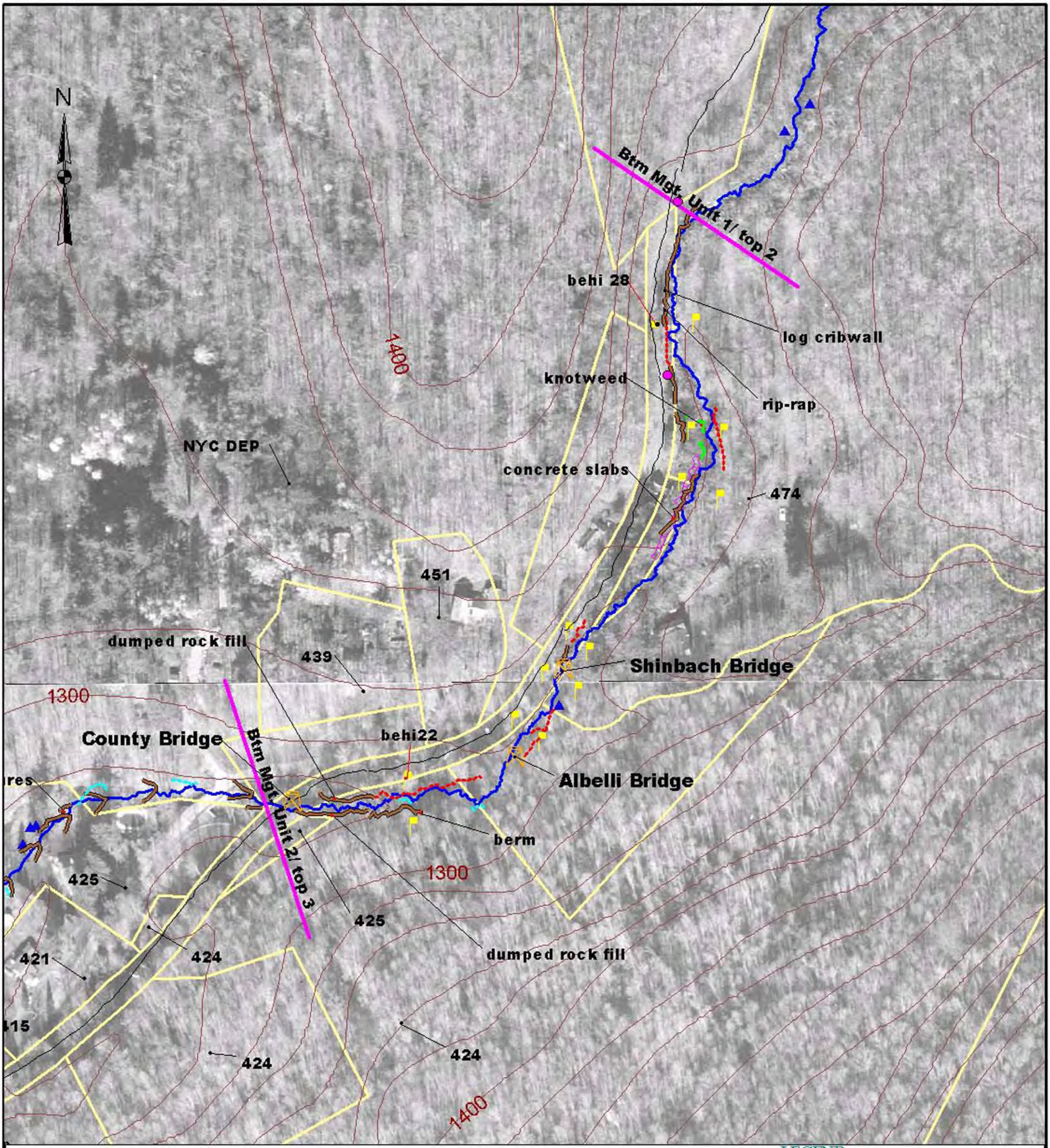

GIS Parcel, Contour and Wetland coverages are edited and provided by NYC DEP, 2000,UTM NAD 27, Zone 18 North, meters. Aerial Photography provided by UCSWCD & NYC DEP November 2001. All other coverages were developed using GPS in the UTM, Zone 18 North projection, NADCON (Conus), datum. GPS data collected 2001, by UCSWCD & NYC DEP SMP.

Note: G.I.S. data are approximate according to their scale and resolution. Data may be subject to error and are not a substitute for on-site inspection or survey. Parcel coverages are based on Ulster County Real Property tax maps 2000 and may not reflect actual surveyed property boundaries.

Broadstreet Hollow Management Unit 2

Contour Interval 20 feet

50 0 50 100 150 200 Feet

Scale 1:2,400

LEGEND

247 Street Address/911 code	Clay exposure
Greene parcels	Revetment
Ulster parcels	Eroding bank
Land fills	Tributary
Managment units	Behi pin
Stream Center (Thalweg)	Bridge
Culvert	Broadstreet Hollow Road
Wetland	Knotweed

Broadstreet Hollow Management Unit 2

General Description:

Photo 1. Looking upstream near the top of MU2, road at left at the top of the bank

Management Unit 2 (MU2) is located in Greene County, NY[1&2]. The top of MU2 begins at a section of failing log crib wall where the road begins to run very close to the stream, approximately 2,400 feet from the top of Broadstreet Hollow Road (Photos 1 and 2). The Unit extends downstream approximately 1,480 feet to the outlet of the new County Bridge just below where Regina's Way intersects Broadstreet Hollow Road.

The stream in this unit runs close to the road for most of its length, and has three bridges (two private and one County maintained). MU2 is a largely un-stable reach that is in poor condition. This is primarily attributed to the proximity to the road, as well as existing berms and stream bank conditions. This unit has several long eroding banks and hundreds of feet of stream bank stabilization measures, or *revetments*[3]. Though not extensive, *glacial lake clay* exposures in the stream bed and banks in this unit could worsen stream instability or add to water quality problems[10]. Stream assessment done in 2001 documented both the largest stand of the invasive plant, *Japanese Knotweed*, in the entire valley, as well as the most extensive stream-side dumping site[7].

Photo 2. Looking upstream from bridge in the middle of MU2, road at left at the top of the bank.

The structural shape, or *morphology*, of the stream (i.e., slope, width and depth) changes frequently in this unit, creating smaller sections, or *reaches*, with discrete morphologic character, or *stream type*[5]. The valley in MU2 is particularly narrow throughout, with steep, close valley walls on one side and the road on the other, producing a predominantly *entrenched* stream shape. Typically stable stream types associated with this type of valley are relatively narrow and steep, with small waterfalls ("steps"), and stream banks formed into low benches, or *discontinuous floodplains*, that function as small overflow areas during floods. MU2 lacks these discontinuous floodplains on the banks near the road, and for much of its length on the opposite bank as well.

I. Flooding and Erosion Threats

A. Infrastructure and Private Property

There are eleven properties (land parcels) associated with MU2. Six of these parcels contain or are bounded by the stream. The other four have boundaries within 150 feet of the stream[1&2].

The upper section of Broadstreet Hollow Road at the top of MU2 is packed dirt for approximately the first 480 feet, changing to oil and crushed stone for approximately 660 feet before becoming paved. Stream assessment data for 2001 shows the road centerline ranging from 1 to approximately 90 feet from the stream (measured from the *thalweg*, or the deepest part of the stream).

Photo 3. Looking upstream at bridge on Broadstreet Hollow Road, just below Regina's Way intersection (BIN 3201230).

One County maintained bridge crosses the stream in MU2 on Broadstreet Hollow Road, just below the intersection with Regina's Way (Photo 3). This bridge was replaced following the flood of 1996, and is wide enough to accommodate both a low flow stream channel and to allow the stream to maintain a generally natural shape consistent with dimensions upstream and downstream.

Photo 4. Looking upstream at private crossing.

Two private properties each have privately maintained bridge crossings (Photos 4 and 5). For the purposes of stream assessment, bridge width is defined by the length of the span over the stream from bank to bank, or abutment to abutment. These bridges are both constructed more narrowly than the natural stream both upstream and downstream from the bridge location.

A bridge that is too narrow can result in maintenance problems, both of the bridge itself as well as the stream channel or banks both upstream and downstream of the bridge. The constriction at the bridge can cause water to back up during floods, which can lead to increased erosion both upstream of the bridge as the water eddies behind it, and downstream as the water rushes through and eddies around the banks just downstream. Both of these bridges show evidence of such bank erosion both upstream and downstream of the bridge structure.

Photo 5. Looking upstream, private crossing at Shinbach property.

Landowners have reported property loss on both sides of the stream and many costly repairs. Both bridges will likely have maintenance problems over time, unless they are reconstructed to accommodate the natural width of the stream.

MU2 Culverts

Two culverts were found during the stream assessment survey in 2001, both near the top of MU2. There may be other culverts within this unit the survey did not find. Neither culvert had water flowing in it at the time of the survey, completed during the lowest stream flow period of the year, or summer base flow, following drought conditions in summer, 2001. Culvert function under flooding conditions was not documented, though culvert outlet condition appeared to be relatively stable at the time of the survey.

B. History of Stream Work

Approximately 800 feet, or 25%, of the stream banks in MU2 have been altered or hardened (Table 1)[3]. Dumped rock fill comprises the greatest length of revetment used in the unit (Photos 6 and 7), much of which continues to wash or fall into the stream during and following flood events and remains an ongoing maintenance problem for Town and County Highway Departments.

Table 1. Altered Banks*
Broadstreet Hollow MU2.[2]

*based on linear feet of both sides of stream bank.

Revetment Type	Length	Percent of Unit
berm	155 feet	5
rip-rap	63 feet	2
log crib wall	125 feet	4
dumped rock fill	290 feet	10
concrete slabs	120 feet	4
Total revetment	**803 feet**	**25%**

Photo 6. Dumped rock fill upstream of Shinbach's bridge, right bank.

Photo 7. Failing log crib wall, with dumped rock fill, at the top of MU2.

Broadstreet Hollow stream can transport very large rocks, or *sediment*, along the stream bed (sediment in transport is called *bedload*). The size of sediment in dumped rock fill is often smaller than the bedload. As a result, rocks on the bank continue to wash downstream over time, needing periodic replacement. Continuing disturbance of the bank area prevents streamside, or *riparian*, trees and other vegetation from becoming established[7]. Further, some riparian tree species become stressed and weakened when their trunks are buried, so existing trees that may be providing some bank protection are eventually killed by ongoing maintenance, reducing long-term bank stability, as well as compromising other important habitat and aesthetic benefits. Alternatives to dumped rock fill should be considered, to reduce maintenance costs and preserve riparian areas[3].

C. Exposed banks

Stream assessment conducted in 2001 showed approximately 505 feet (17%) of eroding stream bank in MU2, in seven sections (Photos 8 - 14). All seven sections have been monumented at a representative location for future monitoring (locations designated as “monitoring cross-sections”) to determine erosion rates and priority for potential restoration [3]. These sites have been assessed and ranked based on calculation of a *Bank Erodibility Hazard Index* (BEHI) using data collected at the time of the stream assessment survey in 2001[4].

Photo 8. Eroding right bank at Broadstreet Hollow Road fill area, monitoring cross-section 22 (flow from right to left).

Photo 9. Eroding left bank at residential lawn, monitoring cross-section 23 (flow from left to right).

Four of the seven eroding banks are associated with road fill areas (see Photos 8, 10,11 and 14); one of these is also associated with eddy erosion at the outlet of the private bridge (see Photo 10). The bank at monitoring cross section 23 is associated with both a residential lawn area and the private bridge approach (see Photo 9).

Photo 10. Eroding right bank at Broadstreet Hollow Road, and private bridge outlet, monitoring cross-section 24 (flow from right to left).

Photo 11. Eroding right bank at Broadstreet Hollow Road, monitoring cross-section 25 (flow from right to left).

Photo 12. Eroding right bank at deteriorated house and dumping site, monitoring cross-section 26 (flow from right to left).

An old dumping site (see Photo 12) was found in this reach which has exposed the bank and has triggered ongoing bank erosion. This site poses a safety hazard from metal degradation of old concrete slab revetment and glass refuse material, in addition to the aesthetic and property value issues resulting from a dumping site.

Photo 13. Eroding left bank at forested floodplain, opposite berm and fill area, monitoring cross-section 27 (flow from left to right).

Photo 14. Eroding right bank at Broadstreet Hollow Road, monitoring cross-section 28 (flow from right to left).

II. Water Quality

A. Sediment

Multiple eroding banks in MU2 may cause increased turbidity in this reach from fine sediment (*silt* and *clay*) coming from stream bank and bed material. Of the approximately 475 feet of actively eroding bank documented in 2001, only one site contained an exposure of *glacial lake clay* in the stream bed (left bank Photo 15; right bank, monitoring cross-section 22, see Photo 8)[10].

The berm on the left bank in this reach appears to be material pushed into that area in response to flood damages in the vicinity of the bridge just downstream (County Bridge just below Regina's Way intersection) (Photo 15)[3]. This practice of "cleaning" the gravel out of a stream in this way is thought to increase flood capacity by creating a larger stream channel. Unfortunately, berms such as these generally do not offer any protection from flooding, and can cause stream entrenchment and higher flood stage locally by preventing floodwaters from flowing over the floodplain, cutting off an important function of these flat areas.

Photo 15. Berm on the left bank (in the middle of the photo), at monitoring cross-section 22 location (flow from left to right).

Floodplains function to reduce flood velocity, increase absorption of floodwaters, encourage deposition of silt and fine sediments (keeping them from being washed further downstream) and decrease flood stage, or height, in downstream areas. The majority of Broadstreet Hollow stream floodplains consist of small, low, discontinuous floodplain benches that perform the important floodplain functions in small mountain streams. Because MU2 is particularly entrenched and confined, with little floodplain storage, removal or restructuring of this berm should be considered to add floodplain function to this area[3].

Additionally, vegetation would help reduce bank erosion at the toe of the right bank at the erosion site, and intercept runoff from the road just beyond. In the absence of the berm, vegetation alone may be adequate to stabilize this bank.

B. Landfills/Dumping sites

Approximately 180 feet (6%) of MU2 was mapped as a single dumping site, the largest one documented in 2001. This area overlaps with the eroding bank (with failing concrete slab revetment) represented by monitoring cross-section 22 (see Photo 12), though extends beyond this lot and the eroding bank area. There is a deteriorated house on this lot that coincides with the dumping area. Planning efforts to organize a cleanup endeavor at this site were initiated in 2002.

C. Other Water Quality Issues

Investigation of other possible sources of contamination was not part of the stream assessment conducted in 2001. However, no evidence was found for *nutrient* or *pathogen* contamination in the stream (i.e., odors or discolored water). Any road runoff roadside ditches and culverts that may contain salts or other pollutants was not specifically investigated, but lack of well-vegetated streamside or *riparian buffer* areas could reduce the capacity of the stream banks to assimilate, or slow the input of, contaminants to the stream[7]. More than 40% of the stream banks in MU2 are either hardened (with some kind of revetment) or actively eroding, and have insufficient riparian vegetation to provide full benefits of bank stability, pollutant uptake and other habitat benefits.

One side stream, or *tributary*, enters the main stream in MU2, between the two private bridge crossings. *Confluence* areas (where the two streams join) tend to be unstable by nature's design, as the smaller stream delivers pulses of flood waters and sediment to the main stream. Though this confluence appears to be relatively stable, this reach may be highly sensitive to ongoing erosion problems due to narrow valley conditions, insufficient riparian vegetation and bridge constrictions.

III. Stream Ecology

A. Aquatic Habitat and Populations

No specific aquatic habitat or population monitoring was conducted in MU2 as part of the stream assessment survey in 2001. However, as part of the stream restoration demonstration project completed in MU3 in 2000, fish and aquatic insect population data have been gathered yearly since 1998 within the stable reference reach (MU1), the project site (MU3) and the control reach (MU17). These data show the Broadstreet Hollow self-supports, without stocking, populations of all three common trout species (rainbow, brook and brown) as well as a healthy and diverse community of aquatic insects[9]. The impact that stream bed and bank instability has on these aquatic organisms or their communities is unknown.

B. Riparian Vegetation

The stream assessment conducted in 2001 did not investigate specific streamside (riparian) plant species or density, other than to note areas of insufficient or stressed vegetation that could affect stream stability, flooding or erosion threats, water quality or aquatic habitat for trout species. Based on these general observations, riparian vegetation throughout MU2 is insufficient to provide the full benefits of a healthy riparian zone. As mentioned above, the road is at most 90 feet from the stream thalweg throughout MU2. This narrow area is generally quite steep, making vegetation both more difficult to support as well as more important for maintaining stream bank and road fill stability and preserving other riparian vegetative benefits. Existing riparian vegetation between the road and the stream can be stressed by ongoing road runoff, plow side-cast, and maintenance of revetments. Under-vegetated areas in the vicinity of dumped rock fill, rip-rap and road fill sections in this reach should be vegetated with a mixture of native riparian species to improve shade, cover and water temperature conditions for aquatic habitat[9], as well as to improve bank stability and reduce the need for bank stabilization work that could cause or increase stream ecosystem disturbances[3].

The east side of the stream, opposite the road (the left bank) contains generally healthy riparian vegetation, excepting the reach between the two private bridges (at monitoring cross-section 23). This reach would benefit from additional native trees and shrubs to protect the property and improve bank stability upstream from the lower bridge[3]. Additionally, the berm and rip-rap areas on the left bank at the downstream end of MU2 at the County bridge should also be vegetated to improve bank stability opposite the eroding bank (at monitoring cross-section 22) and improve shade and cover for the stream in the areas with dumped rock fill just upstream of the County bridge[3].

Photo 16. Japanese Knotweed, winter dormant state, right bank at monitoring cross-section 27 (flow from right to left).

Japanese Knotweed, a non-native, invasive plant, was documented on 95 feet (3%) of the banks in this unit during stream assessment in 2001 (Photo 16). This species is an invasive exotic, and damaging to riparian integrity[7]. Japanese Knotweed is fast growing, can crowd out native vegetation and the roots provide little or no soil-anchoring action.

Japanese Knotweed is aggressive and spreads easily; pieces break off, wash downstream and can take root where they land, especially in disturbed areas (such as eroding banks or continually disturbed maintenance areas). To avoid further spread of this plant to downstream areas that may be vulnerable to colonization, Japanese Knotweed at this reach should be removed, and the area replanted with a mix of competitive native species to prevent re-colonization. Additional maintenance of this area may be needed, as Japanese Knotweed is very difficult to remove successfully.

[1]Broadstreet Hollow Management Unit 2 Map
[2] Volume II Appendix 3.1.5 Management Unit 2 Workbook.
[3] Volume II Section 2.2 Watershed Management Recommendations
[4] Volume II Section 2.2.1-Monitoring Cross Section and Summary Tables
[5] Volume I Sections 3.2.1&2 Stream Processes, Morphology and Classification
[6] Volume I Section 3.5 Fisheries and Wildlife
[7] Volume I Sections 3.4 & Volume II 2.2.2 Riparian Vegetation Issues and Recommendations
[8] Volume II 2.0 Stream Stability Restoration Projects, Techniques and Contact Information & Appendices
[9] Volume I Sections 3.4 & Volume II 2.2.2 Riparian Vegetation Issues and Recommendations
[10] Section 3.2.4.2 Broadstreet Hollow Geology