E. Chestnut Creek Management Unit 5

1. Summary Description

This section is intended to summarize the overall character and condition of Management Unit 5 (MU5). Subsequent sections will discuss specific issues (e.g., *riparian* land use and public infrastructure, channel stability, etc.) in greater detail.

This unit is approximately 8015 linear feet (1.50 miles) in length and includes the segment of Chestnut Creek from immediately downstream of the Kelly Bridge to a point immediately downstream of the Covered Bridge at the Town Park and Fairgrounds (Photo 1). The drainage areas at the upstream and downstream ends of the management unit are 4.75 and 9.45 square miles, respectively (MU5 General map, Figure 1).

Land use along the stream corridor is predominantly forest along adjacent hillslopes with a number of residences, the

Photo 1. Looking downstream upstream at the historical Covered Bridge at the Town of Neversink, Agricultural Society Fairgrounds along Route 55, at bottom MU 5.

Town Highway Facility as well as the Town Park and Fairgrounds situated near the *floodplain*. Although the riparian areas on private land are generally maintained as mowed lawn with scattered trees and shrubs, a significant portion of the corridor is owned by NYCDEP and maintained as forest. Storm water runoff from yards is conveyed predominantly as *sheet flow*. The parking lot/equipment storage area at the Highway Facility and the parking lots and tennis courts at the Park drain to the creek via sheet flow and vegetated swales.

This section of Chestnut Creek appear to have been straightened and *channelized* at some time in the past. An analysis of a series of historic aerial photographs covering the period 1974-2001 indicates that routine channel maintenance occurred until recently (Aerial Photos 2, 3 & 4).

Field evidence, as well as information obtained from interviews with residents and town officials indicates that MU5 has been the focus of periodic maintenance activity. (For more information see Public Infrastructure and Landowner Concerns and Interests, Volume I, Section B). The banks have been armored along sections of the management unit. Efforts of the Town and landowners to protect infrastructure and property have resulted in approximately 10% of the channel length through this unit undergoing some type of alteration (e.g., *riprap, gabion*, and concrete *revetment).* These protective measures appear to have been relatively successful in some areas, while less successful in other areas. Gravel flood *berms* are present along some *reaches*. In addition, it is evident that portions of the floodplain have been filled to accommodate development. These channel

Photo 2. 1974 Aerial Photograph of Management Unit 5.

Photo 3. 1995 Aerial Photograph of Management Unit 5.

Photo 4. 2001 Aerial Photograph of Management Unit 5.

and floodplain modifications have resulted in a confined channel with a moderate to high *width/depth ratio*, low *sinuosity* and a relatively steep gradient. As such the creek and adjacent floodplain are more susceptible to stability and flooding problems.

2. Riparian Land Use and Public Infrastructure

There are 41 developed properties within the stream corridor along MU5 that include private residences with ancillary structures, the Town Highway Facility, and the Town Park and Fairgrounds. As noted above, development of the riparian corridor has historically involved floodplain fill and/or the construction of flood berms to protect structures placed in these areas. The Town Highway Facility property includes the old maintenance shop, storage sheds, and a large parking lot and equipment storage area that covers most of the property. The Town Park and Fairgrounds includes several large buildings, storage sheds, athletic fields, tennis courts, a swimming pool, and several large parking lots.

Maintenance of public infrastructure is always a concern for local municipalities. There are two drainage culverts and four bridges in MU5. The bridge names from top of MU5 to the bottom are Clark Road, Mohr's, Hilltop Road, and the Covered Bridge. The County bridge at Clark Road (CBN: 319, BIN: 3357090) was rebuilt in 1995 (Photo 5). The new bridge was designed to convey the 25-year storm flow. Bridge inspections in 2000 and 2001 indicate that the decking, abutments, and wingwalls for this structure are in satisfactory condition.

Photo 5. Looking downstream at Clark Road Bridge.

Although privately owned, the bridge at the Mohr Property provides emergency access for several landowners. The bridge was originally used as access for the local school before the present day Tri-Valley School was established in 1950. The bridge is currently in poor condition. The bridge span was measured to be less than the *bankfull width* immediately both up and downstream of the structure. The left abutment (looking downstream) is also located in the *thalweg* or deepest part of the active stream channel which can be seen in Photo 7. This puts significant stress on the structure as well as the stream channel in the vicinity of the bridge as evidenced by the large scour hole that has undermined the left abutment (Photo 6). Approvals were obtained from NYSDEC in 1998 to repair the failing abutment. The concrete wall that runs along the left bank adjacent to Route 55 is attached directly to the failing abutment (Photo 7). If the bridge is not repaired or replaced the factors contributing to its failure may ultimately affect the structural integrity of the concrete wall.

Photo 6. Failing left abutment (on photo right) attached to concrete wall at Mohr's Bridge, stream flow from right to left.

Photo 7. Looking downstream at concrete wall on left bank tied into edge of Route 55 and Mohr's Bridge.

Hilltop Road Bridge also a County bridge (CBN: 340, BIN: 3357180) was built in 1967 (Photo 8). The bridge width from bank to bank, is smaller than the immediate up and downstream cross sections. This narrow span may contribute to backwater conditions and scour through the bridge opening. Flood damage to the foundation and wingwalls occurred during a severe thunderstorm in July 1995. A general permit was issued for repairs that included removal of gravel and debris deposits, replacing riprap, new toe footings and base protection. Bridge inspections in

Photo 8. View looking downstream at Hilltop Road Bridge, gabion revetment can be seen on left of photo.

2000 and 2001 indicate minor scour erosion was evident. However, the decking, abutments, and wingwalls for this structure are in satisfactory condition.

The historic Covered Bridge was built in 1976 as a bicentennial community project (see Photo 1). Inspected by NYSDOT as a County bridge (BIN: 5524660), it provides access to the Town Park and Fairgrounds and an emergency access to Davis Lane. Although the cross-sectional area of the bridge opening is adequate to pass the bankfull discharge, the relatively narrow span may contribute to backwater conditions and scour through the bridge opening, as the width from bank to bank is smaller than the up and downstream bankfull cross sectional width. During the 2001 Stream Assessment Survey, scour was noted along the right abutment (looking downstream). The bridge wingwall was repaired in 1991 (Photo 9). Bridge inspections in 2000 and 2001 indicated that additional repair work was required. Repairs planned for 2003 were conducted.

At the bottom of MU5, below the Covered Bridge, (actually located at the

Photo 9. Looking upstream right bank Covered Bridge and Fairgrounds. Archive photo obtained from NYS DEC of repair work conducted on wingwall scour in 1991.

top of MU6) the town maintains a dry hydrant, (located on the map with a drainage culvert symbol). As with many rural communities, streams provide a critical source of water for fighting fires. To provide a readily available supply of water, dry hydrant facilities are maintained by the Fire Department at key points of access along Chestnut Creek. These facilities can only function if the water in the area of the pump intake is deep enough to accommodate continuous pumping without being drawn down during an emergency. As designed currently, gravel and other debris tend to accumulate in these areas reducing water depth and available pump volume. Standard practice has been to routinely remove these accumulated gravels to maintain proper function of the facility. An alternative design for dry hydrants that significantly reduces the need for maintenance should be addressed, suggestions are presented in the Recommendations section at the end of MU5.

As noted above, storm drainage conveys storm water runoff from streets and parking lots directly to the creek (Photo 10). Two storm drain outfalls were identified in this management unit during the 2001 Assessment Survey.

Photo 10. rip-rap along left bank and Rt. 55 with 2' diameter culvert from the road – below Mohr's bridge.

The volume as well as the water quality of the runoff is a function of the size and characteristics of the land area each system drains. For example, land areas with a high percentage of impervious surfaces tend to generate considerably more runoff than areas that are predominantly forest or lawn. The size and land use characteristics of the areas draining to the outfalls identified, as well as the potential for storm water retrofit opportunities was not evaluated as part of the initial assessment. However, a review of the aerial photographs indicates that the properties along the corridor with the highest percent impervious surfaces include the Town Highway Facility, a private residence along Route 55 at Hilltop Road, and the Town Park and Fairgrounds. These properties do not have storm water management facilities for controlling runoff.

A planned extension of the existing sanitary sewer system may enable existing residences, currently using on-site treatment and disposal systems to connect to DEP's Grahamsville Sewage Treatment Plant. Four extensions to the existing sanitary sewer system are being planned, three of them emanating out of Grahamsville. One of the extensions being planned will extend along Rte 55 west for approximately 1.5 miles from Clark Road to Armstrong Road, upstream of Scott Brook. In some places the sewer alignment will be close to Chestnut Creek. Depending on its ultimate location, the installation of the sewer system could impact a significant length of the riparian area along the creek. In addition, it may be necessary to install lateral extensions across the creek to serve properties on the opposite side of the creek from the sewer main. Current construction specifications, which require that sanitary sewer lines be installed a minimum of three feet below the streambed should minimize the potential for the laterals to create a situation similar to that at Davis Lane, where an unnatural grade change imposed by the sewer crossing may adversely affect the stream (see MU6 description). Careful planning of the main sewer alignment can reduce impacts to the riparian area along Chestnut Creek.

3. History of Stream and Floodplain Work

As noted Chestnut Creek appears to have been straightened and channelized at some time in the past. Channel work to remove gravel deposits and maintain flood conveyance has been routine until recently. Development of the riparian corridor along Chestnut Creek historically involved floodplain fill and/or the construction of flood berms to protect structures placed in these areas. Filling floodplain areas to accommodate development on private as well as public land is still a common practice in the Chestnut Creek watershed. Efforts by the Town, as well as landowners focused on protecting infrastructure and property have involved the installation of *riprap*, *flood berms*, *gabions*, and *concrete revetment* along 20% of the channel length through this management unit (Photos 11, 12 & 13). Maintenance of public infrastructure and the extension of public services have required periodic encroachments on the channel and floodplain.

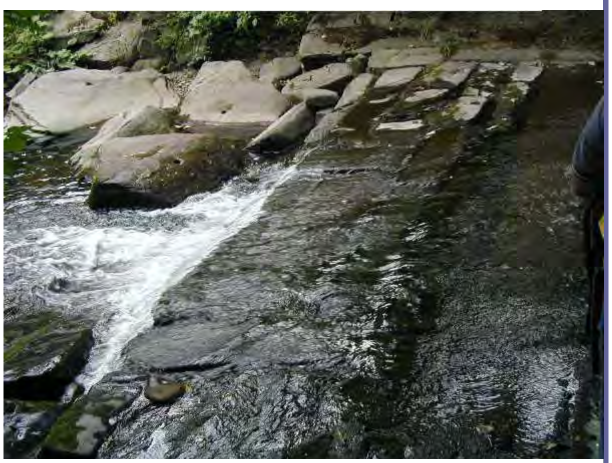

Photo 11. Rock and cement bed/elevation control – looking toward right bank below Clark Road Bridge.

Photo 12. Left channel riprap looking upstream several hundred feet above covered bridge opposite fairgrounds.

Photo 13. Rip-rap on right bank below Clark Rd. Bridge – view looking upstream at end of bridge opposite from Route 55.

General impacts of traditional approaches to stream management have been addressed in the Watershed Recommendations for Best Management Practices, Volume II, Section II.A of this plan. Specific impacts and management considerations in relation to the assessment of MU5 are included with this section of the plan.

4. Channel Stability and Sediment Supply

During the 2001 Stream Corridor Survey, MU5 was divided into twelve *reaches* on the basis of the Level II – *Morphologic* Description (Rosgen, 1996). Stream classification for Chestnut Creek predominantly follows the Rosgen classification system with a few exceptions (see Intro to Stream Processes Volume I, Section III.D, and Watershed Assessment, Volume I, Section I.E.2). Five reaches in MU5 (#1, 7, 8, 9, and 10) contain very short sections of bedrock, though these reaches are otherwise dominated by cobble or gravel-sized sediment. Because locations of bedrock exposure still represent an important control on stream morphology, these sections were documented as a double stream type, such as B1/B3. A B1/B3 reach would be predominantly a B3 (cobble), but would have section (s) of B1 (bedrock) too small to be broken out into a separate reach or reaches. Additional reach type splits may include borderline slope classification, such as B3/B3a, where "a" signifies an A channel slope with a B cross-section morphology.

The largest portion (68%) of this unit includes moderately *entrenched* channel types B3 and B1 with a moderate width to depth ratio (i.e., 18-30). These types of channels tend to be resilient to disturbance and recover well from impact. B-types are generally effective at moving sediment transported from upstream reaches. Although mature trees and shrubs provide lateral control along the majority of the management unit, channel maintenance activities have left all of the reaches in this unit with moderate to high width to depth ratios making them less efficient at moving sediment.

Highly entrenched reaches (i.e. F-types) account for 32% of the total length. Because they lack a floodprone area (i.e., an area adjacent to the channel where floodwaters can spread out and reduce the energy against the streambed and banks), entrenched reaches experience considerable stress during storm flow and tend to be more susceptible to stability problems, particularly bank erosion and bed scour or *degradation*. In addition, these types of channels route storm flow quickly to downstream reaches where they can contribute to channel instability and flooding. The morphological data collected along the reaches is summarized in Table 1 and illustrated in Figure 2.

As evident in the current aerial photographs, the channel *plan form* along this management unit is characterized by low sinuosity and *meanders* with large radii of curvature. The altered meander geometry is the result of channel straightening to accommodate Route 55, development of properties along the stream corridor, and periodic channel maintenance. For example, a significant portion of the upper reaches of Chestnut Creek is confined between Route 55 along the left banks and floodplain, terraces and steep hillslopes adjacent to the right banks. Both left and right banks are developed in this area.

Information obtained from interviews with residents indicates that landowners along the middle reaches have altered the location of the stream over the years. An analysis of a series of historic aerial photographs covering the period 1974 – 2001 indicates that routine channel maintenance activities and subsequent natural channel adjustments has been on-going. The effects of the channel maintenance and natural adjustments are most evident in the 1974 and 1977 aerial photographs. Apparent from the imagery is a consistent down valley migration of the meander bend upstream of the Black property, located upstream of the Covered Bridge near the entry of a small tributary which bounds the upstream side of their property. A noticeable straightening of the same meander occurred between 1977 and 1985 possibly from a chute cutoff during a high flow event or as a result of channel

Table 1 - Summary of Morphological Data for Reaches along Management Unit 5. The first reach is shared with last reach in MU4. The last reach in MU5 is shared with the first reach in MU6.

Reach	Length (ft)	Area (ft^2)	Width (ft)	Mean Depth (ft)	W/D	Ent	Slope (ft/ft)	Stream Type
1	646	41.7	26.2	1.6	17	1.4	0.015	F1/F3
2	447	43.2	29.4	1.35	20	1.5	0.025	B3
3	582	44.5	34	1.3	26	1.27	0.020	F3
4	109	35.4	24.5	1.4	18	1.5	0.020	B3
5	275	42.9	29.7	1.4	21	1.2	0.015	F3
6	334	68.3	36.5	1.9	20	1.6	0.020	B3
7	658	62	38.7	1.6	25	1.2	0.010	F1/F4
8	951	62.7	39.7	1.6	25	1.55	0.020	B1/B4
9	352	60.5	38.5	1.6	24	1.4	0.015	F1/F3
10	1332	66	38.6	1.7	23	1.7	0.020	B1/B3
11	247	70	40	1.8	22	1.3	0.020	F3
12	2926	70.5	44.9	1.64	30	1.74	0.020	B3

maintenance activities. The *meander* continued to migrate in a down valley direction between 1995 and 2001 moving progressively closer to the Black's residence. The largest change in channel plan form occurred along the meander bend adjacent to the tennis courts, just upstream of the Covered Bridge adjacent to the Town Fairgrounds. In this area the bend location shifted 60 feet between 1974 and 2001. The meander bend adjusted several times through the photo series, most noticeably with the shift from a well-developed point bar evident in 1977 to a mid-channel bar existing currently.

Historic bed degradation, floodplain fill, and the construction of gravel flood berms contributed to the current entrenched situation along Reaches 1, 3, 5, 7, 9 and 11. Exposed bedrock currently provides grade control along a significant portion of the unit, thereby preventing further channel degradation. However, field observations and the aerial photographic record indicate that aggradation is an on-going process throughout this management unit. Mid-channel and lateral bars have developed along many of the reaches. The overwide condition (i.e., high width to depth ratio) of the channel along a number of reaches is likely a result of historic channel maintenance.

As pointed out in Introduction to Stream Processes and Ecology, Volume I, Section III.A, natural streams are composed of three distinct flows that include: a *baseflow* or low flow channel, which provides habitat for aquatic organisms; a bankfull channel, which is critical for maintaining sediment transport; and a floodplain, which effectively conveys flows greater than the bankfull discharge (i.e., 1 – 3-year peak flow).

Standard engineering practice to designs channels that convey large storm flows (e. g., 25-, 50-, or even 100-year peak flows) without overtopping the adjacent streambanks. While enlarging the channel to improve its ability to convey storm flows may seem logical, in fact this approach usually creates channels that have poor habitat, are ineffective at transporting sediment, and require constant maintenance. These engineered channels are generally designed to convey all flows (baseflow, bankfull flow, and flood flow) in a single channel that is relatively straight, very wide and trapezoidal in *cross-sectional area*, with a uniform profile.

In these altered channels, baseflow is usually very shallow or may actually flow beneath the substrate because it is spread out over such a large surface area. The uniform profile replaces the typical *riffle*-pool sequence with a continuous shallow riffle-run that provides no cover for fish to avoid predation or strong flushing currents. A very wide, shallow channel is less efficient at moving sediment under bankfull flow conditions. As a consequence, sediment (e.g., *sand, gravel, cobble*) tends to accumulate, developing lateral and/or mid-channel bars along these altered reaches. Ironically, the accumulation of sediment and the development of bars significantly reduce the channel's capacity to convey the large storm flows for which it was designed. The 2001 Stream Assessment Survey conducted by SCSWCD showed that approximately 2825 feet (35%) of channel is affected by aggradation.

Lateral control along 20% of channel length is currently provided by riprap, gabions, and concrete revetment. These protective measures appear to have been relatively successful in some areas, while less successful in other areas. For example, the banks along the rear of the Black Property in the middle reaches of this unit had been rip rapped during previous maintenance attempts. Currently riprap has been dislodged, fallen into the channel and is inappropriately redirecting higher flows and scouring stream banks (Photo 14).

Mature trees and shrubs provide sp,e lateral control along the management unit. The 2001 Stream Assessment Survey determined that 2040 feet (12.7%) of the

Photo 14. Dislodged riprap in the channel.

Photo 15. Looking downstream towards eroded left bank and fallen Sycamore trees near Fairground area-monitoring cross section 6.

streambanks are actively eroding (Photo 15). Bank to bankfull height ratios along this unit ranged from 1.1 – 3.6, confirming that a significant length of the channel is *incised.* Rosgen (2002) notes that bank to bankfull height ratio is a good measure of vertical stability, as well as an indicator of sediment supply potential. Stability assessment resulted in banks along the actively eroding areas to be rated very high in terms of bank erosion potential, meaning that the potential for continued bank erosion, loss of trees and channel migration is very high compared to other sites. In fact, as meander bends and bars continue to develop lateral erosion and meander migration will accelerate. Because the channel is cutting into terraces and fill slopes in some areas they may continue to be a significant source of sediment for downstream *reaches*.

Debris jams, dams and other channel obstructions can cause problems by deflecting storm water into stream banks and trapping sediment that initiates the development of gravel bars and reduces channel capacity, and scouring the bed and banks. At the time of the 2001 Stream Assessment Survey debris jams were not a significant problem along the reaches in this unit, although subsequent visits have shown new trees undercut and fallen (Photo 15). A number of man-made structures were observed including; a log sill and several rock check dams (Photos 16, 17 & 18). It was not clear whether these structures are negatively affecting channel stability and/or sediment transport.

As part of the 2001 Assessment Survey *monumented* cross-sections were installed in a number of locations along Chestnut Creek to monitor stream bank erosion and streambed changes in specific reaches of

Photo 16. Rock check dam, between Clark Road Bridge and Hilltop Road Bridge.

Photo 17. Just below Covered Bridge MU5, Wood Weir serving dry hydrant in downstream MU (see MU6 for more detail).

Photo 18. Log sill located just above Covered Bridge.

concern (Bank Erosion Hazard Index, BEHI, and Bank Monitoring Cross–section, BMX, to observe aggradation) Accordingly, four cross-sections were established and surveyed in MU5 along the reaches upstream of the Covered Bridge adjacent to the Town Fairgrounds (Photos 19, 20, 21 & 22, MU5 Stream Type Cross Section map, Figure 2). Three of the sites were established to monitor lateral erosion (BEHI 4,5&6) and one along a section that appears to be aggrading (BMX 1). The cross-sections will be resurveyed and compared to the initial surveys to

Photo 19. Monitoring cross section 4 at eroded left bank view from right opposite tennis courts at Fair-ground.

Photo 20. Monitoring cross section 5, view looking at right bank, tennis courts in background beyond tree, approximately 200’ downstream of monitoring cross section 4.

Photo 21. Monitoring cross section 6, approximately 200’ eroded right bank, downstream of monitoring cross section 5.

Photo 22. Aggradation monitoring cross section 1, just upstream Covered Bridge.

document the rate at which stream bank and streambed changes occur. Data obtained from these surveys will also allow estimates of sediment loadings to be developed.

Evaluating the reaches along Chestnut Creek to determine whether they are contributing to sediment problems in the Chestnut Creek/Rondout Reservoir System was a component of the Assessment

Survey. The preliminary results of the fieldwork indicate that the actively eroding banks and mid-channel bars noted above may be a source of sediment to downstream reaches. Where they accumulate, these sediments may reduce channel capacity and contribute to localized channel stability problems.

The sediments eroded from the reaches along Chestnut Creek are generally coarse (i.e., *sand, gravel and cobble*). Unlike other watersheds where exposed *silt* or *clay* deposits are a water quality concern because they contribute very fine material to the suspended sediment load, these coarser sediments tend to move as *bed load* and settle out quickly after storms. As a consequence, sediment eroded from the streambed and stream banks along this management unit does not appear to directly affect water quality within the Chestnut Creek/Rondout Reservoir System.

5. Riparian Vegetation

The riparian area along Management Unit 5 can be characterized as: reaches adjacent to roads and parking lots with little or no buffer; reaches with mowed lawns and scattered trees and shrubs; reaches with small wooded buffers of mature trees, shrubs, and herbaceous plants; and reaches along steep hillslopes and terraces with mature forest. In riparian areas where small wooded buffers are present, their width varies from 75 feet to 250 feet. In general these areas are less than 100 feet wide. Along developed properties, the riparian vegetation has been affected by clearing, routine yard maintenance, and other land use activities. The properties along the stream corridor with the lowest percent of riparian vegetation and buffer include the Town Highway Facility in the upper reaches and the private residences fronting along Route 55 in the middle reaches.

The results of the 2001 Assessment Survey indicate that control of *multiflora rose* has been a problem along some areas. *Japanese knotweed*, an *invasive species*, was sighted along the banks in this management unit. It occupied a total of 110 feet on both the left and right banks in three separate locations. Invasive, exotic plants such as this crowd out the natural flora of the area and generally provide little streambank stabilization or habitat (Riparian Vegetation Issues in Stream Management, Volume I, Section IV.B.3).

6. Restoration and Management Recommendations

As presented previously, the Chestnut Creek Management Plan will be utilized to guide and facilitate stakeholders in their efforts to correct stream channel instability problems, restore and maintain natural floodplain functions, control runoff from developed areas to reduce pollutant loadings from channel and upland sources, restore and protect in-stream habitat, and reduce the need for future channel maintenance.

This section includes specific restoration and management recommendations for Management Unit 5, as well as a general discussion of the approach to stream corridor restoration and management recommended for the Chestnut Creek Watershed. The SCSWCD, NYCDEP, and other agencies and organizations will be working with the community to implement the restoration and management strategies outlined in this Management Plan. It is critical that stream and upland area projects be integrated to avoid potential conflicts in their respective objectives. Therefore, this section also includes comments and recommendations regarding the integration of proposed strategies in upland areas, in particular floodplain management and storm water management practices.

Restoration and Management Recommendations Management Unit 5

1. Assess small tributaries and springs that feed the mainstem in MU5. Prioritize projects along mainstem and tributaries. Repair and stabilize the worst erosion sites along mainstem and the tributaries draining to MU5.

2. Implement storm water management for the properties with the highest percent impervious surface along the corridor, including the Town Highway Facility and the Town Park and Fairgrounds, and any other significant impervious areas identified during the field reconnaissance recommended below. The storm water management facilities should be designed to provide water quality management for the first half-inch of runoff and quantity management that reduces the peak discharge runoff rate for the 1 – 3-year storm flows.

3. Convert the existing F and unstable B reaches to stable B channels by removing existing mid-channel bars, removing poorly sited and/or poorly functioning check dams, removing gravel flood berms, and reconstructing these overwide and entrenched channels with lower width/ depth ratios and wider floodprone areas.

4. Evaluate the potential for removing all or a portion of the paving and fill along the Town Highway Facility Property in order to reestablish a wooded buffer zone and floodplain area.

5. Repair or replace the bridge at the Mohr’s Property. If the bridge is replaced it should be designed to convey the 25-year storm and have a cross-section and width that effectively conveys the bankfull discharge without causing scour or deposition.

6. Evaluate the potential for reconstructing the channel along the historically active reaches from upstream of the Black Property to the tennis courts at the Town Park.

7. Evaluate the Covered Bridge to determine the best method for reducing scour and improving sediment transport and conveyance of bankfull and flood flows.

8. Establish a better angle on unstable banks and lower the bankfull to bank height ratio by removing gravel flood berms and grading high, vertical banks.

9. Stabilize the banks and provide long-term lateral control by reestablishing bank vegetation composed of native trees, shrubs and grasses.

10. Provide grade control structures (e.g., cross vanes) at key points along the channel to maintain bed stability as an alternative to bank armoring, after conducting on-site inspections and full assessment at problem areas.

11. Install flow-diverting structures (e.g., rock vanes, J-Hook vanes, etc) at key points along the channel to reduce stress in the near bank region as an alternative to bank armoring, after conducting on-site inspections and detailed assessment at problem areas.

12. Initiate a knotweed eradication and control program along this unit.

13. Reconstruct problematic dry hydrant sites utilizing cross vanes to provide low maintenance facilities.

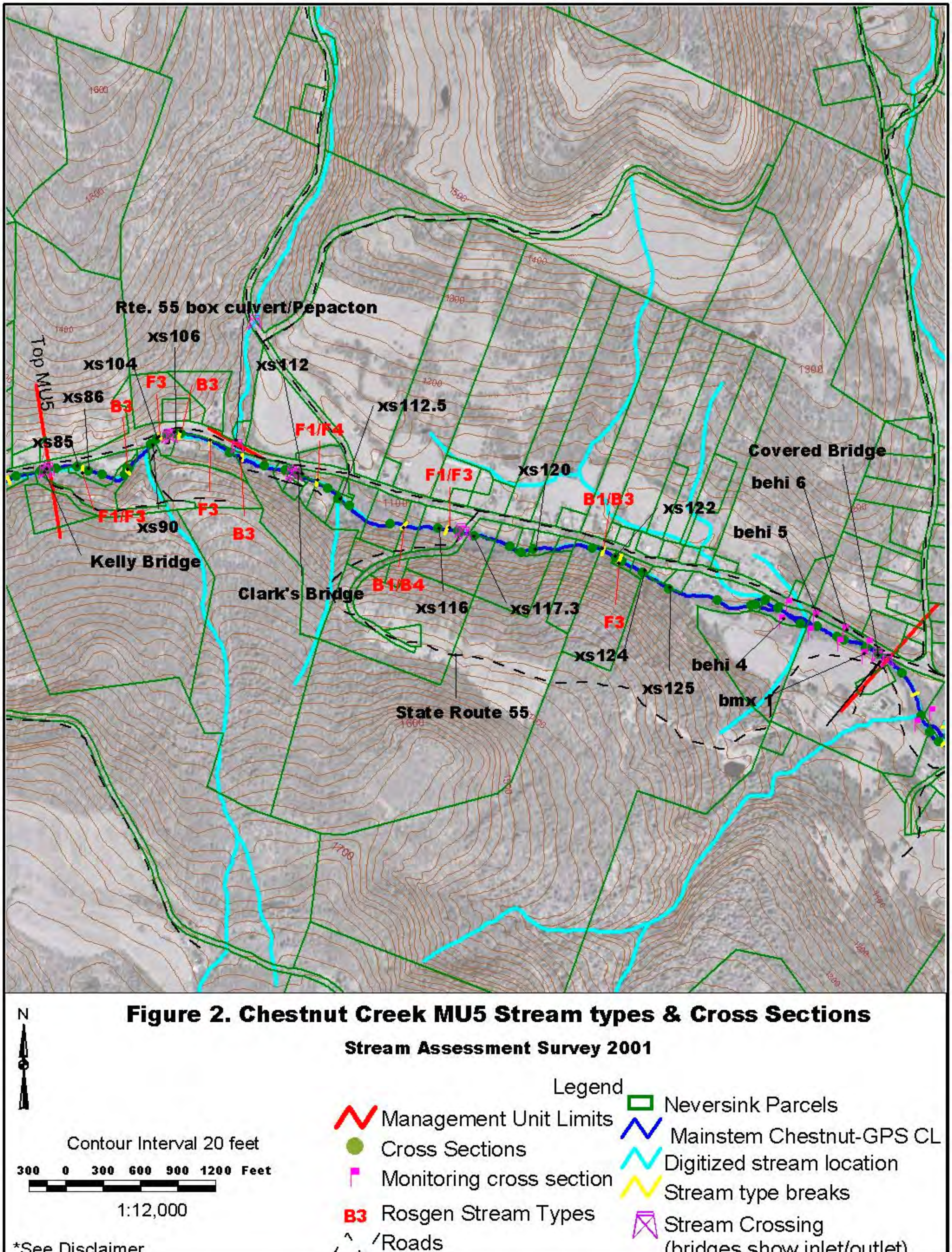

Figure 2. Chestnut Creek MU5 Stream types & Cross Sections

Stream Assessment Survey 2001

*See Disclaimer

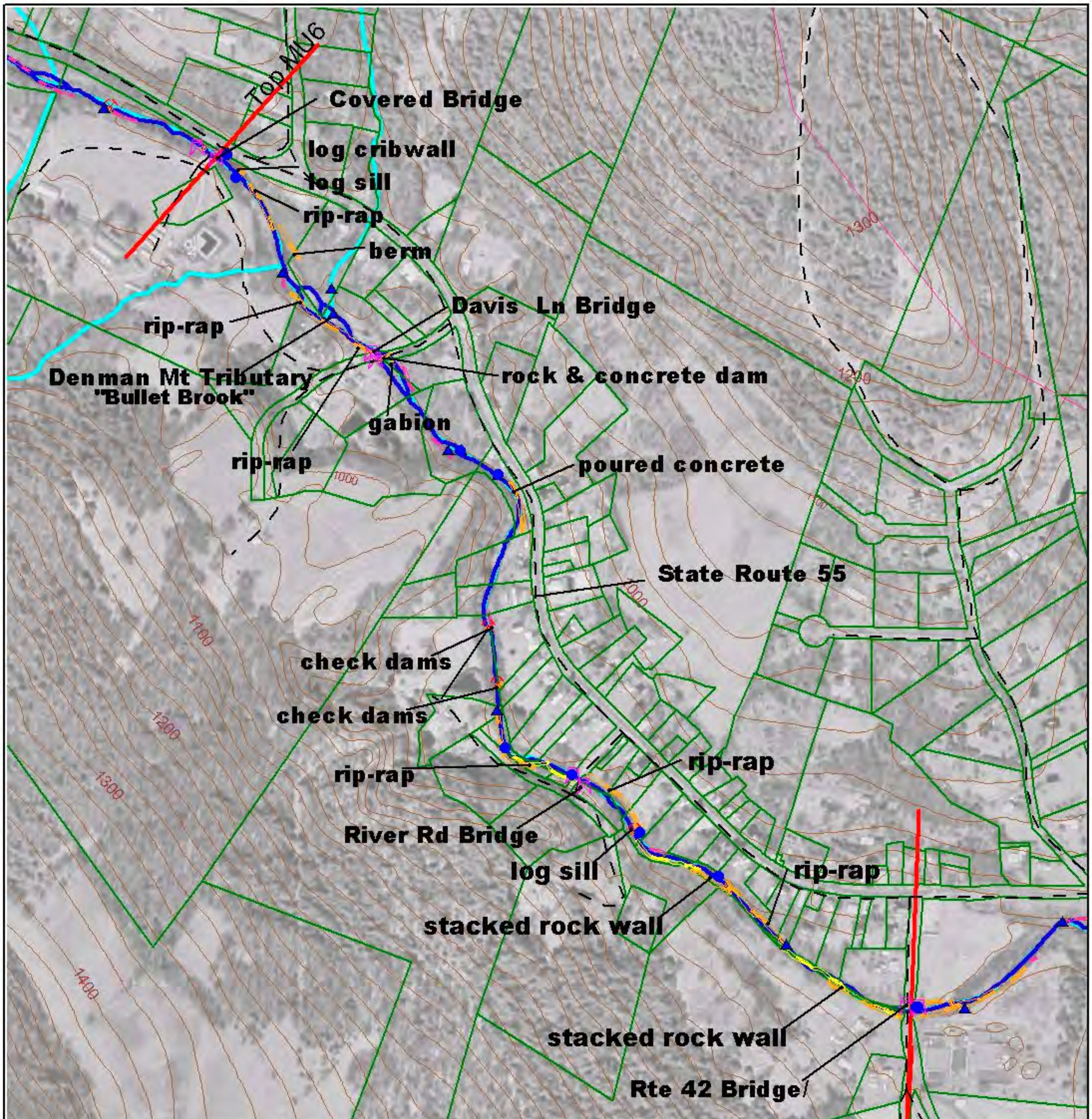

Figure 1. Chestnut Creek Management Unit 6

Stream Assessment Survey 2001

N

Contour Interval 20 feet

300 0 300 600 Feet

Scale 1:7000

*See Management Unit Disclaimer

Legend

- Neversink Parcels
- Management Unit Limits
- Revetment
- Road
- Stream Crossing (bridges show inlet/outlet)
- Drainage culvert
- Digitized stream location
- Mainstem Chestnut-GPS CL
- Landfills
- Tributary confluence
- Bedrock
- Erosion
- Debris Jams or Dams
- Knotweed