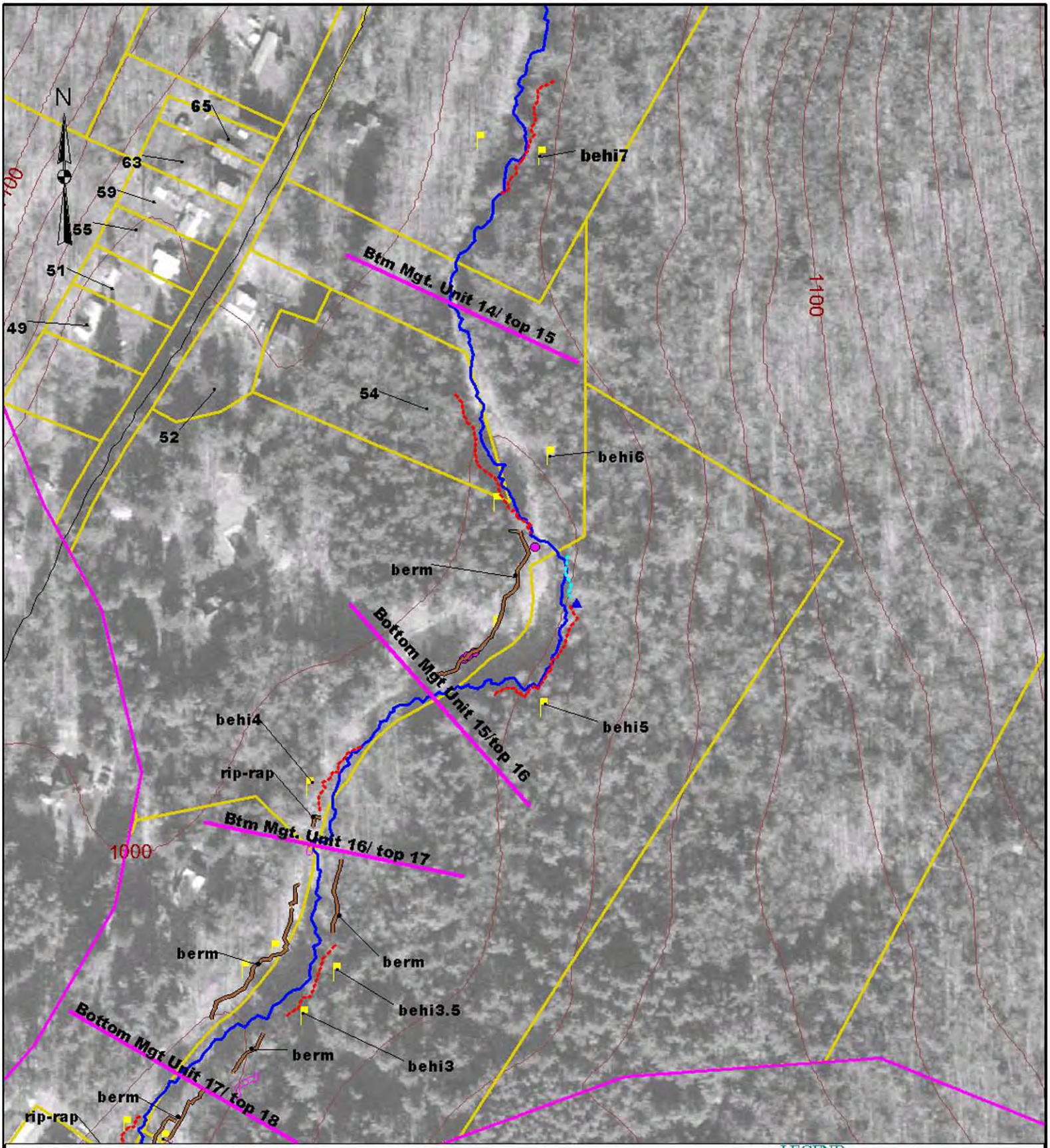

GIS Parcel, Contour and Wetland coverages are edited and provided by NYC DEP, 2000, UTM NAD 27, Zone 18 North, meters. Aerial Photography provided by UCSWCD & NYC DEP November 2001. All other coverages were developed using GPS in the UTM, Zone 18 North projection, NAD CON (Conus), datum. GPS data collected 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 15

Contour Interval 20 feet

50 0 50 100 150 200 Feet

Scale 1:2,400

LEGEND

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

Broadstreet Hollow Management Unit 15

General Description:

Management Unit 15 (MU15), is located in Ulster County, NY, the top (Photo 1) beginning just upstream of the water diversion for a small pond (land parcel 5.4-1-29), and extending approximately 880 feet down through the property to just past the pond outlet on the right bank (looking downstream)[1&2]. This unit can't be seen from Broadstreet Hollow road.

Photo 1. Looking upstream into the top of MU15, just upstream of residential water diversion.

The structural shape, or *morphology*, of the stream (i.e., slope, width and depth) shifts in this unit, creating four smaller sections, or *reaches*, with discrete morphologic character, or *stream type*[5]. Though the valley isn't particularly narrow through MU15, the stream runs against the valley wall on the left (looking downstream) opposite the road, and has cut into its bed enough that the wide flat area between the road and the stream that used to be the floodplain is now a *terrace*, functioning as a floodplain only at during very high flows. The upstream half of MU15 has not cut into its bed enough to produce an *entrenched* stream shape, though there is active stream bank *erosion* over a large section of the terrace bank (Photo 2).

Photo 2. Looking upstream into the top half of MU15, showing vegetated gravel bar areas and healthy riparian forests on both banks (some trees leaning into the stream to the right associated with a long eroding hillside, discussed below).

The downstream half of MU15 is in considerably worse condition, or *unstable*, with an entrenched stream shape showing the stream is confined by its valley and bank conditions in this reach (Photo 3). One of the most extreme eroding hillsides documented in Broadstreet Hollow in 2001 is contained in this section (described below), and a long section of over-widened stream with multiple, unstable channels exacerbating bank erosion on both banks.

Photo 3. Looking upstream from near the bottom of MU15, into an over-wide, unstable section characterized by shifting gravel bars, eroding banks and multiple fallen trees.

Typically stable stream types associated with this type of valley are relatively narrow, with riffles and pools, and stream banks formed into low

benches, or *discontinuous floodplains*, that function as overflow areas during floods and provide areas for healthy streamside, or *riparian*, vegetation. Less steep areas with more floodplains have more space in which to maintain a stable shape, and better riparian vegetation to stabilize the banks and provide other habitat benefits[5&7]. MU15 maintains some of these discontinuous floodplain bench and vegetated side gravel bar features in the upstream reach on the non-eroding bank, but lacks these features entirely in the lower reaches, adding to instability in this section. Additionally, the shifting bar pattern in the middle of the stream in the lower reaches of MU15 contributes to ongoing bank erosion in this area [5] (see Photo 3).

I. Flooding and Erosion Threats

A. Infrastructure and Private Property

Three properties (land parcels) are associated with the stream in MU15; all three contain or are bounded by the stream[2].

The centerline of Broadstreet Hollow Road ranges from approximately 310 to 720 feet in distance from the deepest part of the stream, or *thalweg*. There are no bridges in this unit, and no culverts draining roadside ditches directly to the stream.

A hand-built water diversion, consisting of a low cobble dam with corrugated pipe, feeds a small pond on the right bank [1] (Photo 4).

Photo 4. Looking upstream near the top of MU15, showing hand-built water diversion cobble dam, and corrugated pipe.

MU15 Culverts

Three culverts were documented in MU15 during the stream assessment survey conducted in 2001. All three culverts provide drainage from this small pond. Culvert outlets may be threatened by ongoing instability and bank erosion along the berm surface in this reach (see discussion below). Minimally, without addressing stream morphology and underlying causes of stream instability in this reach, adding woody vegetation at culvert outlets, with a mixture of native riparian species would potentially improve bank stability and longevity of the berm structure and culvert outlet areas. Vegetation would also improve shade and cover conditions for aquatic habitat [7].

B. History of Stream Work

Stream assessment survey in 2001 documented one section of altered stream bank, approximately 295 feet, or 17% of MU15 by length, consisting of a linear mound of earth, or berm, along the stream bank forming an embankment for the small pond [3] (Photo 5). This feature, while preventing the pond from stream inundation and damage, contributes to the

Photo 5. 295-foot earthen/cobble berm on the right stream bank, forming an embankment for the small pond. Pond is visible in the background to the right, stream is out of the frame to the left.

entrenched stream channel shape in this reach, though the actual impact to stream stability was not determined. Both stream banks are eroding in this reach (monitoring discussed below[4]), including fill material comprising the berm (Photo 6).

No other streamside development or stream work was documented in MU15 in 2001.

C. Exposed Banks

Stream assessment in 2001 documented approximately 500 feet, or 29% of the stream bank length in MU15, in two sections of approximately equal length. The eroding left bank in the downstream half of MU15, at approximately 15 feet from top of bank to the base, or toe, in the stream, has a significant exposure of highly erodible *glacial lake clay* (Photo 7). Mature trees sliding down the hillslope and failure scarps (large cracks in the hillside, parallel to the stream, created as blocks of land slide downhill) show multiple *rotational failures* and bank *slumping*. This failure mechanism is fueled by stream erosion at the bottom, or *toe*, of the slope, continually delivering soil, rocks and vegetation into the stream and preventing an adjustment of the stream channel to a stable shape[4].

Photo 6. Right bank berm protecting the pond, showing ongoing erosion, protected to some extent by shrubs and other riparian vegetation. Stream flow in side channel is from right to left.

Photo 7. Eroding left bank clay hillside, at unstable reach in MU15, monitoring cross-section 5. Stream flow is from left to right.

This clay comprises the entire hillside, similar to the eroding banks at the bottom of MU8 and the middle of MU5, over which the riparian forest is sliding and slumping into the stream in large sections, despite the presence of large healthy trees (Photo 8, and see Photo 7). A representative location was chosen and permanently marked with metal rebar, or *monumented*, for future monitoring (designated as "monitoring cross-section 5") to determine erosion rates and priority for potential restoration (see Photo 7, orange flagging at the top of the bank above the large fallen tree marks cross-section location) [3&8]. This site has been assessed and ranked based on calculation of a *Bank*

Photo 8. Upstream section of eroding left bank clay hillside, upstream from location shown in Photo 8. Stream flow is from left to right.

Erodibility Hazard Index (BEHI) using data collected at the time of the stream assessment survey in 2001[4]. This bank received a BEHI rank of "high" potential for further erosion, with the greatest threat from this bank to water quality from the clay (see discussion below). No structures or other development are currently directly threatened by erosion at this site.

Photo 9. Eroding right bank, at forested riparian terrace, monitoring cross-section 6. Stream flow is from right to left.

The eroding right bank in the upstream half of MU15 (Photo 9) is quite different in character from the downstream eroding clay hillside (see Photos 7 and 8). This bank, monumented and designated "monitoring cross-section 6", comprises an eroding section of terrace, approximately six feet from top of bank to the toe, or base of the bank, in the stream channel. The top soil layer is held together by fairly dense riparian forest trees, though roots do not penetrate deeply enough to hold the entire bank in place. This bank received a BEHI rank of "moderate" potential for further erosion, though the concentration of stream energy against this bank due to the shape of the stream channel increases this potential[4]. No structures or other development are currently directly threatened by erosion at this site.

II. Water Quality

A. Sediment

In addition to exposed clay along the left bank at monitoring cross-section 5, where the stream runs directly against the valley wall (see Photos 7 and 8), an additional 65 feet (4%) of exposed clay was documented on the left bank and stream bed just upstream [4] (Photo 10). Approximately a quarter of the stream bank length in MU15 contains exposed fine sediments (*silt* and *clay*) in the banks and bed that may cause increased *turbidity*, especially during high flows.

Photo 10. Glacial lake clay exposure, in the stream bed along the right bank, just upstream of the eroding right bank clay hillside at monitoring cross-section 5. Stream flow is from left to right.

Due to the inherent instability of the valley wall hillslope along the left bank in the lower half of MU15, the extent of the clay exposure and the generally poor stabilization ability of riparian vegetation due to the thin soils, the potential for large inputs of silts and clays into the stream during floods will continue to be a problem unless the reach is restored.

Structural revegetation[7], or *bioengineering*, should be considered in conjunction with a full-scale restoration of stream channel morphology in this reach, to reduce ongoing erosion pressure on the valley wall hillslope and berm area next to the pond. Additionally, the hillslope failure should be assessed to determine the extent of *geotechnical* failure mechanisms, as well as to advise the appropriate solution for this continued problem[8].

B. Landfills/Dumping Sites

Stream assessment conducted in 2001 did not reveal any current dumping sites in or near the stream in MU15 that could contribute to water quality impairment from leaching of toxic materials.

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 runoff of water from the road and culverts that may contain salts or other pollutants was not specifically investigated. However, the long distance from the road, and the density and health of the riparian vegetation, definitely provides some protection from such runoff.

Photo 11. Ephemeral (runs only following storms) tributary, entering the main stream on the left bank between stream bed clay exposure and eroding left bank clay hillside at monitoring cross section 5. Stream flow in the main channel is from left to right.

One small, ephemeral (only runs after storms) side stream, or tributary, feeds into MU15 from the left, between the bed clay exposure and the eroding hillside at monitoring cross-section 5 (Photo 11). *Confluence* areas (where 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. This confluence appears to be relatively stable, though could exacerbate suspension of clays from the stream bed during floods. No specific management of this tributary is recommended at this time.

III. Stream Ecology

A. Aquatic Habitat and Populations

No specific aquatic habitat or population monitoring was conducted in MU15 as a part of the stream assessment in 2001. However fishery 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)[6].

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 in this unit, particularly the over-widened split channel area in the downstream half of MU15, with associated eroding clay hillside area at monitoring cross-section 5. Undercut banks along the bank at monitoring cross-section 6,