosion along the 23,828 ft. of total streambank length in the unit (Fig. 4.3.1). *Revetment* has been installed on 0.54% (129 ft.) of the streambanks. Approximately 1.74% (415.7 ft.) of the streambanks have been bermed.

Stream Channel Conditions (2008)

The following description of stream channel conditions references insets in foldout, Figures 4.3.1a and 4.3.1b. Stream stationing presented on this map is measured in feet and begins at the confluence with the Schoharie Reservoir in Conesville. "Left" and "right" streambank references are oriented looking downstream, photos are also oriented looking downstream unless otherwise noted. Italicized terms are defined in the glossary. This characterization is the result of an assessment conducted in 2008.

1980 USGS topographic map – Livingstonville Quadrangle contour interval 20ft

Management unit #3 began at Beaver Hill Road. The drainage area ranged from 11.25 mi^2 at the top of the management unit to 16.26 mi^2 at the bottom of the unit. The valley slope was 0.78%.

Valley morphology in this management unit was relatively unconfined with a broad glacial and *alluvial* valley flat. Generally, stream conditions in this management unit were

unstable, with deficient sediment transport capacity resulting in aggradational conditions throughout, and approximately 6,388 feet of erosion. There were 41 eroding banks documented in this management unit, including two mass failures. Management efforts in this unit should focus on preservation of existing wetlands and forested areas and improvements to the riparian buffer by planting *herbaceous* areas with native trees and shrubs.

Bridge and Aggradation at Stations 38909 &39020

Management Unit 3 began at the Beaver Hill Road bridge (Station 38909). Upstream of the bridge, full channel aggradation (Station 39020) was observed. While the bridge opening seemed to provide an adequate span for low flows, higher flows appear to backwater, reducing stream velocity, resulting in upstream aggradation. If this bridge is replaced in the future, it is recommended that a hydraulic analysis be conducted in order to determine the appropriate bridge width capable of conveying the available water and sediment. At the time of the assessment flow was subsurface downstream of the bridge.

Just downstream of the bridge, there was a well-vegetated berm (Stations 38884 – 38677), with shrubs and young trees, along approximately 207 feet of the left streambank. Berms such as this, while created with the best of intentions, tend to raise flood elevations and increase the erosive power of the stream. It is recommended that berms be evaluated for their influence on floodplain connectivity and stream entrenchment, and that removal should be considered where there is significant negative impact. There are many stands of Japanese knotweed downstream of the bridge. Japanese knotweed is an invasive non-native species which does not provide adequate erosion protection due to its very shallow rooting system and also grows rapidly to

Japanese knotweed along Berm at Station 38796

crowd out more beneficial streamside vegetation. The best means for controlling knotweed is prevention of its spread. Therefore, efforts should be made to ensure that existing stands are not fragmented via unnatural processes (i.e. mowing without removal of all mowed material) and transported into downstream areas. Small stands should be eradicated immediately to avoid further spread within this unit and downstream management units. There are removal methods that may be used for larger stands (see Section 2.7), these methods should be used with caution, and carefully executed to avoid further spread of Japanese knotweed.

As the stream meandered to the right, there was a 0.8 acre riverine wetland (Stations 38770 – 38456). 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. This wetland is classified as R2USA, *riverine, lower perennial, unconsolidated shore, temporarily flooded* (see Section 2.6 for detailed wetland type descriptions).

Wetland boundary approximately delineated by NWI (Stations 38770 - 38456)

Also along this meander bend, the channel was manipulated with large cobbles and small to medium boulders forming what appeared to be a *rock vane*. Rock vanes usually protect the stream bank by redirecting the thalweg away from the stream bank and towards the center of the channel, and tend to improve in-stream habitat through scour, oxygenation, and cover. There was scour of the channel bed, just downstream of the rock

Rock vane at Station 38660

structure. However, this rock vane had failed structurally and was no longer functional.

Center Bar at Stations 38564 - 38341

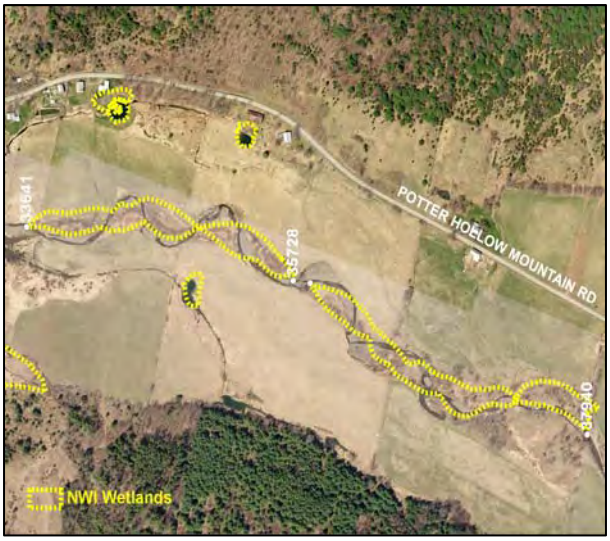
Through this section of stream, there was channel *aggradation*, the process by which streams are raised in elevation by the deposition of material eroded and transported from other areas. The main channel appeared to be along the left of a vegetated center bar (Stations 38564 – 38341). Continuing downstream, there were additional depositional features, including side and point bars. Along the right side of the center bar and continuing downstream of the bar, there was erosion of the right streambank (38562 – 38068) for approximately 494 feet. Localized dredging and berming through this stretch of stream appeared to contribute to the condition of this eroded bank. There was also minor hydraulic erosion along the left stream bank with some fallen shrubs that appeared to contribute to upstream aggradation and localized scour of the channel bed. Japanese knotweed persisted through this stretch of stream.

Riparian Planting Site at Stations 38170 - 36468

As the stream meandered to the left, and continuing downstream for approximately 1,702 feet, there was a proposed riparian planting site (Stations 38170 – 36468) along the right streambank. This is the first of many proposed planting sites within management unit three. A vigorous buffer with mature trees is important at this site because it may also filter nutrients and pollutants, if any, from the adjacent agricultural fields. Along portions of this site, herbaceous vegetation is maintained to the edge of the stream, while there are also short sections with a thin wooded buffer. Opposite the downstream portion of this planting site, there is a second proposed planting site (Stations 37087 – 35810) along the left streambank

Riparian Planting Site at Stations 38170 - 36468

for approximately 1,277 feet. Vegetative and stream stability conditions are similar along this site. Recommendations for both sites include establishing a buffer where none exists, and augmentation of the existing buffered areas by planting native trees and shrubs along the streambank and the upland area. Buffer width should be increased by the greatest amount agreeable to the landowners. Increasing the buffer width to at least 100 feet will increase the buffer's functionality and protect water quality by slowing stormwater runoff, filtering nutrients and pollutants and increasing streambank stability. Portions of both proposed planting sites are experiencing erosion. Therefore, prior to proceeding with any vegetative plantings, these conditions should be given careful consideration when identifying the appropriate species and locations for plantings. A more detailed site assessment may be necessary to determine whether stream bank grading will be required. Along both planting sites, there was a 1.2 acre palustrine wetland (Stations 37940 – 37460) followed by a 3.3 acre riverine wetland (37460 – 35800). These wetlands were classified as PEM1A, *palustrine, emergent, persistent, temporarily flooded*, and R2USA, *riverine, lower perennial, unconsolidated shore, temporarily flooded*, respectively. Along these wetlands excess sediment deposition caused multiple point bars and full channel aggradation. Point bars commonly form on the inside of meander bends, where stream velocity is slower during high flows, allowing sediment to drop out of the water column and settle along the stream bed.



Wetland boundary approximately delineated by NWI

(Stations 37940 - 35800)

On the right streambank, along the first planting site, just before the stream meandered to the left, there was a channel *divergence* (Station 37900) where a *flood chute* split off from the main channel. Flood chutes convey flow through a secondary channel during periods of high flows. This flood chute converges (Station 37416) with the main channel approximately 484 feet downstream. There were multiple stands of Japanese knotweed along both sides of this secondary channel. At the time of the assessment there was no flow in the secondary or main channel. Along the right bank of the secondary channel, there was erosion (Stations 37711 - 37631) for approximately 80 feet, followed by an earthen berm (Stations 37622 – 37536) for approximately 86 feet. There were also multiple locations of large woody debris that contributed to aggradational conditions and localized scour.

Berm at Stations 37622 -37536

The stream channel was relatively unstable through this stretch of stream. The depositional conditions and the multiple secondary channels with eroding banks are evidence that the stream is actively moving across its floodplain. There was a channel divergence (Station 37456) on the left streambank. This secondary channel converged (Station 37300) with the main channel approximately 156 feet downstream and was followed by a channel divergence (Station 37112) along the left that converged (Station 36855) with the main channel approximately 257 feet downstream. Along this channel, there were approximately 359 feet of hydraulic erosion (Figure 4.3.1a Inset D, Stations 37120 – 36869), exposing 1,976 square feet of the left streambank. This eroding bank was along the second proposed riparian planting site that was previously discussed. Japanese knotweed persisted

Convergence at Station 36855

within both secondary channels and the main channel through this stretch of stream. Along the left streambank, there was another secondary channel (divergence at Station 36855, convergence at Station 36300). This braided section of stream is actively moving across its floodplain, but should eventually reach equilibrium. Planting a riparian buffer in appropriate locations may assist the stream with reaching equilibrium in a shorter period of time.

As the stream gently meandered to the left, there was erosion (Stations 36800 – 36580) along the right streambank and a proposed planting site for approximately 220 feet. With the exception of a thin wooded buffer along the upstream portion of the erosion site, there was herbaceous vegetation to the edge of the stream. The woody vegetation had been compromised along the undercut banks, with exposed roots and one tree that had fallen along the erosion site. There was a point bar (Stations 36743 – 36626) opposite the eroding bank.

Erosion at Stations 36800 - 36580

As the stream sharply meandered to the right, there was erosion (Stations 36317 – 36107) along approximately 210 feet of the left streambank. Along the erosion site, there was a woody debris obstruction (Station 36236) across the stream channel. The debris, which included a fallen tree, appeared to contribute to localized aggradational conditions and rerouting of the stream. There were also multiple stands of Japanese knotweed.

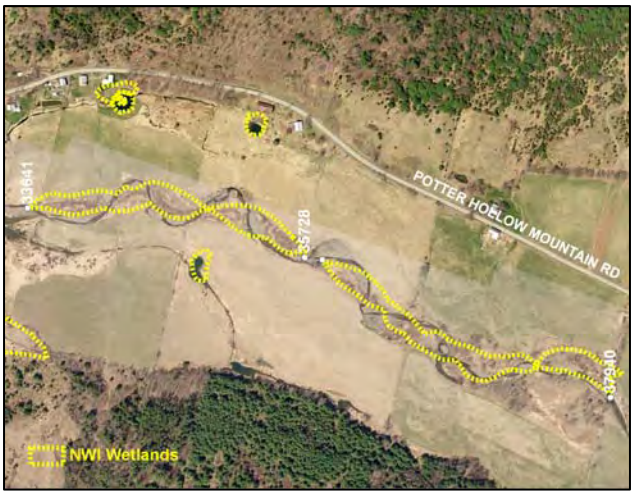
Riparian Planting Sites between Stations 36200 & 34000

As the stream meandered to the left, there was a third proposed riparian planting site (Stations 36190 – 34170) along

Erosion at Stations 36183 - 34909

2,020 feet of the right streambank. Along the opposite bank, the second proposed planting site (discussed previously, Stations 37087 – 35810) continued and was followed by a fourth proposed planting site (Stations 35743 – 34149). Along both of these sites, herbaceous vegetation was maintained to the edge of the stream for most of the site length, but there were also short sections with a thin wooded buffer. As with the previously mentioned planting sites, recommendations for these sites include establishing a buffer where none exists and augmentation of the existing buffered areas by planting native trees and shrubs along the streambank and the upland area. Buffer width should be increased to 100 feet or by the greatest amount agreeable to the landowners. Portions of both proposed planting sites are experiencing erosion in multiple locations along the streambank. Therefore, prior to proceeding with any vegetative plantings, these conditions should be given careful consideration, and additional assessment may be necessary.

As the stream meandered to the right, there was erosion (Stations 35839 – 35560) along approximately 279 feet of the proposed planting site on the left. At the time of the assessment, flow changed from subsurface to surface flow near this location. There were multiple areas of channel aggradation, including a *transverse*, or diagonal bar (Figure 4.3.1a, Inset C, Stations 35749 - 35704). The transverse bar directed flow towards the left bank and appeared to exacerbate the erosion at this site as the stream sought to increase its meander geometry.



Wetland boundary approximately delineated by NWI (Stations 35728 – 33641)

Beginning along this stretch of stream and continuing downstream, there was a 3.9 acre riverine wetland (35728 –

33641). This wetland was classified as R2USA, *riverine, lower perennial, unconsolidated shore, temporarily flooded*. Set back from the stream's edge, there was a small, 0.3 acre, palustrine wetland classified as PUBHh, *palustrine, unconsolidated bottom, permanently flooded, diked/impounded*.

Continuing along the riverine wetland and proposed planting sites, there was erosion (Stations 35374 – 35173) along approximately 201 feet of the left streambank. Starting just upstream of the eroding bank there was a transverse bar (Stations 35415 – 35175) that directed flow at the toe of the left bank, contributing to the erosion at this site. Japanese knotweed persisted along this stretch of stream. This erosion site may be a good candidate for remediation using vegetative toe and bank protection. In addition to the planting recommendations for the proposed riparian planting site, planting native sedge species along the toe of the bank is recommended to reinforce and help stabilize the streambank. As mentioned previously, additional site assessment may be necessary prior to proceeding with any work along this stretch of stream.

Transverse Bar at Stations 35415 - 35175

As the stream meandered to the left, aggradational conditions persisted, including point, side and transverse bars. A transverse bar (Stations 35150 – 35125) directed flow at the toe of the right streambank, contributing to approximately 1,245 square feet of erosion (Stations 35202 – 34891) along 311 feet of the streambank. With only herbaceous vegetation to the edge, and without deep-rooted shrub and tree species, it is likely that this bank will continue to erode during future high flows. The hydraulic erosion had caused the first significant clay exposure (Station 35120) within this management unit; clay was

Erosion at Stations 35202 – 34891 and Transverse Bar at Stations 35150 - 35125

exposed along the streambank and channel bed for approximately 12 feet. Clay inputs into a stream are a serious water quality concern because they increase *turbidity,* degrade fish habitat, and can act as transport for other pollutants and pathogens.

Beaver Dam at Station 34903

Continuing downstream of the erosion site, there was a beaver dam across the stream channel. The dam appeared to be actively maintained and contributed to backwater and downstream aggradational conditions. While beaver impoundments can sometimes be a nuisance, beavers have historically played a beneficial and ecologically important role in the stream system. Beaver activity adds organic debris (trees, leaves, etc. which provide the base of the food chain), reduces water velocities and flood-related hazards downstream, and creates wetland areas that filter sediment and release water to the stream and groundwater slowly throughout the year.

As the stream meandered to the right, the left streambank was eroding (Stations 34890 – 34658) for approximately 232 feet. Streambank erosion often occurs on the outside of meander bends where the stream velocity is greatest during high flows. The face of this streambank was stratified, with distinct layers of different sized material, including mixed till and lacustrine clay. The clay exposure (Figure 4.3.1a, Inset C, Stations 34839 – 34658) stretched for approximately 181 feet along the eroding bank. Excess sediment deposition persisted along this stretch of stream including full channel aggradation, point and transverse bars.

Erosion at Stations 34658 - 34547

Just downstream of the erosion site, there was a channel divergence (Station 34658) where a secondary channel split off from the main channel. This channel

Erosion at Stations 34597 - 34159

converges (Station 34547) with the main channel approximately 111 feet downstream. There was erosion (Station 34658 – 34547) along approximately 139 feet of the left streambank of the secondary channel.

As the stream meandered to the left, there was erosion (Stations 34597 – 34159) along the downstream end of the proposed riparian planting site (Stations 36190 – 34170) on the right streambank. Along this erosion site, there is a small clay exposure in the right stream bed. Excess sediment deposition persisted through this stretch of stream, including full channel aggradation, point and transverse bars.

Just downstream of the eroding bank there was a stream crossing (Station 34166) to provide access to agricultural fields on both sides of the stream. Along the downstream end of the fourth proposed riparian planting site (Stations 35743 – 34149) there was erosion (Stations 34100 - 33881) for approximately 219 feet on the left streambank. Portions of the streambank were overhanging and slumping into the stream channel. At the downstream end of the erosion, lacustrine clay (Figure 4.3.1a, Inset A, Station 33915) was exposed for approximately 10 feet of the left bed and streambank. Aggradational conditions, which included a transverse bar (Stations 34043 – 33996), appeared to contribute to the instability at this site by directing flow towards the toe of the left streambank. The source of the aggregation condition should be determined prior to any work in this reach. Japanese knotweed persisted through this stretch of stream.

Erosion at Stations 34100 - 33881

Continuing downstream, there was an additional significant clay exposure (Station 33749) along approximately 15 feet of the channel bed and left streambank. As the stream

gently meandered to the left, there was erosion (Stations 33670 – 33398) along approximately 272 feet of the right streambank. Portions of the eroding bank were overhanging and slumping into the stream channel and portions of an old wire fence were compromised. There were two lacustrine clay exposures (Stations 33554 and 33486) stretching approximately 10 and 12 feet respectively, along the eroding streambank. Herbaceous vegetation was maintained to the stream's edge. Although this section of the stream channel was not identified as a proposed planting site during the assessment, a wooded buffer with deep rooted vegetation is critical for providing streambank stabilization and protecting water quality from potential nutrient and pollutant inputs associated with the agricultural activity on the adjacent lands. Recommendations for this site include discontinue mowing to the stream's edge, allowing succession to proceed with natural regeneration of shrub and early successional tree species. Buffer width should be increased by the greatest amount agreeable to the landowners. The erosion and clay along this site may need to be addressed prior to proceeding with any riparian plantings of native sedge, shrub and tree species.

Clay Exposure at Station 33554

Tributary at Station 33464

Continuing downstream an unnamed *tributary* entered from the left streambank (Station 33464, photo orientation looking upstream). The New York State Department of Environmental Conservation (NYSDEC) classifies streams and rivers based on their "best use" (NYSDEC, 1994). This tributary was classified C by the NYS DEC, indicating that the best uses for this stream are supporting fisheries and other recreational activities. There was a relatively deep pond-

like area along this tributary, upstream of its confluence with the Manor Kill (see aerial imagery in Figure 4.3.1a); it appeared to be caused in part by beaver activity.

Erosion at Stations 33109 -33010

Downstream of the tributary, there was erosion (Stations 33496 – 33212) along the left streambank for approximately 239 feet. The erosion had caused a significant lacustrine clay exposure along approximately 30 feet of the streambank. There were multiple beaver slides along this eroding bank. Just downstream, on the opposite streambank, there was an erosion site (Stations 33109 – 33010) along the right with lacustrine clay (Station 33059) exposed in the channel bed and streambank. At the downstream end of this erosion site, there was a *headcut* (Station 32995), or a marked change in stream bed slope, where the channel appears to have been modified by dredging activity.

Continuing downstream, there were multiple areas with excess sediment deposition. The depositional features appeared to be caused by, or added to through channel modifications. Through this stretch of stream, it was evident that material was dredged from the stream bed and deposited along the toe of both streambanks, contributing to the formation of a point bar (Stations 33058 – 32925) along the left bank and a side bar (Stations 32967 – 32877) along the right bank. It appeared as though this material was being used to create a berm to provide streambank protection. However, due to the size of the material, it is likely that much of it will be mobilized during future high flows. This type of channel modification is not recommended. The NYS DEC Protection of Waters Program requires a permit for stream bed or bank disturbance including excavating gravel material and placing fill along streambanks to provide stabilization.

Side Bar at Stations 32967 - 32877

Along this stretch of stream there continued to be herbaceous vegetation to the stream's edge on both sides of the stream (Stations 33000 – 32000 along the right and Stations 33000 – 32500 along the left). At the time of the assessment these banks were not identified as proposed riparian planting sites. However, due to the lack of a riparian buffer and relatively stable streambanks, it is recommended that these areas be considered for riparian planting efforts, which may include reinforcing the toe of the banks with native sedge species and planting native shrubs and trees along the streambank and upland area. Minimally, it is recommended that landowners discontinue mowing to the stream's edge, allowing a buffer to naturally establish through succession. Buffer width should be increased to 100 feet or by the greatest amount agreeable to the landowners.

Wetland boundary approximately delineated by NWI (Stations 33133 – 31400)

Beginning along this stretch of stream and continuing downstream, there was a 2.6 acre palustrine wetland (Stations 33133 - 31936) along the stream corridor. This wetland was classified as PEM1A, palustrine*, emergent, persistent, temporarily flooded*. Set back from the stream's edge, there was a wetland complex that drained to the Manor Kill through a downstream tributary (Station 31364). This complex included 4 palustrine wetlands; these wetlands were classified as PEM1A (3.5 acres), PEM1/SS1A (2.2 acres), *palustrine, emergent, persistent, scrub-shrub, broad-leaved deciduous, temporarily flooded,* PEM1E (0.1 acres), *palustrine, emergent, persistent, seasonally flooded/saturated,* and PUBHh (0.15 acres), *palustrine, unconsolidated bottom, permanently flooded, diked/impounded*.


Tributary at Station 32604

Continuing downstream an unnamed *tributary* entered from the right streambank, draining the adjacent agricultural fields

(Station 32604, photo orientation looking at). This tributary was classified C(TS) by the NYS DEC, indicating that the best uses for this stream are supporting fisheries and other recreational activities, including trout spawning. The channel of the tributary, and the Manor Kill at the tributary confluence, had been dredged. The dredged material was deposited along the Manor Kill on the right streambank downstream of the tributary and on the left streambank, opposite the confluence. This type of channel modification requires a NYSDEC issued permit, and is not recommended, especially due to the trout spawning activity that may take place in this tributary and along the Manor Kill. Further downstream, another unnamed tributary that drains the adjacent fields (Figure 4.3.1b, Inset D, Station 32487) entered along the left streambank. This tributary was not classified by NY DEC.

Dredged material from Tributary at Station 32604

Continuing downstream, there were additional proposed riparian planting sites along both streambanks. Along the left streambank, the planting site (Stations 32465 – 30800) stretched for approximately 1,561 feet. Along the right streambank, the planting site (Stations 31909 – 28916) stretched for approximately 2,654 feet. Along both of these sites, herbaceous vegetation was maintained to the edge of the stream. Aggradational conditions persisted along these planting sites, including multiple point, side, center and transverse bars.

Riparian Planting Sites, Stations 32500 - 30800

As with the previously mentioned planting sites, recommendations for this site include planting native trees and shrubs along the streambank and the upland area. Buffer width should be increased to 100 feet or by the greatest amount agreeable to the landowners. Sections of both proposed planting sites are experiencing some erosion. Also, along this stretch of stream multiple beaver dams were

Stream Crossing at Stations 32212

destroyed and deposited along the streambanks. Therefore, prior to proceeding with any vegetative plantings, these conditions should be given careful consideration, and additional assessment may be necessary. Any vegetation that is planted may require protection, such as tree tubes, to minimize the impact that beaver activity may have on survival of planted species.

Continuing along this stretch of stream, there was a stream crossing (Station 32212) that appeared to be used frequently to access the agricultural fields along both sides of the stream. Further downstream, a tributary (Station 31970) entered along the right streambank, draining the adjacent agricultural fields. At the time of the assessment, it appeared as though material had been excavated from the tributary and the Manor Kill, and deposited along both streambanks (Figure 4.3.1b, Inset C, near Station 31970, right streambank) just downstream of the confluence. There was minor erosion behind the gravel and cobble that had been deposited along the right streambank; the deposited material appeared to be used for bank stabilization. As mentioned previously, this type of channel modification is not generally recommended and requires a NYS DEC permit.

Continuing downstream, there was minor erosion (Stations 31766 – 31718) along approximately 48 feet of the left streambank. There were two woody debris obstructions (Stations 31753 and 31711) and a transverse bar (Stations 31757 – 31691) that contributed to localized scour along this streambank. Further downstream, there were multiple stands of Japanese knotweed.

Tributary at Station 31364

As the stream gently meandered to the right, an unnamed tributary (Station 31364) entered along the left streambank. The tributary flows into a relatively deep pool along the Manor Kill; this pool is along the

Erosion at Stations 31303 - 31180

left side of a center bar within the main channel. Upstream through the tributary channel, there were additional deep pool areas. There appeared to be abundant beaver activity along this tributary and wetland area.

Just downstream of the tributary there was erosion (Stations 31303 – 31180) along the left streambank. Portions of the streambank were overhanging and slumping into the stream channel. During high flows, it is likely that tributary flow contributes to this erosion.

Continuing downstream, two tributaries (Stations 30749 and 30689) entered along the left streambank. Sections of the first tributary appeared to have been influenced by beaver activity, with multiple deep and wide pools along a relatively narrow stream channel. The second tributary appeared to contribute to approximately 71 feet of erosion (Stations 30712 – 30641), including two lacustrine clay exposures, totaling 17 feet, along the toe of the left streambank and channel bed. The adjacent land along the left streambank was forested downstream of the second tributary.

There were multiple woody debris obstructions (Station 30619) along the left and right streambanks downstream. The woody debris obstructions were caused by the removal of a beaver dam from the main channel and placement of the dam materials along each side of the stream. The remaining debris appeared to contribute to upstream sediment deposition and rerouting of the stream. Along this stretch of stream, and continuing downstream aggradational conditions persisted and there were multiple stands of Japanese knotweed. There were also three additional clay exposures (Stations 30541, 30427 and 30405) totaling approximately 33 feet. A fallen tree from the left bank was partially buried along

Woody Debris at Station 30619

the right bank where there was additional accumulation of woody debris that provided an obstruction (Station 30416) at all flows and appeared to contribute to upstream scour and downstream sediment deposition.

Riparian Planting Site at Stations 30280 - 30046

Continuing downstream, there was a proposed riparian planting site (Stations 30280 – 30046) for approximately 234 feet of the left streambank. This site had a relatively narrow successional old field between the stream's edge and the adjacent forest. Recommendations for this site include willow staking along the toe and streambank. It is also recommended that this field remain in succession with no mowing activity, in order to allow natural regeneration of shrubs and trees.

Further downstream, aggradational conditions persisted, including multiple point and transverse bars. Along the left streambank, multiple trees had fallen from the left bank across the channel to the right bank causing an obstruction (Station 30011) at all flows. The obstruction appeared to contribute to upstream aggradation and to localized scour along the channel bed and left streambank. Starting at the fallen trees and continuing for approximately 53 feet, there was significant erosion (Stations 30011 – 29959) along the left streambank. There was an open forest at the top of the streambank and some trees along this bank appeared to be compromised by beaver activity. Portions of the bank are overhanging and slumping into the stream channel. Continuing downstream, there were logs in multiple woody debris obstructions including obstructions caused by logs that stretched across the stream channel and were partially buried within the channel bed; these may have been a result of beaver activity or human placement to create pools for fishing.

Erosion at Stations 30011 - 29959

Beaver Lodge at Station 29715

Downstream of the obstructions, there were three beaver lodges along the main channel, including one on the right streambank (Station 29715) and two on the left streambank (Stations 29684 and 29572), and multiple locations of woody debris accumulation along both streambanks.

As the stream gently meandered to the right, hydraulic erosion (Stations 29682 – 29664) on the left streambank was followed by the first *mass failure* in this management unit. Streambank erosion often occurs on the outside of meander bends where the stream velocity is greatest during high flows; along this section of stream, the thalweg flows up against the toe, undermining the streambank. This resulted in an erosion area of approximately 1,724 ft^2, exposing lacustrine clay along the bed and banks and compromising a wire fence along the adjacent pasture. Although future high flows may continue to erode this bank, it did appear to be self- recovering and may be a good candidate for remediation using vegetative toe and bank protection including willow staking and planting sedges along the toe of the streambank. Prior to proceeding with any work, this site would require a more detailed site assessment.

Mass Failure at Stations 29682 - 29664

Beginning at this erosion and continuing downstream, a proposed riparian planting site (Stations 29657 – 28169) was identified along the left streambank; along the right, a previously mentioned planting site (Stations 31909 – 28916) continued. Recommendations for the planting site along the left include streambank and upland plantings of native shrub and tree species. Buffer width should be increased to 100 feet or by the greatest amount agreeable to the landowners. Due to multiple erosion sites along this planting site, additional assessment and streambank grading may be necessary.

Consideration should also be given to the abundant beaver activity along this stretch of stream; vegetative plantings may require protection, such as tree tubes, to maximize survival rates. Along this stretch of stream, there was a 2.9 acre palustrine wetland (Stations 33133 - 31936) along the stream corridor. This wetland was classified as PEM1A, *palustrine, emergent, persistent, temporarily flooded*. The Army Corps of Engineers regulates federal wetlands; therefore, if the planting sites require streambank grading or modifications, these wetlands will need to be considered and the appropriate permits should be obtained.

Wetland Boundary approximately delineated by NWI
Riparian Planting Sites
(Stations 25968 - 28200)

Continuing downstream, there was a large beaver dam (Figure 4.3.1b, Inset B, Station 29463). This dam has contributed to channel widening upstream of the dam, contributing to backwater conditions and creating a large, deep pool immediately upstream; there were also several smaller pools further upstream near the beaver lodges. Japanese knotweed was growing in the dam. The dam was contributing to downstream aggradational conditions, including a point bar (Stations 29549 - 29421) on the right that directs flow towards the left streambank. Along the right side of the dam, there was a beaver slide, creating a small secondary channel where water gets around the dam and flows behind the point bar and a small area vegetated with willows; this channel converged (Station 29400) with the main stem approximately 63 feet downstream.


Point Bar at Stations 29549 - 29421

Further downstream, there was another eroding bank (Stations 29319 – 29201) along the left streambank for approximately 118 feet. This erosion site had herbaceous vegetation to the edge of the stream and along the toe of the streambank. Along the downstream portion of this site, there was a lacustrine clay

Erosion at Stations 29319 - 29201

exposure (Station 29211) in the channel bed and the toe of the streambank for approximately 10 feet. As mentioned previously, there is a proposed riparian planting site along this stretch of stream; a vigorous buffer with mature trees is important at this site because it may also filter nutrients and pollutants from the adjacent agricultural fields. Between the erosion site (Stations 29682 – 29664) upstream of the beaver dam, and this erosion site, there was an older erosion site with slumping banks that had settled. This bank appeared to have self-recovered and was well vegetated with herbaceous vegetation, willows and shrubs. If the beaver dam is removed or destroyed by flood flow, the recovered bank may start to actively erode and connect the upstream and downstream sites, creating a much more significant erosion site. There was also an erosion site (Stations 29196 – 29061) along the right streambank for approximately 135 feet, exposing mixed till. There was herbaceous vegetation to the edge of the bank, with exposed roots and overhanging and slumping bank material. Excess sediment (between Stations 29300 - 28765) deposition persisted through this stretch of stream and continued downstream including, full channel aggradation, a side bar, a transverse bar, and multiple point bars.

Continuing downstream, a small unnamed tributary (Station 28787) that drains the adjacent agricultural fields, entered along the right streambank. As the stream meandered to the left, there was a channel crossing to provide cows access to pasture fields along both sides of the stream. Along this crossing there was also full channel aggradation; maintenance of the crossing appeared to contribute to the localized aggradational conditions. Just downstream of the channel crossing, there was a short section of rip rap, comprised of small to medium cobbles, along

Channel Crossing at Station 28745

Erosion at Stations 28600 - 28585

the toe of the right streambank. Continuing downstream, there were multiple areas with minor hydraulic erosion along the left (Stations 28716 – 28702, Stations 28555 – 28487, and Stations 28377 - 28371) and right (Stations 28600 – 28585 and Stations 28509 - 28473) streambanks. Along this stretch of stream there continued to be excess sediment deposition within the stream channel, and there were multiple stands of Japanese knotweed. All of these erosion sites had herbaceous vegetation to the edge with small saplings, followed by a fence, beyond which were pasture fields. The saplings were planted as part of the Conservation Reserve Enhancement Program (CREP), which is a voluntary program available to agricultural producers. Through this program, the landowner sets aside land from production to provide protection for environmental resources, such as ground and surface water. Here, participation in CREP has provided protection to the streambanks of the Manor Kill by setting aside land adjacent to the stream for plantings and to allow natural succession. Participation in this program has also provided protection to the stream by limiting the access of pastured animals, which helps to prevent nutrient inputs directly to the stream and minimizes the impact that animals may have on streambank stability.

As the stream gently meandered to the left, the right streambank was reinforced with rip rap (Stations 28068 – 27939) for approximately 129 feet. At the time of the assessment, the rip rap had failed and was providing little to no streambank protection. Beginning behind the rip rap and continuing downstream, there was erosion (Stations 28011 – 27857) along approximately 154 feet of the right bank. During the field assessment, this bank was identified as a proposed Bank Erosion Monitoring Site

Erosion at Stations 28011 - 27857

(BEMS) to study erosion along this reach. To monitor bank erosion, a cross-section and longitudinal profile may be completed to collect baseline data. Once the baseline data has been collected, this cross-section can be resurveyed in the future to calculate the bank's erosion rate. Improving the riparian buffer along this site is important and has been recommended; however, other stream bank stabilization techniques may be required to reinforce the bank and to minimize any loss of planted vegetation. Opposite this erosion site, the left streambank was eroding (Stations 28006 -27778) for approximately 228 feet. A CREP site continued along both of these erosion sites. A riparian planting site was also identified along the right streambank (Stations 28488 – 27218). Recommendations for this site are consistent with recommendations made for previous planting sites within this management unit.

Tributary at Station 27951

Along the eroding bank an unnamed tributary (Station 27951) entered from the right. This tributary drains the slopes of Huntersfield Mountain before it reaches the flatter topography of the valley floor where it enters the Manor Kill. This tributary was classified C by the NYS DEC, indicating that the best uses for this stream are supporting fisheries and other recreational activities.

Beaver Dam Remnants at Station 27600
Transverse Bar at Stations 27622 - 27581

Continuing downstream, there were two additional erosion sites. Along the left, there was some minor hydraulic erosion (Stations 27653 - 27621) for approximately 32 feet that appeared to be self-recovering. On the right, there was more significant erosion (Stations 27643 – 27584) along 59 feet of the streambank. There was an old beaver dam (Station 27600) that had been destroyed during previous high flows and was

no longer being maintained, or had been partially removed in an attempt to restore channel flow. It appeared as though this dam had contributed to the erosion along the right streambank. The remnants of the beaver dam contributed to aggradational conditions that persisted through this stretch of stream, including a transverse bar (Stations 27622 – 27581), that was causing backwater along the right.

Wetland Boundary approximately delineated by NWI (Stations 27610 – 27412)

Continuing downstream, there was a wetland complex comprised of two palustrine wetlands. The complex began adjacent to the stream channel and stretched back into the fields along the left side of the stream. The first one was approximately 4.7 acres and is classified as PEM1B, *palustrine, emergent, persistent, saturated.* Two small tributaries (Stations 27552 and 27518) flowed through this wetland. The second wetland was approximately 0.4 acres and is classified PEM1/SS1A, *palustrine, emergent, persistent, scrub-shrub, broad-leaved deciduous, temporarily flooded.* A proposed riparian planting site continued along the opposite streambank.

As the stream meandered to the right, there was erosion (Stations 27424 – 27154) along approximately 270 feet of the left streambank. Along the much of this erosion, the CREP site continued with herbaceous vegetation to the top of the bank, followed by shrubs and young trees. As land use changed from agricultural to forested, the erosion continued causing exposed roots and compromising mature trees that had fallen along the streambank. There were two woody debris obstructions resulting from the erosion (Station 27290 and Figure 4.3.1b, Inset A, Station 27261). Both obstructions contributed to localized scour of the toe of the left streambank and the channel bed, and caused upstream aggradational conditions across the


Woody Debris at Station 27290

Erosion at Stations 27246 - 27183

full channel. Opposite this erosion the right streambank was eroding for approximately 63 feet. This minor erosion site (Stations 27246 – 27183) may be a good candidate for remediation using vegetative toe and bank protection. Reinforcing the toe of the streambank with native sedge species is recommended. A CREP site and proposed riparian planting site (Stations 27246 – 27183) continued along this erosion site. Prior to proceeding with any work, this site may require a more detailed site assessment.

As the stream continued to meander to the right, there was excess sediment deposition including a transverse bar (Stations 27163 – 27144) and a well-vegetated center bar (Stations 27144 – 27085). There were also remnants of an old beaver dam (Station 27144) that contributed to these aggradational conditions. The depositional features and dam remnants all appeared to contribute to upstream backwater conditions. Also along this meander bend, there was a mass failure (Stations 27163 – 26938) on the left bank for approximately 161 feet in management unit 3 and then continued into management unit 4 for an additional 64 feet. There was a mixture of herbaceous vegetation and open forest along this mass failure; mature trees were compromised and had fallen along the streambank. The erosion appeared to be self-recovering, with sedges along the toe of the bank and herbaceous vegetation, shrubs and willows establishing along the face of the bank; although future high flows may result in continued erosion along this meander bend. There were multiple small patches of Japanese knotweed along this stretch of stream. Management Unit 3 ended at Station 26995.

Mass Failure at Stations 27163 - 26938

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 3.2 for more details on Stream Processes).

Sediment transport in this unit is influenced by valley morphology and multiple beaver dams and woody debris obstructions. The unconfined valley form and topography suggest that this unit is a sediment storage zone, supplied by tributaries and active erosion. This unit suffers from wide-spread sediment transport deficiencies. Bed load transported through this unit exceeds the transport capacity of this management unit, resulting in channel aggradation and lateral migration. In general, sediment storage areas benefit the general health of the stream system by limiting bedload delivered to downstream reaches during large storm events. However, mature riparian vegetation will be important in such settings to limit the extent of lateral channel migration and continued bank erosion. The broad floodplains that have traditionally made this a productive agricultural area are also conducive to lateral stream migrations, which may be slowed by a healthy riparian buffer.

Riparian Vegetation

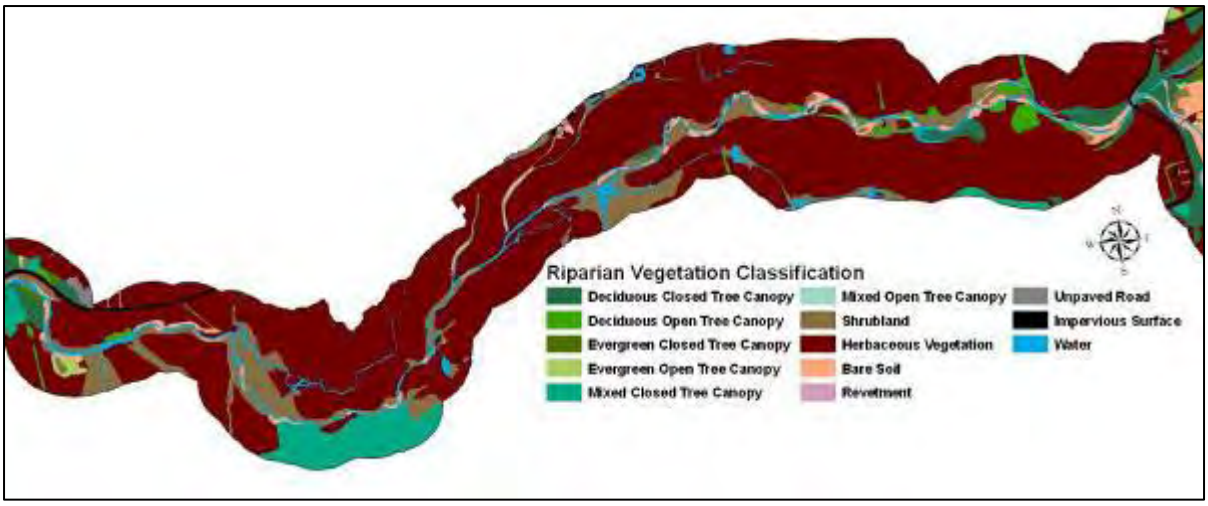
One of the most cost-effective and self-sustaining methods for landowners to protect streamside property is to maintain or replant a healthy buffer of trees and shrubs along the banks and floodplains, especially within the first 50 to 100 feet of the stream. A dense mat of roots under trees and shrubs binds the soil together, making it much less susceptible to erosion. Mowed lawn (grass) does not provide adequate erosion protection on stream banks because it typically has a very shallow rooting system and cannot reduce erosive forces as well as trees and shrubs. One innovative solution is the interplanting of revetment with native shrubs which can significantly increase the working life of existing rock rip-rap, while providing additional benefits to water, habitat, and aesthetic quality. *Riparian*, or streamside, forest can buffer and filter contaminants coming from upland sources, shallow groundwater or overbank flows, and slow the velocity of floodwaters causing sediment to drop out, while allowing for *groundwater recharge*. Riparian plantings can include a great variety of flowering trees, shrubs, and sedges native to the Catskills. Native species are adapted to our regional climate and soil conditions and typically require less maintenance following

planting and establishment. There were nine riparian improvement planting sites documented within this management unit; proposed planting sites cover approximately 57.81 percent of the streambanks in this unit.

Japanese knotweed at Station 35300

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 its 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 results can include rapid streambank erosion and increased surface runoff leading to a loss of valuable topsoil. Japanese knotweed locations were documented as part of the stream feature inventory conducted during the summer of 2008 (Riparian Vegetation Mapping, Section 2.7). In total, 63 Japanese knotweed occurrences along an estimated length of 5,682.6 feet were documented during the stream feature inventory. The best means for controlling knotweed is prevention of its spread, therefore, effort should be made to ensure that all fill brought into the area is clean and does not have fragments of knotweed or other invasive plants. If Japanese knotweed sprouts or small stands are observed, they should be eradicated immediately to avoid further spread within this unit and downstream management units.

An analysis of vegetation was conducted using aerial photography from 2006 and field inventories (see map below and Riparian Vegetation Mapping, Section 2.7). In this management unit, the predominant vegetation type within the 300 ft. riparian buffer was herbaceous (74.99%) followed by shrubland (9.88%). *Impervious* area (0.34%) within this unit's buffer was primarily the local and private roadways. Areas of herbaceous (non-woody) cover may present opportunities to improve the riparian buffer with tree plantings in order to promote a more mature vegetative community along the streambank and in the floodplain.



Riparian vegetation classification map based on aerial photography from 2006

Flood Threats

As part of its National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) performs hydrologic and hydraulic studies to produce Flood Insurance Rate Maps (FIRM), which identify areas prone to flooding. The NYS DEC Bureau of Program Resources and Flood Protection has developed new floodplain maps for the Manor Kill on the basis of recent surveys. The new FIRM hardcopy maps are available for viewing at the Schoharie County Soil & Water Conservation District Office.

100-year floodplain boundary map

According to the current floodplain maps (above), two existing structures in this unit appeared to be situated within the estimated 100-year floodplain. For this management unit,

floodplain map coverage did not include the upstream portion of the Manor Kill. It is recommended that hydraulic analysis be completed to create floodway and floodplain maps from the end point of existing maps upstream to the headwaters wetland complex where the main stem begins. 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 local flood record. Most communities regulate the type of development that can occur in areas subject to these flood risks.

Aquatic Habitat

Generally, habitat quality appeared to be poor throughout this management unit. Canopy cover was inadequate along a significant portion of both streambanks. For a portion of this unit, flow was subsurface at the time of the assessment which eliminates habitat for a variety of aquatic organisms and creates a blockage for fish passage to upstream and downstream portions of the stream that had surface flow. Canopy cover to provide shading for the stream channel was absent along a significant portion of the stream, which has a negative impact on the quality of habitat where there was surface flow. There were some areas of woody debris accumulation observed in the unit. Woody debris provides critical habitat for fish and insects, and adds essential organic matter that will benefit organisms downstream.

In 2008, researchers from SUNY Cobleskill conducted macroinvertebrate and fish surveys along the Manor Kill. There were four sampling sites within Management Unit 3. See the macroinvertebrate and fish reports (Appendix F) for more detailed information regarding the surveys and their findings.

It is recommended that an aquatic habitat study be conducted on the Manor Kill with particular attention paid to springs, tributaries and other potential thermal refuge for cold water fish, particularly trout. Once identified, efforts should be made to protect these thermal refugia locations in order to sustain a cold water fishery throughout the summer.

Water Quality

Clay/silt exposures and sediment from stream bank and channel erosion pose a potential threat to water quality in the Manor Kill. Fine sediment inputs into a stream

increase *turbidity* and can act as a transport mechanism for other pollutants and pathogens. There were 16 significant clay exposures in this management unit.

Stormwater runoff can also have a considerable impact on water quality. When it rains, water falls on roadways and parking areas before flowing untreated directly into the Manor Kill. The cumulative impact of oil, grease, sediment, salt, litter and other unseen pollutants found in road runoff can significantly degrade water quality. However, there were no stormwater culverts observed in this management unit in 2008.

Nutrient loading from failing septic systems is another potential source of water pollution. Leaking septic systems can contaminate water with nutrients and pathogens making it unhealthy for drinking, swimming, or wading. There were a few buildings located in close proximity to the stream channel in this management unit. These building owners should inspect their septic systems annually to make sure they are functioning properly. Servicing frequency varies per household and is determined by 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. To assist watershed landowners with septic system issues, technical and financial assistance is available through two Catskill Watershed Corporation (CWC) programs, the Septic Rehab and Replacement program and the Septic Maintenance program (See Section 2.12). Through December 2007, two homeowners within the drainage area of this management unit had made use of these programs to replace or repair a septic system.

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