PROJECT REPORT

Bank Stabilization East Branch Rondout Creek Demonstration Project

Ulster County Highway Garage

The finished project exhibits the live willow planted oak crib wall atop the stone base with native plants and traffic barriers at the top.

Rondout Neversink Stream Program is a partnership project of

Sullivan County Soil and Water Conservation District and NYC DEP.

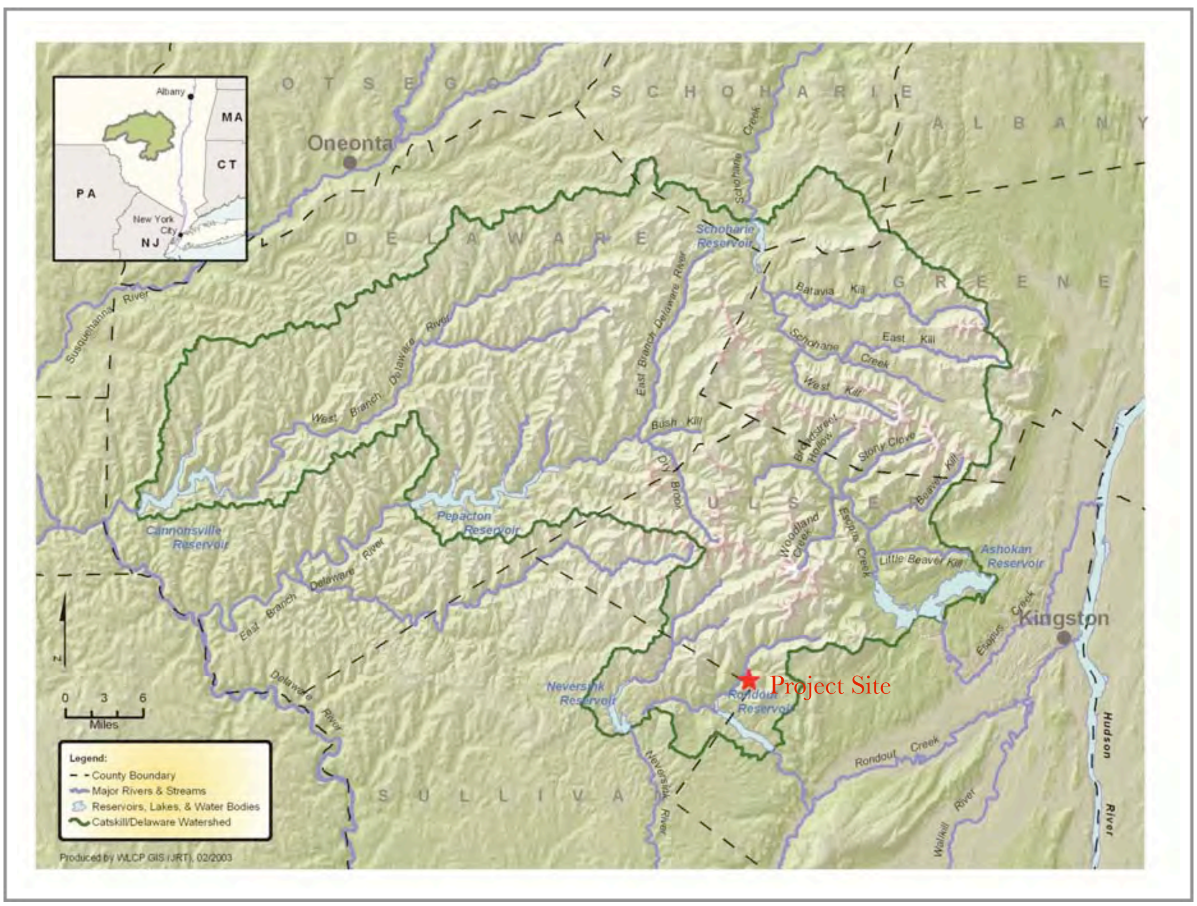
Report produced by John G. Perrella, Construction Supervisor

Fall/Winter 2011

East Branch Rondout Creek

Project Description

The East Branch of the Rondout Creek is located in the Town of Denning, and is a major tributary to the Rondout Creek, which flows into the Rondout Reservoir- a primary source of water for New York City. The Rondout Creek watershed delivers high quality water, yet during storm events material can be eroded from stream banks and as a result the water becomes turbid. As part of the Filtration Avoidance Determination deliverables to USEPA, the DEP Stream Management Program, in conjunction with County Soil and Water Conservation Districts, has been developing stream management plans and constructing stream restoration projects that demonstrate the use of bioengineering techniques for stream bank stabilization. The primary purpose of the plans and restoration projects is to improve the water quality of the streams that feed the NYC water supply reservoirs. This report summarizes the development and completion of a demonstration project on the East Branch of Rondout Creek.



East Branch Rondout Creek

Pre-Construction Conditions June 23, 2011

The project area covers approximately 700 linear feet of the stream corridor and includes the road abrasive storage yard for the Ulster County Highway Garage located on the right bank. At the time of the site inspection, there were several coarse gravel piles in two grading material storage locations that were not contained by silt fencing or other stormwater best management practices. The gravel piles closest to Sheely Road appeared to be eroding during rain events with gravel conveyed by runoff onto the right bank and into the channel, leading to bank failure at this location.

The project is located approximately 900 feet upstream of East Branch Rondout Creek's confluence with Rondout Creek, and the direction of flow is east to west. The total watershed of East Branch Rondout Creek is approximately 6.61 square miles at Sheely Road. The creek flows approximately 4.53 miles within this watershed, and the average basin slope is 1,180 feet per mile (0.22 ft/ft or 22%). The mean channel bed slope is 2.6%, typical of many mountain rivers. The channel is generally confined on both banks by steep-faced glacial till terraces composed of glacial till and outwash. The channel at this location is classified as Rosgen Type B2a, based upon the slope, planform and geometry. The channel is moderately incised as indicated by the limited floodplain, high steep banks, and scour.

The demonstration project objectives include the following:

•Stabilize the exposed stream bank to reduce entrainment of fine sediment

•Provide a buffer for activities at the highway garage storage yard

•Improve stream and riparian habitat

•Reduce sediment runoff from entering the stream by improving existing stormwater Best Management Practices (BMPs) and/or implementing supplemental stormwater BMPs

Pre-Construction Conditions

The engineering design goals for the project included improved stormwater management and stream bank protection:

1. A stormwater retention swale that will filter and divert runoff from the staging area to protect the bank from surficial runoff that is otherwise erosive.

2. A live crib wall that will stabilize the bank above the bankfull height. This is consistent with literature on bioengineered solutions that state that the permissible shear stress of "grown live brush mattress" of 3.90 to 8.2 lb/sq ft and a velocity of 12 ft/sec (Fischenich, 2001).

3. Use of a more traditional revetment strategy below bankfull, such as stacked stone revetment, to maintain a stable base for the riparian buffer above. The stream bank below bankfull height is most likely subject to greater sustained shear stresses than the higher bank due to the frequency and duration of high velocity flow at that level.

4. Development of stormwater BMPs for the ongoing operations at the garage site. These BMPs could be organized into a stormwater management plan that could outline high priority adjustments to DPW garage operations to best protect and restore the East Branch Rondout Creek in this location. BMPs would include runoff containment and management including permanent sediment containment around the gravel storage areas.

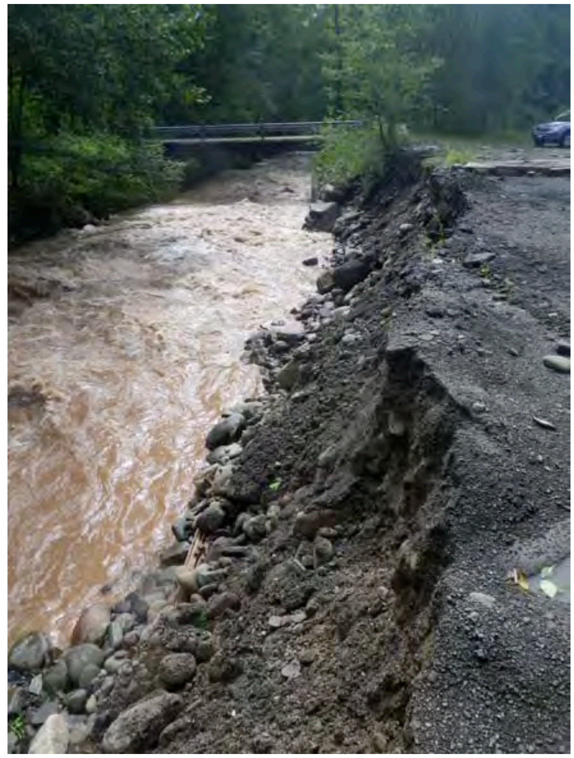
The full conceptual project design report is attached as Appendices A-F. An as-built survey is attached as Appendix L.

Pre-Construction Meeting

The mandatory site showing of the East Branch Rondout Creek Demonstration Project garnered the attendance of ten contractors. Also attending were representatives from involved government agencies and the engineering firm of Milone & MacBroom, Inc. Osterhoudt Excavating was awarded the contract on August 9th (Appendix I).

From left to right are Brenden Wagner, Meredith Maglio, Andie Green, Cookie Rotella, Ulster Co DPW, Supervisor of Sundown Site; Catskill Streams Buffer Initiative; SCA Americorps Intern; P. E. LEED AP, Associate at Milone and MacBroom (MMI); Kirk Peters, Ulster Co Highways and Bridges, Assistant Civil Engineer; Karen Rauter, Rondout Neversink Stream Program Coordinator; Mark Vian, Project Manager NYC Environmental Protection Stream Management Program; Doug Dekoskie, Stream Engineering Coordinator/Associate Project Manager NYC Environmental Protection; Jenn Hoyle, Water Resource Engineer at Milone and MacBroom (MMI).

As part of the material approval process Howard Osterhoudt, Mark Vian, Matt Hofer and Brenden Wagner visited the sawmill located in Callicoon, NY to view prospective white oak cribbing logs. In an approved contract change, white oak logs that are sawn top and bottom to create even 8” thickness were chosen for the crib wall.



On July 28, 2011 Tropical Storm Irene swept through the Catskills and inflicted major damage to much of the area. This storm affected the demonstration site by scouring a substantial amount of material from the stream bank of the demonstration site. The photo above left shows existing conditions just upstream of the demonstration site before storm event. On the right hand photo above it can clearly be seen that a large amount of material was removed from the bank resulting in a change order to the contract (Appendix I).

Mark Vian, Department of Environmental Protection Restoration Ecologist, calculating water flow just below the work site.

The contract specified for dewatering pumps with a minimum discharge of 20 cubic feet per second (cfs) be maintained to by-pass water around the construction site. Additionally, in an emergency flooding event, the contractor was to supply pumps capable of discharging larger flows of 50 cfs within 24 hours notice. Ultimately, Thompson 12JSCJ-DJDST-45H-MC ENVIROPRIME® Solids Handling Jet Pumps designed for flows up to 7,800 gallons per minute (17.4 cfs) were used at the site. A temporary coffer dam was built just upstream of the work area. Water was pumped via two 12’ pipes past the work site. The turbidity in the stream is the result of the very heavy rains and subsequent damage caused by Tropical Storm Irene.

An early meeting with Mark Vian and Osterhoudt Excavating to discuss the manner and placement of the base stones for the large stone portion of the project. The stones were keyed 18" below grade at the line of the stone wall. This photo further illustrates conditions of the stream bank at the start of the project.

Large quarried stones were shipped to the site to be used in the construction of the base stone wall. The first section of wall with its gravel fill was used to create a base for the installation of the first oak cribbing logs. This ductile iron drain pipe being set connects to the catch basin at the end of the trench drain.

This is the first section of the stone wall that has been brought up to height and is ready for the beginning of the white oak crib wall. It is pitched back one foot for every four foot in height. The wall follows a 2% grade which matched the grade of the stream at this location.

Gary Hoff and Taylor Walsh locate the point of the first bend in the wall. The center photo shows a load of stone material to be used in the backfill of the wall. The right hand picture views the wall as it progresses up stream.



The first white oak logs are set on top of the stone wall. Landscape fabric is applied over the first layer. The logs are drilled and pinned with #6 reinforcing bar. The first layer of soil is being placed and compacted.



Consulting Engineer Ed Giering, retired Brigadier General and civil engineer, from Louisiana is on the left and Chris Hoag, riparian plant ecologist, from Idaho is on the right. Both men consulted on the design and installation of the project and are part of Hoag Riparian and Wetlands Restoration, LLC. Details such as the density of the willows laid in the wall, the proper compaction of the soil, the placement of the natural fabric wrap used to keep the soil in place and many more details were contributed by this expert pair. As specified by the contract, all willow material was provided by Sullivan County Soil and Water Conservation District. The willows which had been harvested in the spring were stored in a cooled trailer over the summer and soaked in a temporary pond before being transported to the site.

This photo illustrates the various components in the wall. The base stone rising to bankfull height. The crib wall being constructed layer by layer each course composed of willows, soil and fabric. Note the blue watering pipes just in front of the rear oak log. The soil can be observed to fill the entire void behind the crib wall.

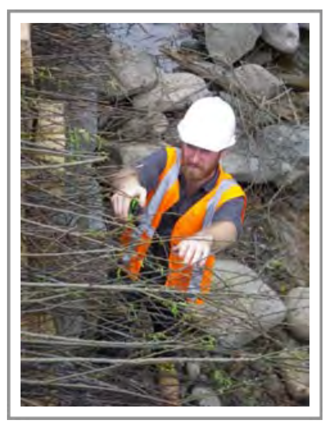
Chris Hoag offered bioengineering expertise.

All who had a hand in harvesting, moving, storing and taking care of the willows became known collectively as "The Willow People". A large amount of time, effort and care were expended on this effort. Pictured above are most of the team along with Chris Hoag, the project riparian expert. Karen Rauter, pictured below left, indispensably coordinated all the efforts. Brenden Wagner is shown, below right, pruning the willows after they have been embedded in the crib wall.

All plant material specified for the East Branch Rondout Creek Stream Restoration Demonstration project was provided by Sullivan County Soil & Water Conservation District. 40-50 1-2 gallon potted plants of gray birch and button bush (interplanted in the rip rap) were propagated from seed collected in the Catskills and grown out by two nurseries, Greenbelt in Staten Island (managed by NYC Dept. of Parks and Recreation) and RPM in Ithaca, NY. Larger yellow and gray birch trees were purchased from Pinelands Nursery in Columbus, NJ for planting along the cribwall top; the source for these is specified as NY State, along with sweet fern (from Catskill Native Nursery) and meadowsweet (from Greenbelt). Over 7,000 willow cuttings were harvested along the Neversink River while dormant over 8-10 days in March and refrigerated in a storage trailer at the Tri-Valley Central School until September, when 7-12th grade students at the school in Conservation Class built a willow soaking pit. The cuttings remained in water for about two weeks per batch until they began showing roots along their length; and then planted in 5 courses between the timber frame cribs of the stream bank wall, held together with soil and coir fabric. The willow harvesting was carried out by the staff and interns of Sullivan County Soil & Water Conservation District. Thanks also goes to the Garigliano Family Maple Farm in Grahamsville, who stored the first batch of willows in their deep freeze until the trailer was rented.

Karen Rauter, Rondout Neversink Stream Program Coordinator.

Mark Vian describing the project to distinguished guests from the United States Environmental Protection Agency and the New York State Department of Health.



Brenden Wagner, Stream Conservation Associate Intern oversaw the care of the thousands of willows at Tri-Valley High School storage location.

As illustrated in these photographs the crib wall was constructed layer upon layer until the final height was obtained. Each layer comprised of soil wrapped in biodegradable fabric, the willows embedded on the soil and logs forming the structural element that holds it all together. Below is the stone wall, built to the height of the East Branch of the Rondout Creek bankfull level. The ductile iron drain pipe, which is attached to a catch basin, will channel excessive water that may accumulate on top of the structure safely to the stream. The blue watering pipes are spaced at four foot intervals for the entire length of the structure to assist in watering, which will foster root growth in dry conditions.

A concrete dead man running most of the length of the crib wall was poured about eighteen feet back from the face of the wall and positioned 18” below final grade. Anchored to the face of the crib wall by nine 1” galvanized steel threaded rods and galvanized steel plates attached to the concrete on one end and to the face of the crib wall by being threaded through nine 12”x12”x 42” long pressure treated timbers. The concrete is steel reinforced and was poured tilted back to accommodate the angle of the threaded rod. Tension was applied by tightening the nuts on the crib wall end of the threaded rod.

A trench drain was constructed in front of the Ulster County Highway Department salt shed to catch and direct runoff from the salt shed and loading area into the settlement pond which existed on site.

A revetment, purpose built to protect the up stream end of the crib wall, was constructed of large stones, angled back and into the bank to anchor the entire assembly of wood, willows and plantings. More stones were placed at the base along the stream bank for additional protection against scouring during high water events.

The entire area upstream of the revetment and in between the placed stones is planted with native species. Karen Rauter, Brenden Wagner and the Osterhoudt construction crew are in the act of planting in the above photos.

The top of the wall was covered with soil and planted with native species consisting of Yellow Birch (Betula alleghaniensis), Gray Birch (Betula populifolia), Sweetfern (Comptonia peregrina) and White Meadowsweet (Comptonia peregrina). Teacher Robert Hayes and students from Tri-Valley High School conservation class accomplished the planting. The area was then seeded with grass, covered with straw and the individual plants were mulched with organic matter. The swale that leads to the catch basin can be seen in the upper right hand photo. The bottom right photo shows the willows already sprouting as winter sets in and is a good harbinger for the future Spring.

Views of the finished product; East Branch Rondout Creek Demonstration Project at the Ulster County Highway Garage.

The advent of Tropical Storm Irene in late August 2011 produced three areas of scouring just upstream of the cribwall in the demonstration project. These three areas were designated A, B and C and were treated with a combination of large stone, root wads and plantings. A series of photos depicting the three areas before treatment, during the construction process and the final result of the corrective measures which were taken follow.

Section A utilizes large stones to stabilize the bank at the base. Willow clumps or local origin are planted among the stones.

Section B is implanted with several root wads bracketed with large stones which are planted with willow clumps. Willow fascines are planted in horizontal rows above the stones and native plants are planted toward the top of the restored area.

Section C, the largest area to be restored, is embedded with root wads and large stones at its base. Willow clumps are planted among the large stones and root wads. Fascines are planted in the soil area above and native plants intersperse the upper area.

The Gate House sits at the southern end of the pristine Rondout Reservoir and in the distance is Denman Mountain, the highest point in Sullivan County.

The East Branch Rondout Creek Stream Restoration was implemented through the Rondout Neversink Stream Program, a project of Sullivan County Soil & Water Conservation District funded by New York City Department of Environmental Protection. The following agencies and organizations worked under contract and in collaboration in the design and construction of this water quality improvement project.

Sullivan County Soil & Water Conservation District
Rondout Neversink Stream Program
Brian Brustman
Karen Rauter
John Perrella
Bobby Taylor
Brent Gotsch
Meredith Maglio
Brenden Wagner

New York City Department of Environmental Protection
Stream Management Program
Mark Vian
Doug Dekoskie

Ulster County County Community College Watershed Conservation Corp
Chris Tran
Stacie Howell
Jesse McCarthy

Ulster County Department of Public Works
David Bolles
Kirk Peters

Hoag Riparian & Wetlands Restoration, LLC
J. Chris Hoag
Ed Giering

Milone and MacBroom, Inc.
Andrew Greene
Jenn Hoyle

H. Osterhoudt Excavating
Howard Osterhoudt
Gary Hoff
Kristen Walsh

Appendices A-F

Stream Stabilization Project

Full Conceptual Design Report

STREAM STABILIZATION PROJECT

(DRAFT)

ULSTER COUNTY HIGHWAY GARAGE
EAST BRANCH RONDOUT CREEK
SUNDOWN, NEW YORK

January 25, 2011

MMI #3597-07

Prepared for:

New York City
Department of Environmental Protection
Stream Management Program

Prepared by:

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1.0 INTRODUCTION AND EXISTING CONDITIONS SUMMARY

The New York City Department of Environmental Protection (NYCDEP) and the Sullivan County Soil & Water Conservation District (SCSWCD) are progressing with a stream stabilization project along the East Branch Rondout Creek (Sundown Creek). The East Branch Rondout Creek Demonstration Site is located at the Ulster County Highway Garage in the town of Denning, hamlet of Sundown, Ulster County, New York. The project area covers approximately 700 linear feet of the stream corridor and includes the road abrasive storage yard for the Ulster County Highway Garage, the stream channel, and floodplain adjacent to the left and right banks through the project area.

The demonstration project objectives include the following:

- Stabilize the exposed stream bank to reduce entrainment of fine sediment
- Reduce sediment runoff from entering the stream by improving existing stormwater Best Management Practices (BMPs) and/or implementing supplemental stormwater BMPs
- Provide a buffer for activities at the highway garage storage yard
- Improve stream and riparian habitat

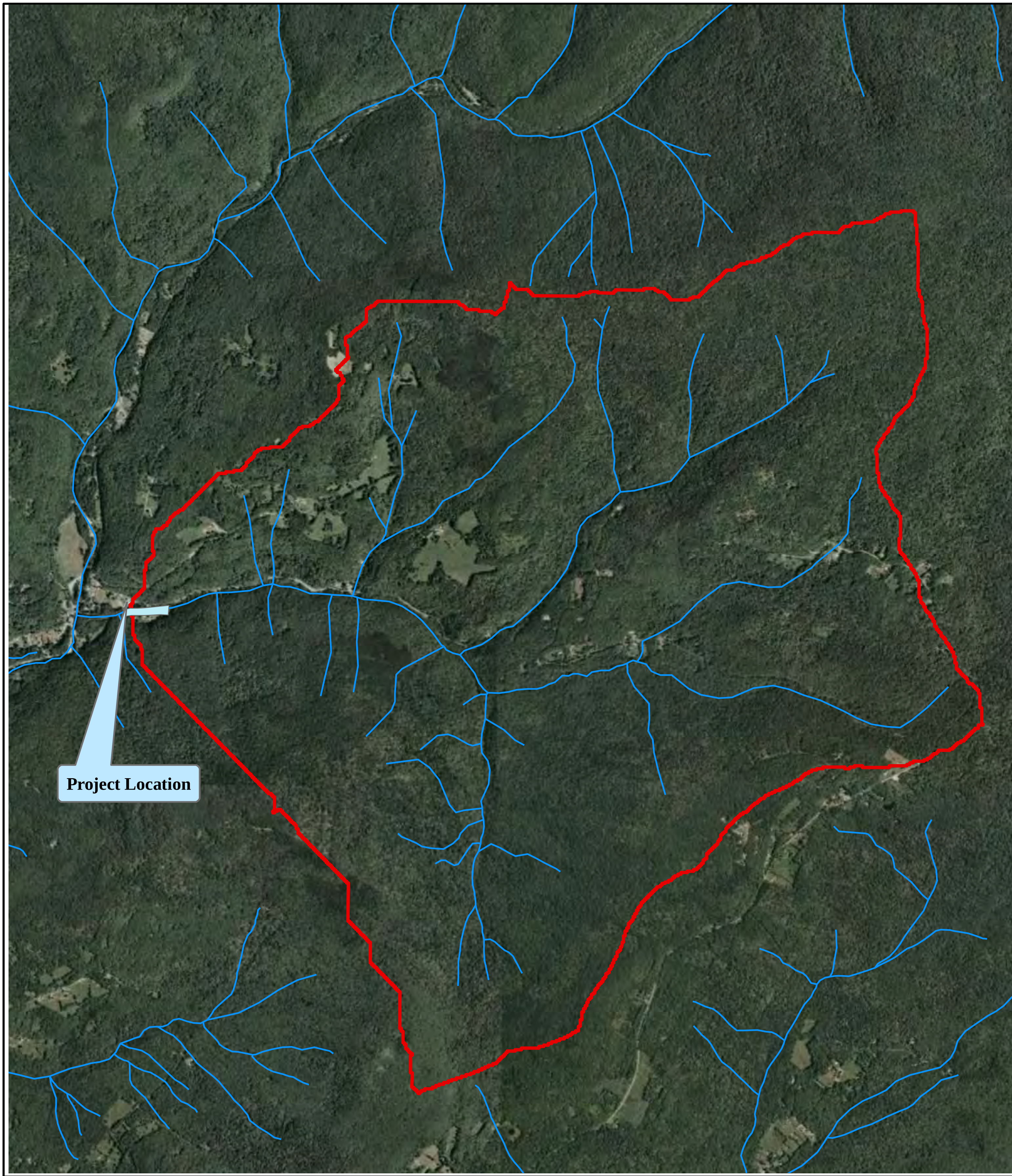
While the end result of the work being undertaken by Milone & MacBroom, Inc. (MMI) will be a complete engineering design for the demonstration project, the subject report presents the results of only the first phase of the project: field assessment, hydrologic assessment, and existing conditions hydraulic assessment.

1.1 East Branch Rondout Creek Existing Conditions

Figure 1 is a watershed map that shows the project area. The project site is located along the lower third of East Branch Rondout Creek in the hamlet of Sundown in the town of Denning, New York in the Catskill Mountains. This 800-foot long study reach between an unnamed private driveway bridge upstream (river station 16+75) and the Sheely Road Bridge downstream (river station 11+20) includes a mass failure of the right bank (facing downstream) directly upstream of the Sheely Road Bridge adjacent to the Department of Public Works (DPW) garage on Greenville Road (State Route 46).

The channel is located approximately 900 feet upstream of East Branch Rondout Creek's confluence with Rondout Creek, and the direction of flow is east to west. The total watershed of East Branch Rondout Creek is approximately 6.61 square miles at Sheely Road. The creek flows approximately 4.53 miles within this watershed, and the average basin slope is 1,180 feet per mile (0.22 ft/ft or 22%). The mean channel bed slope is 2.6%, typical of many mountain rivers.

The project reach watershed is a narrow, steep glaciated valley surrounded by forested mountains. The ridges and upper valley walls are generally covered with glacial till while the terraced U-shaped valley bottoms are composed of a heterogeneous distribution of



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Ulster County Highway Garage
East Branch Rondout Creek

LOCATION: Sundown, CT

MMI#: 3597-07
MXD: H:Fig1.mxd
SOURCE: NYC DEP

N

Watershed Map

DATE: January, 2011
SCALE: 1" = 3,500'

SHEET: Figure 1

glacial till, variably thick glaciolacustrine silt and clay deposits, glacial outwash, and Holocene alluvium. Bedrock is exposed in the stream corridor in many locations where the channel is adjacent to the valley walls, including a bedrock flume upstream of the study reach.

The bankfull width of the study reach varies from 33 to 43 feet, which is slightly wider than the expected bankfull width of 32 feet indicated by the Catskill Mountain regional hydraulic geometry curves for this size watershed (Miller and Davis, 2003). The visual bankfull depth is three feet, which is slightly deeper than the 1.8 feet indicated by the Catskill Mountain regional hydraulic geometry curves for this size watershed (Miller and Davis, 2003). The channel is generally confined on both banks by steep-faced glacial till terraces composed of glacial till and outwash. Based upon the slope, planform, and geometry, the channel is classified as a Rosgen Type B2a. The channel is moderately incised as indicated by the limited floodplain, high steep banks, and scour.

The channel has a coarse bed consisting mainly of cobble and many boulders that extend onto the lower banks. The larger boulders are likely static while the armor layer of cobbles and small boulders can mobilize during high flow events. The channel generally has a rapids bed form.

1.2 DPW Operations

The Ulster County DPW garage facility located on the right bank from river station 14+25 to the Sheely Road Bridge includes three garage buildings, a fuel tank stored on a concrete pad, a shed, and several grading and two construction material staging areas (one located at the upstream extent of the site and the second located at the top of the bank near station 11+50). At the time of the site inspection, there were several coarse gravel piles in both grading material storage locations that were not contained by silt fencing or other stormwater best management practices. The gravel piles closest to Sheely Road appeared to be eroding during rain events with gravel conveyed by runoff onto the right bank of the study reach and into the channel, leading to bank failure at this location.

2.0 DATA COLLECTION

2.1 Site Topography

MMI prepared a new topographic survey map of the 700 linear foot reach in the project area for this analysis. The map pairs aerial photography with ground survey to establish horizontal and vertical control. This digital map is at a scale of 1"=40' with one-foot contour intervals. New ground surveys were conducted in specific areas to supplement the aerial survey. The initial field survey of the East Branch Rondout channel took place in June 2010 and included cross sections that delineated the edge of water, thalweg, and the active stream channel bed as well as geomorphic features such as pools, riffles, glides, large boulders, and longitudinal profile grade channels. Project base mapping is included as

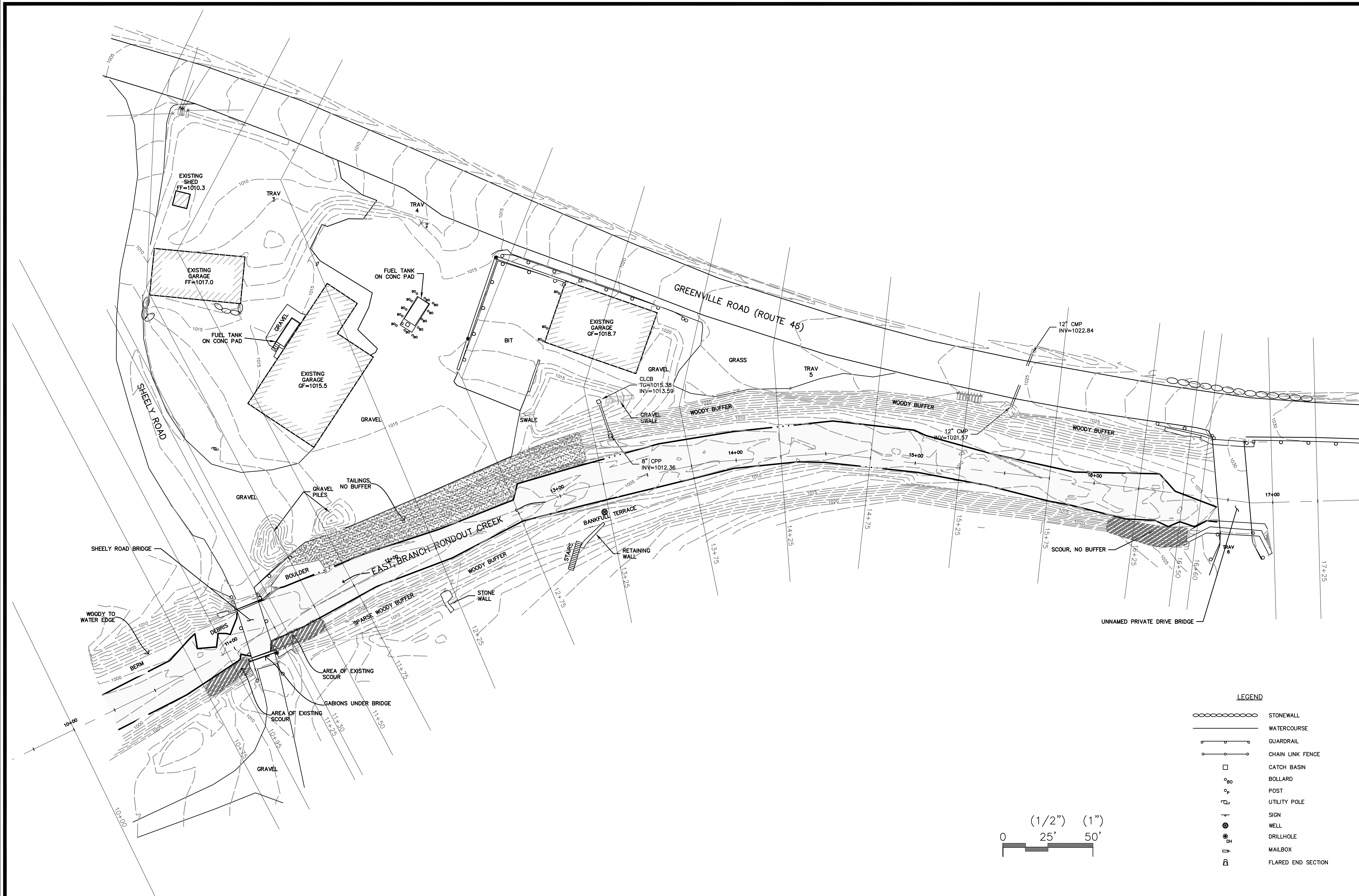
Appendix A. It is a reasonable representation of site conditions at large yet is a snapshot in time relative to microtopography at locations that are subject to erosion.

2.2 Stream Inventory and Inspection

The project reach of East Branch Rondout Creek was inspected on December 9, 2010. Objectives of the inspection were to classify the channel, observe physical characteristics, record areas of bank or bed erosion and deposition areas, confirm topography, and set hydraulic analysis parameters. The inventory also included substrate observations, pebble counts (Wolman, 1954; Kondolf, 1997), and creation of a photo log. The ensuing narrative describes the study reach. The study reach and referenced river stationing are depicted in Figure 2.

The study reach is characterized as being confined by high ground, straight alignment, and having a rocky rapids bed. The mean bed slope is 2.6%. The right bank downstream of the private drive bridge has a 2:1 slope with a sparse woody buffer extending from the bankfull height to the top of the bank. Near station 14+00, the woody buffer is replaced with fine gravel and sand deposited by surficial runoff from the eastern edge of the DPW garage staging area. From the Sheely Road Bridge to station 13+25, the right bank has a combination of stone retaining wall and placed riprap on the lower slope and gravel cover on the upper slope at the DPW garage. About 175 linear feet of the right bank has had a slope failure between station 11+50 and station 13+25 (Photo 1).

Photo 1: Bank Failure site on right bank upstream of Sheely Road Bridge.



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REVISIONS

PROJECT AREA MAP WITH CROSS SECTION LOCATIONS

EAST BRANCH RONDOUT CREEK
ULSTER COUNTY HIGHWAY GARAGE SITE
GREENVILLE ROAD (ROUTE 46)
TOWN OF DENNING, HAMLET OF SUNDOWN
ULSTER COUNTY, NEW YORK

DESIGNED	DRAWN	CHECKED
---	BAM	JGM

SCALE 1"=50'

DATE JAN. 2011

PROJECT NO. 3597-07

SHEET NO. Fig. 2

Drawing: H:\3597-07 ULSTER COUNTY HIGHWAY GARAGE\DWG\ULSTER GARAGE HYDRO.DWG Layout Tab:11X17
Plotted by: BECKKM On this date: Tue, 2011 January 11 - 1:31pm

The left bank is also steep with a 2:1 slope with dense hardwood forest cover. Downstream of the unnamed private drive bridge, there are approximately 50 feet of scour exposing unsorted glacial till (Photo 2) followed by approximately 25 linear feet of undercut bank exposing roots of the 30-inch diameter at breast height (DBH) white pines overhead and glacial till. The bank is undercut by up to three feet in some locations.

Photo 2: Bank scour on left bank downstream of unnamed private drive bridge.

Beginning at station 15+75 through station 11+00, there is a dense forested buffer at least 20 feet thick. Near station 14+75, a terrace has formed at bankfull height that continues to station 12+25 (Photo 3).

Photo 3: Bankfull bench on left bank.

The channel perimeter below the bankfull height is composed of three distinct materials: a dense cover of static boulders that armor the bed and lower banks, a semistatic armor of cobbles and small boulders, and mobile gravel and rounded small cobbles (Photo 4). The latter material is in limited quantity, found in pockets and small bars. The bank and bed roughness is high (estimated Manning's N=0.06).

Photo 4: Rapids bed form and channel roughness of study reach.

2.3 Existing Bridges

Sheely Road Bridge

The Sheely Road Bridge over East Branch Rondout Creek is approximately 28 feet long by 12 feet wide. The bridge consists of a concrete deck slab on concrete abutments. The abutments are composed of stacked concrete blocks that extend upstream and downstream of the bridge approximately two feet on the right bank (Photo 5). The footings are not visible, and the abutment base elevation is unknown. There is no visible bedrock. The downstream right and left abutments appear to be subject to scour and erosion.

Photo 5: Looking downstream at Sheely Road Bridge.

Unnamed Private Drive Bridge

The unnamed private drive bridge over East Branch Rondout Creek is approximately 46 feet long and 18 feet wide. The bridge consists of a concrete deck slab on concrete abutments. The parapets are approximately 25 feet long, 42 inches high, and two feet wide. The upstream right bank consists of a modular concrete unit wall approximately 10 feet in height that extends approximately 100 feet upstream of the bridge crossing (Photo 6). The stone wall is nearly flush with the right bank abutment. Downstream of the crossing, the concrete abutment transitions to a stacked stone wall that extends downstream approximately 20 feet. The left concrete abutment extends approximately six feet into the channel and is limited to the width of the bridge crossing. There are no wingwalls upstream or downstream of the left abutment. The left bank bridge abutment shows signs of scour damage on the downstream side, and the upstream side is not armored. The channel bed in front of the structure is accumulating coarse bed material and is aggrading. Some material is being pushed into the structure.

Photo 6: Looking downstream at unnamed private drive bridge.

2.4 Channel Substrate and Sediment

The purpose of this analysis is to evaluate the effect of sediment transport in the study reach on bank scour and the bank failure site on the right bank upstream of the Sheely Road Bridge. Several observations and types of data are combined for an overall understanding of sediment transport in the reach.

Several methods are available to evaluate bed and bank stability, including analog, empirical, and theoretical procedures. They all require knowledge of the bed and bank strength, which depends on material type (cobble, gravel, sand, and fines), density, and cohesion. Specific measurement methods include direct measurement (pebble counts) of coarse-grained material in the field, sieve tests of sandy and finer sediments, and shear tests of cohesive silt and clay. Field observation of channel bed sediment reveals that the study reach channel bed has four different substrate populations with very different physical processes – static armor, mobile armor, mobile bed, and silty and clay fines.

Static Armor – Composed of large boulders that are largely imbricated or interlocked and do not regularly move. This condition is abundant upstream of the unnamed private drive bridge and within the study reach until approximately station 13+75. These old boulders are so stationary that many are rounded and worn on their upstream end and top, with angular faces on their sheltered end.

Mobile Armor – The most common bed condition consisting of cobbles and scattered unorganized boulders that mobilize during flooding once the threshold water velocity is reached. Much of the mobile armor material is embedded, increasing stability beyond that provided by their weight.

Mobile Bed – Well-worn medium to coarse gravel and small cobbles and traces of sand that are subject to regular bed load transport; found on channel margins. Common in deposition zones upstream of both bridges.

Silty and Clay Fines – Thin layers found as a coating on the downstream ends of side bars. Likely transported as suspended sediment out of the watershed during minor flow increases.

Three pebble counts were performed on East Branch Rondout Creek (Table 1, Appendix B). The counts were measured in the field to identify the grain size distribution of specific sediment accumulations throughout the study section.

TABLE 1
Channel Substrate Data Summary

Location Description	Material Description	D_{50} (mm)[1]	D_{84} (mm)[2]
Exit Reach (Station 8+00)	active deposition bar materials	61	117
Study Reach (Station 15+25)	mobile armor	109	286
Supply Reach (Station 20+00)	mobile armor	81	163

1 - Median sediment size such that 50% of the particles are finer
2 - Sediment size such that 84% of the particles are finer

Within the study reach, the mean diameter (D_{50}) is approximately 109 mm (4.3 inches), cobble size particles that dominate in the rapids. The stream has control points in riffles consisting of cobbles and small boulders represented by the D_{84} size of 286 mm (12 inch) diameter. Results from this pebble count are presented in Table 2.

TABLE 2
Pebble Count Particle Size Distribution

Percent Finer Than	Particle Size (mm)
D_{16}	14
D_{35}	62
D_{50}	109
D_{84}	286
D_{95}	661

The general gradation by count is presented in Table 3 and indicates that 68% of the sampled sediments are in the gravel and cobble range.

TABLE 3
Pebble Count Particle Size Class

Particle Size Class	Percent
Silt and Clay	0
Sand	13
Gravel	23
Cobble	45
Boulder	20
Bedrock	0

A downstream fining trend was observed – mean sediment size decreased in the downstream direction – as evidenced by the D_{50} of 105 mm in the mobile bed material at station 15+25 within the study reach and a D_{50} of 61 mm in the increasingly armored mobile bed material of the exit reach (near station 8+00). Evidence of additional aggradation was observed upstream of both bridges, which often forms upstream of structures where the approach restricts flows that would otherwise effectively transport sediment.

The three modes of sediment transport in stream channels are bed load, suspended load, and wash load. Bed load transport applies to the larger particles of gravel and cobble that are heavy enough to stay in contact with the streambed as the flowing water pushes, drags, slides, or flips them downstream. Long-term bed transport is indicted by extensive imbrication (i.e., shingle-like overlapping) of the static and dynamic armor material. The static armor shows extensive evidence of long-term abrasion with round upstream faces combined with subangular and rounded downstream edges. Bed load transport rates are closely related to excess shear stress and channel base width; little bed load transport occurs on the banks or floodplain.

The suspended sediment load consists of lighter weight particles that are transported above the bed, suspended in the water column by internal flow turbulence and eddies. The rate is closely related to the total flow rate, velocity, and bottom roughness. A portion of the material carried in suspension is so light that it remains suspended by even minimal turbulence and tends not to settle. The latter material is called the wash load, consisting primarily of clay and fine silt.

Field observations indicate that East Branch Rondout has significant bed load transport, but the current imbricated state suggests the larger bed material has great resistance to movement. This is confirmed by rock weathering patterns, with rounded upstream faces and angular downstream faces. The lack of fresh fine sand on the bed after floods suggests much of the suspended material is fine grain wash load of silt and clay. The latter materials seldom settle on a riverbed, so there has to be continuous supply of new material from the banks and colloidal sources.

Channel aggradation (i.e., rising bed) has been observed in this reach of East Branch Rondout due to coarse material deposition. The surplus bed load is likely originating from upstream locations. Fresh overbank deposits along the right bank floodplain downstream of the Sheely Road Bridge after recent floods were composed of coarse sand to fine gravel typical of suspended sediments that readily settle in low velocity zones.

In summary, the stability of a channel's bank and bed influences the river's alignment and slope, which controls the potential for lateral channel movement. Channel migration in turn affects bank erosion and, thus, a cycle exists where the variables describing a channel and stability change and influence each other. Perimeter stability also influences the channel's width, depth, sediment size, and rate of transport. This channel is a sediment storage reach that delivers water and sediment from the upper watershed to the confluence with Rondout Creek downstream. Storage reaches like this one hold bed load that is delivered during large flow events within depositional bars and then release it slowly over time in more moderate flood events.

3.0 FLUVIAL ASSESSMENT

3.1 Channel Classification

Geomorphic classification is used herein to understand the current condition of the East Branch Rondout Creek project area in relation to existing methods for describing channels. The channel was classified using the Rosgen classification system (Rosgen, 2006; Rosgen, 1994). Based on sinuosity, slope, entrenchment ratio, width to depth ratio, and bed substrate size, this channel is classified as a Rosgen Type B2a.

A B2 stream type is described as a moderately entrenched stream with a channel gradient ranging from 2% to 4%. The channel bed morphology is generally dominated by boulders with lesser amounts of cobble, gravel, and sand. Stream features generally include rapids and occasional scour pools. Bed and bank materials are supposedly stable and contribute only small amounts of sediment during high flow events. (Rosgen, 1998)

3.2 Channel Slope

A river channel's slope provides the only source of significant energy (gravity) to convey water and sediment. Slope is not only closely related to water and sediment transport but also to channel alignment, bed form, sediment size, and channel dimensions. The slope of East Branch Rondout Creek was compared to an estimation of equilibrium slope calculations (Shield's resistance to motion $\tau=\gamma*R*S\sim5*D_{50}/304$). The objective of the analysis is to see if the channel wants to be steeper or shallower to establish an equilibrium balance for the current flow and sediment (Lane, 1955). Average channel slope for the study reaches was determined from June 2010 survey and cross sections and bed substrate size measurements. Table 4 presents mean channel slope calculations for select locations. Computations are presented in Appendix C.

TABLE 4
Mean Channel Slope Calculations
(June 2010 Survey Data)

Location	2010 Survey Slope (%)	Equilibrium Slope (%)	Difference (%)
River Station 15+25	3.0	1.2	1.8
River Station 12+25	2.0	1.6	0.4

The static stability calculations illustrate that the channel may be oversteepened throughout the study reach or conversely that the sediment supplied from upstream is too large for the modern channel slope, particularly at the upstream end of the reach. The study reach has not obtained its equilibrium slope.

Generally, the overall equilibrium slope can be computed for a dynamic equilibrium condition that assumes a live bed with sediment transport using the U.S. Army Corps of Engineers Sediment Analysis Model (SAM). However, the study channel is confined with a relatively straight alignment that is characteristic of a threshold or rigid-boundary channel, not a channel in dynamic equilibrium, so the SAM model does not apply to this reach.

3.3 Channel Alignment and Pattern

Evaluating a channel's existing alignment and pattern helps to identify whether it is fundamentally stable or whether there may be a tendency toward lateral migration that can lead to bank erosion. The influence of the river valley and valley sides can lead to confined, semiconfined, or unconfined channels with or without connected floodplains. Rivers can further be described as straight or sinuous, with single, multiple, or numerous channels (often referred to as a braided channel). Over long geologic time spans of many thousands of years, river channels widen their valleys by lateral erosion and create depositional floodplains. They also adjust their longitudinal slope by scour and fill toward equilibrium conditions influenced by flood discharge rates, valley slope, substrate size and type, roughness, and sediment loads.

The study reach is fully confined. Confined and semiconfined channels are typical of geologically young landscapes with mountainous terrain where rivers and valley width have not reached long-term equilibrium – the likely scenario on East Branch Rondout Creek. The permanent human infrastructure (including the DPW garage site and Greenville Road) in the river corridor is common in narrow valleys and increases flood and erosion risks.

The measured channel length between the bridges from recent survey (June 2010) is 554 feet compared to a valley length of 480 feet, with a resulting sinuosity of 1.15, which is consistent with the field assessment that this reach has a relatively straight alignment.

During floods, East Branch Rondout is modifying its valley bottom and side walls both laterally and longitudinally. A primary goal of this predesign assessment is to determine the type of stable equilibrium alignment that would evolve over a long period and whether the channel is currently moving toward or away from this most stable condition. Increased channel stability would lead to less bank and valley wall erosion.

To address the essential question of what a stable East Branch Rondout Creek might look like without confinement, potential future channel patterns have been predicted using two methods. The first method applied was a deterministic sediment transport model by Chang (1988) that differentiates stream pattern as a function of slope, sediment size, and bankfull discharge. The second approach to predicting channel pattern was Parker's (1976) dimensionless analysis of channel cross section dimensions and slope as a function of channel type (i.e., straight, meandering, and braided). The results of these analyses were based on an estimated channel-forming discharge of 682 cubic feet per second (the 1.5-year flood as derived from Rondout Creek stream gauge data, see Table 5) and a representative D_{50} sediment size of 109 mm for a dynamic armor. Chang's sediment transport method forecasts a range from equi-width point-bar stream or stable canal to a meandering channel, indicating a transitional channel that is not in equilibrium. The Parker method of pattern prediction also forecasts a transition channel at the threshold between meandering and straight. Calculations are included in Appendix C.

The interpretation of the results from the multiple method assessment described above is that East Branch Rondout would be a channel of similar alignment with rigid boundaries. It is likely that without the surficial failure that results from unstable right bank composition caused by the DPW garage yard operations the bed and banks of the study reach would be stable. It is likely that there is ample coarse sediment supplied from upstream and transported as mobile bed armor for this terrace to form under normal conditions. This finding improves our understanding of the potential cause of the bank failure site (most likely anthropogenic) and can therefore help guide selection of potential stabilization alternatives.

3.4 Bankfull Channel Dimensions

Bankfull channel analysis was used to help assess whether the East Branch Rondout channel has an appropriate size for its channel forming discharge. The width of a channel measured at the elevation of the bankfull discharge in alluvial channels provides guidance on the preferred size of self-formed channels that are in equilibrium. It is expected that undersized channels will tend to widen and that oversized channels (usually due to flood scour) will tend to narrow via deposition if excess coarse sediment is supplied.

Several methods are available to predict equilibrium dimensions, including regime relations based on discharge rates and substrate, regional hydraulic geometry relations based on watershed area, multiparameter regression equations, and sediment transport relations.

Regional hydraulic geometry relations by Miller and Davis (2003) predict a bankfull channel width of 32 feet and depth of 1.81 feet, which are close to the mean bankfull width of 33.9 feet and depth of three feet measured by MMI surveyors for all cross sections in the study reach. More recent regional relationships (Mulvihill et al., 2010) generate cross sectional dimension predictions of a bankfull width of 41 feet and a bankfull depth of 1.94 feet consistent with field measurements of bankfull width and depth upstream and downstream of the study reach.

Table 7 summarizes the bankfull channel widths from various sources and estimates. In general, the mean existing bankfull channel dimensions in confined reaches are consistent with regional hydraulic geometry relations.

In conclusion, the widths of the East Branch Rondout channel in the study reach are within the expected range. The channel depth is generally larger than the regional and regime values, indicating a slightly incised channel and thereby providing extra flow capacity.

3.5 Geomorphic Assessment Conclusion

The geomorphic assessment of slope, pattern, and bankfull dimensions is quite conclusive. The overall valley slope of 2.6 percent is steeper than an equilibrium slope, indicating that the slightly incised and overwidened channel has insufficient sediment transport capacity. The channel pattern was assessed using both empirical data and theoretical approaches. The estimated channel forming discharge of 682 cubic feet per second (cfs) and mean slope of 3% create conditions commonly associated with a threshold channel (Rosgen Type B2), indicating that the bed and banks should be stable under confined conditions like those observed during the assessment. Based on this analysis, it is likely that the bank failure on the right bank upstream of the Sheely Road Bridge is caused and aggravated by sediment runoff from the Ulster County DPW garage gravel staging area upslope.

4.0 HYDROLOGY

Hydrologic analysis was conducted to define the hydrologic characteristics of surface runoff in East Branch Rondout to aid subsequent channel stability analysis. The steep, mountainous, forested watershed has a total drainage area of 6.61 square miles. The average watershed land slope is an unusually steep 22.3%. Typical annual peak flows for the nearby Rondout Creek for a similar drainage are 500 to 800 cfs. The maximum peak flow during the period of record (1996 to present) for this gauge on the nearby Rondout Creek was 1,340 cfs on July 23, 2004.

4.1 Existing Gauge Data

No gauges are currently in place on East Branch Rondout Creek; however, stream flow information for Rondout Creek is currently measured and recorded by the U.S. Geological Survey at two locations near the study reach. Gauge #01364959 is located above Red Brook at Peekamoose, New York and has a watershed area of 5.36 square miles. Records are available from 1996 to the present, including daily, monthly, and annual flow statistics. Gauge #01365000 is located near Lowes Corners, New York and has a watershed area of 38.3 square miles. Records are available from 1937 to the present, including daily, monthly, and annual flow statistics.

Annual peak flow rates at Gauge #01364959 are reported in Table 5. Peak annual flows have occurred in all seasons, and the flood of record was 412 cfs per square mile. For such a small watershed, East Branch Rondout Creek receives exceptionally high flows due to steep slopes, high headwaters, intense thunderstorms, limited wetland storage, midwinter thaws, and spring snowmelt floods.

TABLE 5
Peak Annual Flow Rates

Water Year	Rondout Creek Gauge at 5.35 SM (cfs)
1996	803
1998	652
1999	736
2000	617
2000	775
2002	203
2003	598
2004	1,340
2005	1,240
2005	1,100
2007	513
2007	732
2009	372

4.2 Flood Frequency Analysis

The online United States Geological Survey (USGS) StreamStats hydrology tool was used to generate initial peak flood flow estimates at the Sheely Road Bridge. This technique uses regional regression equations (Lumia and Freehafer, 2006). A flood frequency analysis was also conducted with the available stream gauge data with the U.S. Army Corps of Engineers computer model, HEC-SSP, using the national standard bulletin 17B procedure (USGS, 1982). The data is from USGS gauge #01364959, scaled by watershed area to the study reach. The data represent only 13 years (May 1996 to 2009), which is a relatively short record for peak flood estimation.

TABLE 6
Peak Flow Estimates

Return Frequency, Years	Regression Analysis (StreamStats)	Gauge Analysis (Bulletin 17B) (HEC-SSP)
1.5	397 cfs	682 cfs*
2	526 cfs	834 cfs
5	937 cfs	1,145 cfs
10	1,290 cfs	1,348 cfs
20	---	1,541 cfs
25	1,810 cfs	---
50	2,270 cfs	1,795 cfs
100	2,780 cfs	1,984 cfs

*Estimated from flood frequency plot

The difference between regional regression versus site-specific (short record) peak flow forecasts is significant, indicating that East Branch Rondout Creek may vary hydrologically from the regional trends. The gauge analysis was used for peak flood flow estimation as it appears to be the best available data and is a more conservative representation of hydrology due to the larger flood estimates.

The use of short-term stream gauge records to forecast long-term trends and rare flood flow rates is not without risk. Therefore, it is prudent to seek alternate data to verify the unusually high runoff rates measured and predicted at East Branch Rondout. Fortunately, rainfall stations tend to have longer records than stream gauges and can be used to check long-term and regional trends.

The USGS report entitled *Magnitude and Frequency of Floods in New York* indicates that mean annual runoff in the small high peaks region that includes East Branch Rondout is 40 inches per year, twice as high as in the Hudson and Mohawk River Valleys, with mean annual precipitation at 60 inches per year, which is matched only by the Tug Plateau as the highest mean annual precipitation in New York. In contrast, Albany receives only about 40 inches of precipitation. Consequently, it is evident that East Branch Rondout has extraordinary runoff rates and that even short-term stream flow data prevails over longer term regional data.

4.3 Channel Forming Discharge

Natural rivers convey a wide range of discharge rates on an annual basis. A widely accepted theory is that alluvial channels adjust their width, depth, and slope in response to natural events equivalent to a "channel forming discharge" (Doyle, et al., 2007). Several surrogates are available to estimate the channel forming discharge, including the bankfull discharge, effective sediment transport discharge, and frequency analysis. Using statistical analysis, the frequency of channel forming discharges is usually about 1.5 years but varies from one to five years and higher at specific sites. For this project, the statistical 1.5 year frequency event for the channel forming discharge is used. The regional bankfull discharge has been computed based upon various regression equation methods. Table 7 summarizes the bankfull discharge rates computed using these various methods.

TABLE 7
Summary of Bankfull Flow Estimates

Flow (cfs)	Source
397	USGS StreamStats
235	Lumia 2006 Regression Equations
511	Mulvihill et al., 1991
326	Miller and Davis, 2003
682	17B Analysis (USGS Gauge Data)

5.0 HYDRAULICS

The term "hydraulic analysis" refers to the computational prediction of a river's water surface elevations, depths, and velocities for specified water discharge rates. This analysis is used to evaluate flooding, scour, sediment transport, and stable channel dimensions and will be used during the design of channel stabilization measures.

An existing conditions model was prepared to develop water surface profiles for the project reach using the detailed channel cross sections and upland topographic survey conducted by MMI. These, along with hydrologic data, were input data used to model and evaluate water surface elevations, depths, and velocities through the project reach under existing conditions. The model was used to evaluate flood surface elevations, channel stress conditions, and structure performance as well as developing sediment versus discharge curves for the reach to help assess the relative capacity.

5.1 Introduction to HEC-RAS Model

Hydraulic analysis was performed using the U.S. Army Corps of Engineers Hydrologic Engineering Center River Analysis System (HEC-RAS) (USACE, 2010). The model is used to compute water surface profiles for one-dimensional, gradually varied flow for steady (i.e., flows constant over time) and unsteady (i.e., flows varying over time) scenarios. This system can accommodate a full network of channels, a dendritic system, or a single river reach. HEC-RAS is capable of modeling water surface profiles under subcritical (i.e., tranquil, smooth, and deep), supercritical (i.e., jetting, turbulent, and shallow), and mixed-flow conditions.

The basic computational procedure for HEC-RAS is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's Equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is utilized in situations where the water surface profile is rapidly varying such as for a mixed-flow regime near dams, bridges, and confluences.

In developing a hydraulic model, channel cross section data are used to define the channel dimensions at selected locations. Critical cross section locations include areas where channel and floodplain dimensions vary moving downstream, approaching and departing structures, and at important design locations. At each location, the channel is defined by lateral station, elevation, and hydraulic roughness (i.e., sediment size and vegetative cover on the bed, banks, and overbanks). Upstream and downstream boundary conditions must be established for the hydraulic analysis. Typical options include normal depth, critical depth, and known water surface elevation at the downstream end of the channel. HEC-RAS documentation is included herein as Appendix D.

5.2 HEC-RAS Existing Conditions Model

An existing conditions hydraulic model of a 700-foot long reach of East Branch Rondout Creek was created using HEC-RAS. The upstream model limit was the upstream side of the unnamed private bridge crossing, and the downstream limit was the downstream side of the Sheely Road Bridge. Eighteen cross sections were input to represent the channel. Aerial and channel survey data collected in June 2010 as part of this study leading to one-foot contours in the river corridor, supplemented by December 2010 field survey at select cross sections, were used as base mapping for this modeling. HEC-GeoRAS 4.1.1, an extension for ArcGIS (ESRI 2006), was used to extract floodplain geometry from terrain data for automated input to HEC-RAS. HEC-GeoRAS is an interactive platform for setting up geometry components necessary for HEC-RAS modeling and viewing results. Floodplain topography was processed using ArcGIS to create a triangulated irregular network (TIN) representing ground elevation for use in modeling.

Stream centerline and overbank distances were delineated based on June 2010 mapping. Centerline stationing starts approximately 100 feet downstream of the Sheely Road Bridge. Floodplain topography was extracted from 2010 topographic mapping with

HEC-GeoRAS for all model cross sections. Field survey of the wet channel cross sections was then substituted into the model for all channel cross sections. Field survey of the channel is required as mapping derived from aerial photogrammetric or LIDAR (Light Detection and Ranging) survey does not penetrate water and adequately define the channel bed. Cross section locations are presented graphically in Figure 2.

The Sheely Road and private driveway bridges were added to the model using field measurements and field survey. Buildings or other features blocking flow of water were added to HEC-RAS as blocked obstructions by delineation in GIS and importing to system geometry using HEC-GeoRAS.

Channel and overbank roughness across the sections was assigned based on field observations. Manning's n varied between 0.045 and 0.05 in the channel and 0.03 and 0.10 in the overbank (Table 8). Expansion and contraction coefficients were typically 0.1 and 0.3 for normal cross sections and 0.3 and 0.5 at bridge cross sections where stronger contraction and expansion are typical. Peak flow estimations developed by MMI using a series of different methods were used in the hydraulic model (Table 9).

TABLE 8
Roughness Values Used in Hydraulic Modeling

Channel		**Overbank**	
n-value	*general description*	*n-value*	*general description*
0.035	fine bed material	0.04	clay bank, smooth bare
0.045	large gravel/cobble	0.04	gravel/cobble bar material
0.05	cobble/some boulder	0.05	clay bank, trees
0.06	cobble/large boulder	0.05	lawn, smooth no trees
0.07	boulder	0.05	riprap, small size, smooth application
0.08	large boulder	0.06	riprap, large size, smooth application
		0.07	riprap, large size, rough
		0.07	forest, thin underbrush
		0.08	thick forest
		0.1	around buildings

The model was run in a mixed flow regime. Water surface elevations and velocities were developed for the bankfull (1.5-year), 2-, 5-, 10-, 25-, 50-, 100-, 200- and 500-year storm events for flows developed via a number of methods. For analysis purposes, model results for the 17B Analysis flows have been used. The upstream model boundary condition was set to normal depth (slope = 0.0386). The downstream boundary condition was set to normal depth (slope = 0.0337).

TABLE 9
Discharge Values Used in Hydraulic Modeling

	Bankfull 1.5-yr 66%	2-yr 50%	5-yr 20%	10-yr 10%	20-yr 5%	25-yr 4%	50-yr 2%	100-yr 1%	200-yr 0.5%	500-yr 0.2%
StreamStats (cfs) (USGS, Lumia, 2006)	397	526	937	1,290	---	1,810	2,270	2,780	3,360	4,230
Flows From Regional Equations (cfs) (Lumia, 2006)	235	304	533	732	---	1,045	1,330	1,657	2,033	2,609
Flows From 1991 Regional Equations (cfs) (Mulvihill, 2009)	511	---	---	---	---	---	---	---	---	---
Flows From 2003 Regional Equations (cfs) (Davis & Miller, 2003)	326	---	---	---	---	---	---	---	---	---
17B Analysis (Peak Flows From Gauge Data Scaled to Drainage Area)	682	834	1,145	1,348	1,541	---	1,795	1,984	2,175	2,431

The existing conditions model was used to determine velocities near the area of scour concern. Bridges often constrict the natural flow path of floodwaters causing altered stream hydraulics. However, the model does not indicate overtopping of the structures for the 1.5-year through 500-year design storms. The top width of water at each cross section shows that the flow is confined within the channels at both the upstream private bridge and the downstream Sheely Road Bridge for all modeled storm events.

The upper bridge in the project reach encroaches on the left bank by approximately six feet while the Sheely Road Bridge encroaches on both banks by approximately five feet. Local contractions occur due to these encroachments.

Both the unnamed private drive bridge and the Sheely Road Bridge influence hydraulics during storm events of 1.5-year recurrence and greater. The water surface elevations upstream of the bridge are raised during any high flow event. As flow contracts and passes through the bridge openings, velocities passing under the bridge increase significantly. The average channel velocity, shear stress, and total stream power are very high at both locations during high flow events.

5.3 Hydraulic Forces at Bank Failure Site

Hydraulic conditions were examined at cross section 15+25, a location with relatively stable banks upstream of the bank failure site and at cross section 12+25 at the bank failure site. Figure 2 shows the cross section locations. Average values for each cross section of velocity and shear stress were calculated in HEC-RAS. Average shear stress was calculated for each cross section using $\tau=\gamma*R*S$, where γ=specific weight of water, R=hydraulic radius, and S=Energy Grade Line Slope. Maximum shear stress was calculated using an approximation $\tau=\gamma*d_{max}*S$. The results are presented in Table 10, and the calculations are included as Appendix E.

TABLE 10
Predicted Shear and Velocity Data

Cross Section	Calculated Hydraulic Condition	Bankfull Discharge (682 cfs)	100-year Discharge (1,984 cfs)
15+25	Maximum Shear (lb-ft/s)	5.7	8.6
	Average Shear (lb-ft/s)	4.5	6.3
	Average Velocity (ft/s)	7.5	10.6
12+25	Maximum Shear (lb-ft/s)	6.8	5.5
	Average Shear (lb-ft/s)	4.8	3.4
	Average Velocity (ft/s)	8.7	9.7

The critical shear stress (T_c) for the study reach of 3.2 lb-ft/s was calculated using Johnson's stability approximation (Johnson et al., 1999) where $T_c = 9*D_{50}$ for dense imbricated gravel. The ratio of the average shear stress to the critical shear stress is between 1 and 2 for both cross sections, indicating that there is some particle movement during bankfull flow events throughout the study reach.

5.4 Hydraulic Summary

The foregoing analysis confirms that East Branch Rondout produces high shear stresses and velocities that are capable of causing significant bank erosion, particularly on steep slopes lacking riparian vegetation. This outcome is consistent with the conclusion derived from the geomorphic assessment that the study channel is not in equilibrium; rather, it fits the characteristics of a rigid boundary channel. The information developed during this task can be applied directly to design of remedial measures to stabilize the bank failure site and minimize erosion of the banks throughout the study reach.

6.0 DESIGN INTENT

Both the geomorphic assessment of slope, pattern, and bankfull dimensions and the hydraulic assessment of channel roughness, shear stress and velocities indicate that the study reach is not an equilibrium channel. The overall valley slope of 2.6% is steeper than an equilibrium slope, indicating that the slightly overwidened channel has decreased sediment transport capacity. In addition, the estimated channel forming discharge and mean slope guide conditions commonly associated with a threshold channel (Rosgen Type B2). Furthermore, the East Branch Rondout produces high shear stresses and velocities that are capable of causing significant bank erosion, particularly on steep slopes lacking riparian vegetation.

The information developed from these analyses can be applied directly during design of remedial measures to stabilize the bank failure site and minimize erosion of the banks throughout the study reach.

First, it is likely that the bank failure on the right bank upstream of the Sheely Road Bridge is caused and aggravated by sediment runoff from the Ulster County DPW garage gravel staging area upslope. Second, all analyses indicate that this channel is a rigid boundary channel that will remain stable with well-armored steep banks.

The engineering design goals for the project include improved stormwater management and stream bank protection via bioengineered treatments including a live crib wall. Therefore, while the complete design will be detailed in subsequent tasks, it is likely that the design will include four components as follows:

1. A stormwater retention swale that will filter and divert runoff from the staging area to protect the bank from surficial runoff that is otherwise erosive.

2. A live crib wall that will stabilize the bank above the bankfull height. This is consistent with literature on bioengineered solutions that state that the permissible shear stress of "grown live brush mattress" of 3.90 to 8.2 lb/sq ft and a velocity of 12 ft/sec (Fischenich, 2001).

3. Use of a more traditional revetment strategy below bankfull, such as stacked stone revetment, to maintain a stable base for the riparian buffer above. The stream bank below bankfull height is most likely subject to greater sustained shear stresses than the higher bank due to the frequency and duration of high velocity flow at that level.

4. Development of stormwater BMPs for the ongoing operations at the garage site. These BMPs could be organized into a stormwater management plan that could outline high priority adjustments to DPW garage operations to best protect and restore the East Branch Rondout Creek in this location. BMPs would include runoff containment and management including permanent sediment containment around the gravel storage areas.

A concept sketch of the proposed restoration design is included herein as Appendix F. This scenario, especially the swale design and site grading, will be further investigated for efficacy and feasibility and presented in detail during the next phase of this project.

REFERENCES

Brierley, G. J. and K. A. Fryirs, 2005. Geomorphology and River Management, Blackwell Publishing, Malden, MA.

Collins, M. J., 2009. Evidence for Changing Flood Risk in New England Since the Late 20th Century. Journal of The American Water Resources Association 45(2):279-290.

Copeland, R. R., 1994. Application of Channel Stability Methods - Case Studies. TR-HL-94-11. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Davis, D., 2009. Photo-Documentation of East Branch Rondout Creek Turbidity on March 19, 2009. NYCDEP Stream Management Program, Phoenicia, NY.

FHWA, 2001. Stream Stability at Highway Structures (Hydraulic Engineering Circular No. 20). FHWA NHI 01-002. Federal Highway Administration, U.S. Department of Transportation, Washington, DC.

Fischenich, Craig., 2010. "Stability Thresholds for Stream Restoration Materials." EMRRP Technial Notes Collection (ERDC TN-EMRRP-SR-29), US Army Engineer Research and Development Center, Vicksburg, MS.

Kondolf, G. M., 1997. Application of the Pebble Count: Notes on Purpose, Method, and Variants. Journal of The American Water Resources Association 33(1):79-87.

Lane, E. W., 1955. The Importance of Fluvial Morphology in Hydraulic Engineering. *In Proceedings of:* American Society of Civil Engineering, Journal of the Hydraulics Division. 81(paper 745):1-17.

Lumia, R. and D. A. S. Freehafer, M.J., 2006. Magnitude and Frequency of Floods in New York. Scientific Investigations Report 2006–5112. U.S. Geological Survey, in Cooperation with the New York State Department of Transportation, Troy, NY.

Miller, S. and D. Davis, 2003. Identifying and Optimizing Regional Relationships for Bankfull Discharge and Hydraulic Geometry at USGS Gauging Stations in the Catskill Mountains, Ny. NYDEP Technical Reports. NYDEP.

Montgomery, D. R. and J. M. Buffington, 1993. Channel Classification, Prediction of Channel Response, and Assessment of Channel Condition (Tfw-Sh10-93-002). Timber, Fish, and Wildlife Agreement, Department of Natural Resources, Olympia, WA.

Mulvihill, C. I., B. P. Baldigo, S. J. Miller, D. DeKoskie, and J. DuBois, 2010. Bankfull Discharge and Channel Characteristics of Streams in New York State. Scientific Investigations Report 2009–5144. U.S. Geological Survey, Prepared in Cooperation with New York State Department of Environmental Conservation, New York Department of State, New York State Department of Transportation, New York City Department of Environmental Protection, Reston, VA.

Rosgen, D. and L. Silvey, 1996. Applied River Morphology, Wildland Hydrology, Pagosa Springs, CO.

USACE, 2010. Hydrologic Engineering Center River Analysis System (HEC-RAS) (V. 4.1). U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, CA.

USGS, 1982. Guidelines for Determining Flood Flow Frequency (Bulletin #17b). Interagency Advisory Committee on Water Data, U.S. Geological Survey, Reston, VA.

Wolman, M. G., 1954. A Method of Sampling Coarse River-Bed Material. Transactions of American Geophysical Union 35:951-956.

Chang, H., 1988. Fluvial Processes in River Engineering, John Wiley & Sons, Inc., New York, NY.

Copeland, R. R., 1994. Application of Channel Stability Methods - Case Studies. TR-HL-94-11. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Highland, Lynne and Peter Babrowsky, 2008. The Landslide Handbook, a Guide to Understanding Landslides, Circular 1325, U.S. Geological Survey.

Hough, B.K., 1969. Basic Soils Engineering, Ronald Press, New York.

Jager, Stefan and Gerald Wieczorek, 1994. Landslide Susceptibility in the Tully Valley Area, Finger Lakes Region, New York USGS Open File Report 94-615.

Kudish, Michael, 2000. The Catskill Forest, A History, Purple Mountain Press, Fleischmann, New York.

Montgomery, D. R. and J. M. Buffington, 1993. Channel Classification, Prediction of Channel Response, and Assessment of Channel Condition (Tfw-Sh10-93-002). Timber, Fish, and Wildlife Agreement, Department of Natural Resources, Olympia, WA.

NFEC, 1986. Soil Mechanics, Design Manual 7.01, U.S. Navy Facilities Engineering Command, Alexandria, Virginia.

Pair, Donald and William M. Koppel, 2002. Geomorphic Studies of Landslides in the Tully Valley, New York, Implications for Public Policy and Planning, Geomorphology, 47 pp 125-135.

Rosgen, D., and Silvey, L., 1998. Field Guide for Stream Classification. Wildland Hydrology.

Simon, Andrew, 2008. Bank Stability and Toe Erosion Model, Agricultural Research Service, U.S. Dept. of Agriculture.

Simons, Noel, 2005. Soil and Rock Slope Engineering, Thomas Telford Publishing Co., London (with Slope/ W Model CD).

Turner, Keith and Robert Schuster, editors, 1996. Landslides, Investigation and Mitigation, Special Report 247. Transportation Research Board, National Research Council.

Wilkerson, Gregory, 2008. Improved Bankfull Discharge Prediction Using 2 Year Frequency Discharge, Journal of the American Water Resources Association, Vol. 44, No. 1.

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APPENDICES

APPENDIX A

PROJECT BASE MAPPING

LOCATION MAP
SCALE: N.T.S.

GRAPHIC SCALE

20 0 10 20 40

(IN FEET)
1 inch = 20 ft.

LEGEND

- STONEWALL
- WATERCOURSE
- GUARDRAIL
- CHAIN LINK FENCE
- CATCH BASIN
- BOLLARD
- POST
- UTILITY POLE
- SIGN
- WELL
- DRILLHOLE
- MAILBOX
- FLARED END SECTION

SURVEY NOTES

1. NORTH ARROW AND COORDINATES ARE BASED UPON NAD 1983 (NEW YORK EAST).
2. BENCHMARKS, ELEVATIONS AND CONTOURS ARE BASED UPON NAVD 1988.

GENERAL NOTES:

1. UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY IS A VIOLATION OF SECTION 7209, SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW.
2. ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH THE SURVEYOR'S EMBOSSED SEAL ARE GENUINE, TRUE AND CORRECT COPIES OF THE SURVEYOR'S ORIGINAL WORK AND OPINION.
3. CERTIFICATIONS HEREON SIGNIFY THAT THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE EXISTING CODE OF PRACTICE FOR LAND SURVEYS ADOPTED BY THE NEW YORK STATE ASSOCIATION OF PROFESSIONAL LAND SURVEYORS, INC. SAID CERTIFICATIONS SHALL RUN ONLY TO THE PERSON FOR WHOM THIS SURVEY WAS PREPARED.

TOPOGRAPHIC SURVEY

EAST BRANCH RONDOUT CREEK
ULSTER COUNTY HIGHWAY GARAGE SITE
GREENVILLE ROAD (ROUTE 46)
TOWN OF DENNING, HAMLET OF SUNDOWN
ULSTER COUNTY, NEW YORK

DESIGNED	DRAWN	CHECKED		PROJECT NO.
---	TJP	MFM	Engineering, Landscape Architecture and Environmental Science	4282-03
SCALE	1"=20'		MILONE & MACBROOM®	SHEET NO. 1 OF 1
DATE	JUNE 17, 2010		99 Realty Drive, Cheshire, Connecticut 06410, (203) 271-1773 Fax (203) 272-9733, www.MiloneandMacBroom.com	

APPENDIX B

PEBBLE COUNT DATA

Project/Sample Information

Project	Ulster County Garage Site
Stream	Sundown Creek
Location	Sundown, NY
Sample ID	Supply Reach pebble count
Sample Date	12/9/2010
Sampled By	Jenn Hoyle, Dan Melnik
Sample Method	

Particle Distribution (%)

silt/clay	0
sand	10
gravel	27
cobble	57
boulder	6
bedrock	0

Sample Site Descriptions by Observations

Channel type	Rosgen B3
D100 (mm)	920mm
Colluvium	
Debris	Some woody debis piles
Other	

Particle Sizes (mm)

D16	24
D35	60
D50	**81**
D84	163
D95	273

(Bunte and Abt, 2001)

Particle Name	Size Limits (mm) lower	upper	Tally	Count	Percent Passing	Cumulative % Finer
silt/clay	0	**0.063**			0.0	0.0
very fine sand	0.063	**0.125**			0.0	0.0
fine sand	0.125	**0.250**		3	2.9	2.9
medium sand	0.250	**0.500**			0.0	2.9
coarse sand	0.500	**1**		8	7.6	10.5
very coarse sand	1	**2**			0.0	10.5
very fine gravel	2	**4**			0.0	10.5
fine gravel	4	**5.7**			0.0	10.5
fine gravel	5.7	**8**		3	2.9	13.3
medium gravel	8	**11.3**			0.0	13.3
medium gravel	11.3	**16**		2	1.9	15.2
coarse gravel	16	**22.6**			0.0	15.2
coarse gravel	22.6	**32**		6	5.7	21.0
very coarse gravel	32	**45**		4	3.8	24.8
very coarse gravel	45	**64**		13	12.4	37.1
small cobble	64	**90**		20	19.0	56.2
medium cobble	90	**128**		20	19.0	75.2
large cobble	128	**180**		13	12.4	87.6
very large cobble	180	**256**		7	6.7	94.3
small boulder	256	**362**		4	3.8	98.1
small boulder	362	**512**			0.0	98.1
medium boulder	512	**1024**		2	1.9	100.0
large boulder	1024	**2048**			0.0	100.0
very large boulder	2048	**4096**			0.0	100.0
bedrock	4096	**-**			0.0	100.0
			Total	105	100.0	-

(Wenthworth, 1922)

F-T Particle Sizes (mm)

F-T n-value	0.5
D16	8.2
D5	0.8

(Fuller and Thompson, 1907)

D (mm) of the largest mobile particles on bar

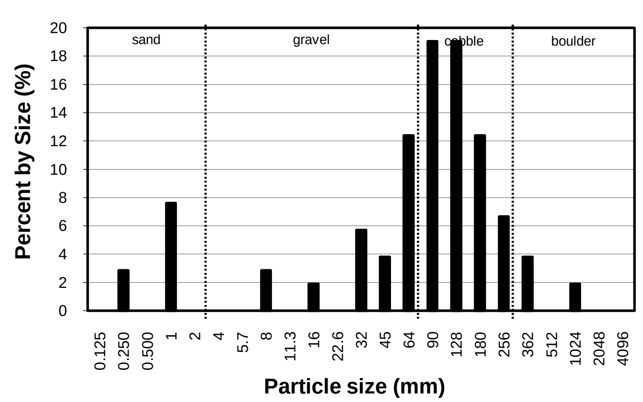
Mean	

Riffle Stability Index (%)

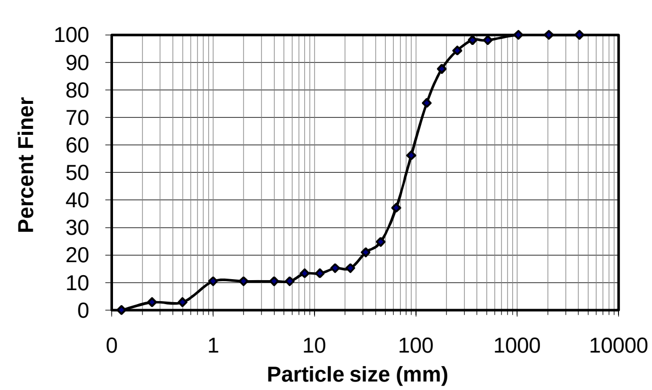
(Kappesser, 2002)

Notes

Particle Size Histogram



Gradation Curve



Project/Sample Information

Project	Ulster County Garage Site
Stream	Sundown Creek
Location	Sundown, NY
Sample ID	Study Reach Pebble Count @ Station 15+25
Sample Date	12/9/2010
Sampled By	Jenn Hoyle, Dan Melnik
Sample Method	

Particle Distribution (%)

silt/clay	0
sand	13
gravel	23
cobble	45
boulder	20
bedrock	0

Sample Site Descriptions by Observations

Channel type	Rosgen B4
D100 (mm)	1448mm
Colluvium	
Debris	no woody debris
Other	

Particle Sizes (mm)

D16	14
D35	62
D50	**109**
D84	286
D95	661

(Bunte and Abt, 2001)

Particle Name	Size Limits (mm) lower	upper	Tally	Count	Percent Passing	Cumulative % Finer
silt/clay	0	**0.063**			0.0	0.0
very fine sand	0.063	**0.125**			0.0	0.0
fine sand	0.125	**0.250**		6	5.9	5.9
medium sand	0.250	**0.500**			0.0	5.9
coarse sand	0.500	**1**		7	6.9	12.9
very coarse sand	1	**2**			0.0	12.9
very fine gravel	2	**4**			0.0	12.9
fine gravel	4	**5.7**			0.0	12.9
fine gravel	5.7	**8**			0.0	12.9
medium gravel	8	**11.3**			0.0	12.9
medium gravel	11.3	**16**		5	5.0	17.8
coarse gravel	16	**22.6**		1	1.0	18.8
coarse gravel	22.6	**32**		2	2.0	20.8
very coarse gravel	32	**45**		7	6.9	27.7
very coarse gravel	45	**64**		8	7.9	35.6
small cobble	64	**90**		7	6.9	42.6
medium cobble	90	**128**		14	13.9	56.4
large cobble	128	**180**		12	11.9	68.3
very large cobble	180	**256**		12	11.9	80.2
small boulder	256	**362**		12	11.9	92.1
small boulder	362	**512**			0.0	92.1
medium boulder	512	**1024**		8	7.9	100.0
large boulder	1024	**2048**			0.0	100.0
very large boulder	2048	**4096**			0.0	100.0
bedrock	4096	**-**			0.0	100.0
			Total	101	100.0	-

(Wenthworth, 1922)

F-T Particle Sizes (mm)

F-T n-value	0.5
D16	11.1
D5	1.1

(Fuller and Thompson, 1907)

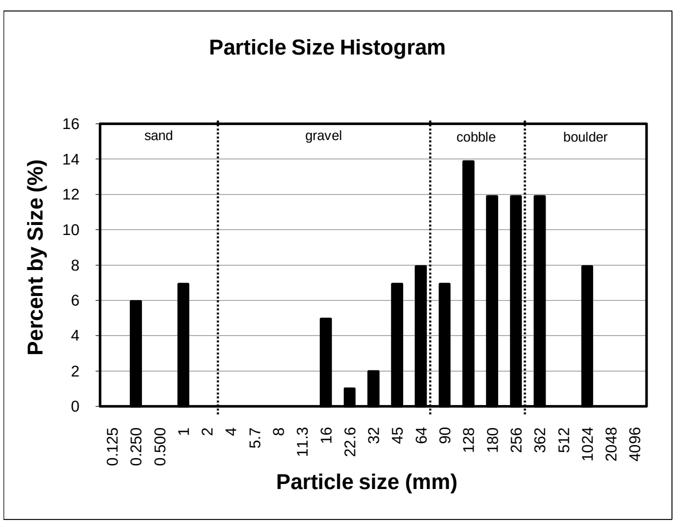
D (mm) of the largest mobile particles on bar

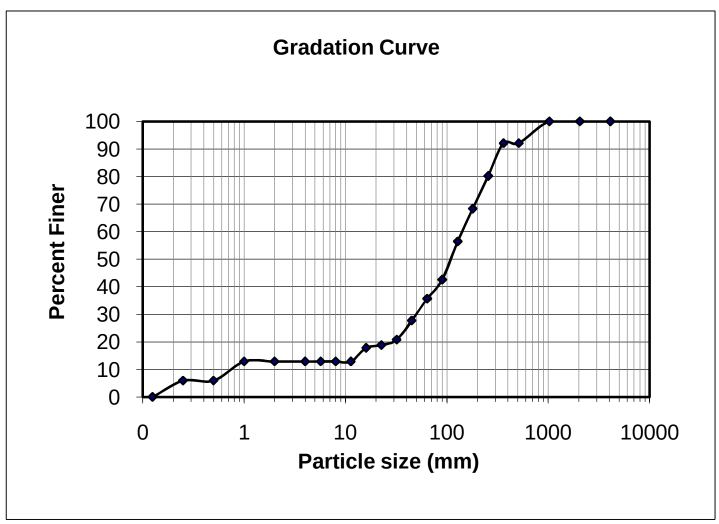
Mean	

Riffle Stability Index (%)

(Kappesser, 2002)

Notes





Project/Sample Information

Project	Ulster County Garage Site
Stream	Sundown Creek
Location	Sundown, NY
Sample ID	Study Reach Pebble Count @ Station 15+25
Sample Date	12/9/2010
Sampled By	Jenn Hoyle, Dan Melnik
Sample Method	

Particle Distribution (%)

silt/clay	0
sand	13
gravel	23
cobble	45
boulder	20
bedrock	0

Sample Site Descriptions by Observations

Channel type	Rosgen B4
D100 (mm)	1448mm
Colluvium	
Debris	no woody debris
Other	

Particle Sizes (mm)

D16	14
D35	62
D50	**109**
D84	286
D95	661

(Bunte and Abt, 2001)

Particle Name	Size Limits (mm) lower	upper	Tally	Count	Percent Passing	Cumulative % Finer
silt/clay	0	**0.063**			0.0	0.0
very fine sand	0.063	**0.125**			0.0	0.0
fine sand	0.125	**0.250**		6	5.9	5.9
medium sand	0.250	**0.500**			0.0	5.9
coarse sand	0.500	**1**		7	6.9	12.9
very coarse sand	1	**2**			0.0	12.9
very fine gravel	2	**4**			0.0	12.9
fine gravel	4	**5.7**			0.0	12.9
fine gravel	5.7	**8**			0.0	12.9
medium gravel	8	**11.3**			0.0	12.9
medium gravel	11.3	**16**		5	5.0	17.8
coarse gravel	16	**22.6**		1	1.0	18.8
coarse gravel	22.6	**32**		2	2.0	20.8
very coarse gravel	32	**45**		7	6.9	27.7
very coarse gravel	45	**64**		8	7.9	35.6
small cobble	64	**90**		7	6.9	42.6
medium cobble	90	**128**		14	13.9	56.4
large cobble	128	**180**		12	11.9	68.3
very large cobble	180	**256**		12	11.9	80.2
small boulder	256	**362**		12	11.9	92.1
small boulder	362	**512**			0.0	92.1
medium boulder	512	**1024**		8	7.9	100.0
large boulder	1024	**2048**			0.0	100.0
very large boulder	2048	**4096**			0.0	100.0
bedrock	4096	**-**			0.0	100.0
			Total	101	100.0	-

(Wenthworth, 1922)

F-T Particle Sizes (mm)

F-T n-value	0.5
D16	11.1
D5	1.1

(Fuller and Thompson, 1907)

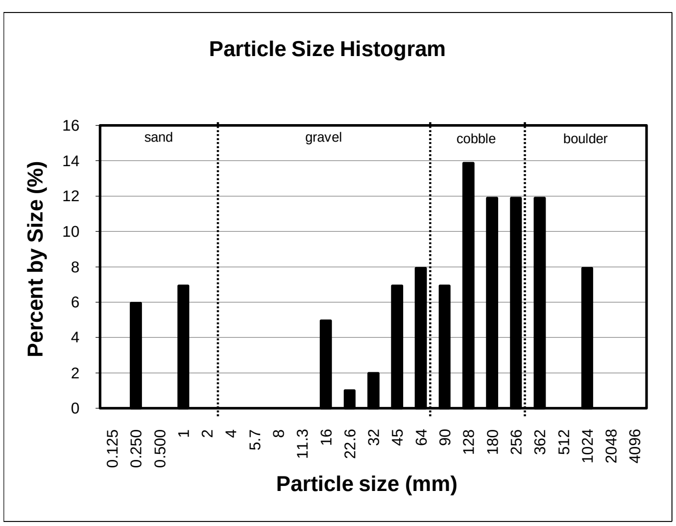
D (mm) of the largest mobile particles on bar

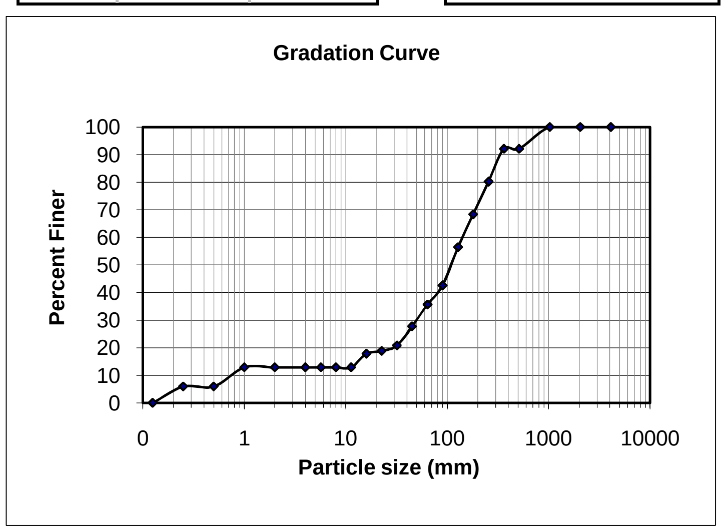
Mean	

Riffle Stability Index (%)

(Kappesser, 2002)

Notes





APPENDIX C

EQUILIBRIUM SLOPE AND CHANNEL ALIGNMENT CALCULATIONS

EQ Slope Calculations through Study Reach Surveyed by MMI 201(
January, 2011

XS 15+25			**XS 12+25**		
DS of Private Road bridge			**At Erosion Site**		
d50	109	mm	**d50**	109	mm
Abf	91.55	ft2	**Abf**	78.43	ft2
Pwet	38.90	ft	**Pwet**	44.28	ft
wbf	37.0	ft	**wbf**	32.5	ft
S	0.03	ft/ft	**S**	0.02	ft/ft
n	0.06		**n**	0.06	
R avg of reach	2.35	ft	**R avg of reach**	1.77	ft
Qbf	682	cfs	**Qbf**	682	cfs

Sheild's resistance to motior			**Sheild's resistance to motior**		
tau=gamma*R*S~5*d50/304			tau=gamma*R*S~5*d50/304		
gamma=	62.4	lb/ft3	gamma=	62.4	lb/ft3
d50=	109	mm	d50=	109	mm
R=A/Pwet=	2.4	ft	R=A/Pwet=	1.8	ft
S=	**1.2**	**%**	**S=**	**1.6**	**%**

Engineering,
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JOB 3597-07
SHEET NO. 1 OF
CALCULATED BY JBH DATE 1/7/11
CHECKED BY DATE
SCALE

Goal: Show East Branch Rocket Creek is NOT an equilibrium channel (transition channel)

Givens: $Q_{bkfl} = Q_{1.5} = 682\ cfs = 19.3\ m^3/sec$
$D_{50} = 109\ mm$ (@ Sta. 15+25)
$S = 2-3\%$ (range)

#1 Chang Diagram (for sand bed rivers)

$$S/\sqrt{d} \times 10^3 = \frac{0.03}{\sqrt{109}} = .0028 \times 10^3 = 2.8$$

$$\frac{0.02}{\sqrt{109}} = .0019 \times 10^3 = 1.9$$

Result: Ranges from Region 1 (stable canal) to Region 3 (wide bed point bar stream)

w/ only 1% change in slope — transitional channel

#2 Parker Diagram

$$\frac{S}{F} = \frac{S}{\frac{V}{\sqrt{gd}}} = \frac{S\sqrt{gd}}{V} = \frac{0.03\sqrt{32.2(3)}}{10}$$

.029

$$= 2.9 \times 10^{-2}$$

assume $V = 10\ ft/s$ (at bkfl)
$d = 3\ ft$

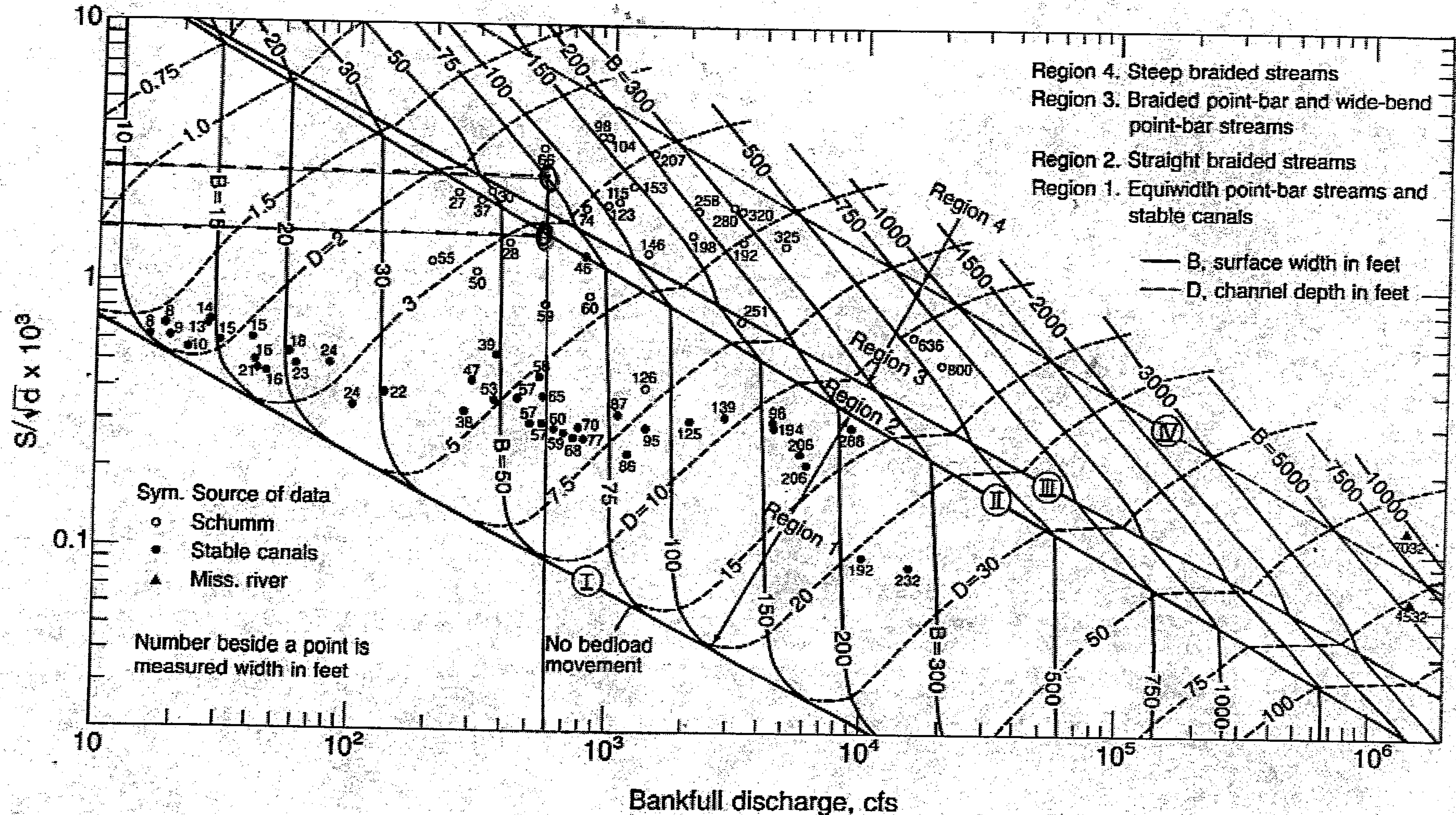
based on RAS output

.02

$$= \frac{0.02\sqrt{32.2(3)}}{10}$$

$$= 1.9 \times 10^{-2}$$

$$\frac{D}{W} = \frac{3}{33} = 0.09 = 9 \times 10^{-2}$$



Region 4. Steep braided streams
Region 3. Braided point-bar and wide-bend point-bar streams
Region 2. Straight braided streams
Region 1. Equiwidth point-bar streams and stable canals
B, surface width in feet
D, channel depth in feet
Sym. Source of data
o Schumm
• Stable canals
▲ Miss. river
Number beside a point is measured width in feet
No bedload movement
Region 1
Region 2
Region 3
Region 4
$S/\sqrt{d} \times 10^3$
Bankfull discharge, cfs

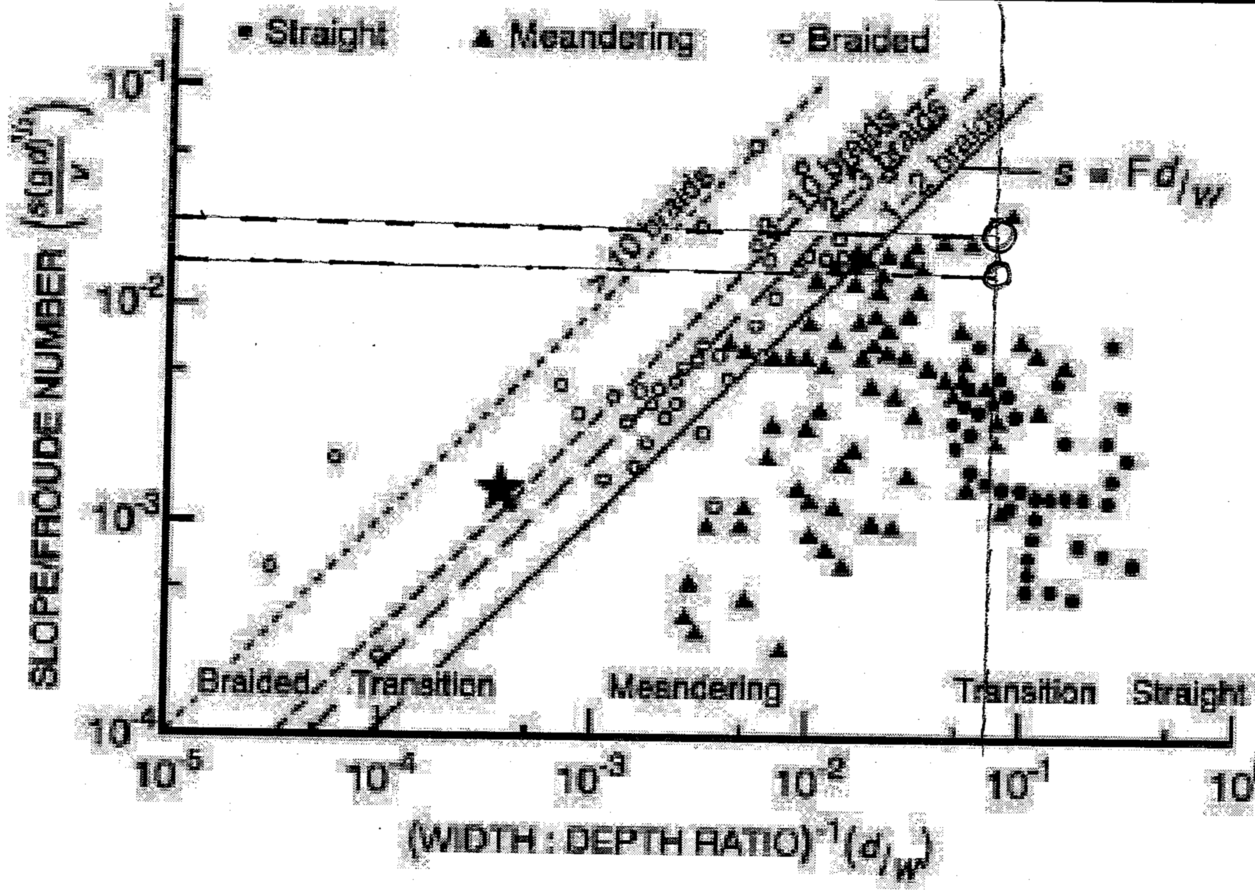


Figure 4: Meander and braiding threshold based on *Parker's (1976)* stability analysis.

APPENDIX D

HEC-RAS MODEL DOCUMENTATION

EastBranchRondout.rep

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X      XXX   XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: EastBranchRondout
Project File : EastBranchRondout.prj
Run Date and Time: 1/5/2011 2:24:17 PM

Project in English units

PLAN DATA

Plan Title: ExCond-17BFlows
Plan File : h:\3597-07 Ulster County Highway Garage\H-H\Hydraulics\HEC-RAS\EastBranchRondout.p04

Geometry Title: XC-GeoRas-Trimmed
Geometry File : h:\3597-07 Ulster County Highway Garage\H-H\Hydraulics\HEC-RAS\EastBranchRondout.g03

Flow Title   : 17B-Flows
Flow File   : h:\3597-07 Ulster County Highway Garage\H-H\Hydraulics\HEC-RAS\EastBranchRondout.f04

```
Plan Summary Information:
Number of:  Cross Sections =   21    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    2    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: Between every coordinate point (HEC2 Style)
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Mixed Flow
```

FLOW DATA

Flow Title: 17B-Flows
Flow File : h:\3597-07 Ulster County Highway Garage\H-H\Hydraulics\HEC-RAS\EastBranchRondout.f04

Flow Data (cfs)

River	Reach	RS	PK1.5(Bkfl)	PK2	PK5	PK10	PK20	PK50	PK100	PK200
Rondout Creek	East Branch	1800	682	834	1145	1348	1541	1795	1984	2175

River	Reach	RS	PK500
Rondout Creek	East Branch	1800	2431

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Rondout Creek	East Branch	PK1.5(Bkfl)	Normal S = 0.0386	Normal S = 0.0337
Rondout Creek	East Branch	PK2	Normal S = 0.0386	Normal S = 0.0337
Rondout Creek	East Branch	PK5	Normal S = 0.0386	Normal S = 0.0337
Rondout Creek	East Branch	PK10	Normal S = 0.0386	Normal S = 0.0337
Rondout Creek	East Branch	PK20	Normal S = 0.0386	Normal S = 0.0337
Rondout Creek	East Branch	PK50	Normal S = 0.0386	Normal S = 0.0337
Rondout Creek	East Branch	PK100	Normal S = 0.0386	Normal S = 0.0337
Rondout Creek	East Branch	PK200	Normal S = 0.0386	Normal S = 0.0337

GEOMETRY DATA

Geometry Title: XC-GeoRas-Trimmed
Geometry File : h:\3597-07 Ulster County Highway Garage\H-H\Hydraulics\HEC-RAS\EastBranchRondout.g03

CROSS SECTION

RIVER: Rondout Creek
REACH: East Branch   RS: 1800

INPUT

```
Description:
Station Elevation Data    num=      44
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 206.0891052.749 215.9021044.619 225.7151037.644 235.531 1033.72
245.3441032.687
 255.1571032.015  264.971032.024 274.7871032.093   284.61032.133
294.4131032.392
 304.2261032.477 314.0421032.267 323.8551032.684 333.6681032.831
343.4811032.723
 353.2971032.635  363.111032.648 372.9231032.736 382.7361032.792
392.5491032.687
 402.3651032.385 412.178 1031.88 421.9911031.214 431.8041030.361
441.6211029.767
 451.4341029.495 461.2471029.318  471.061028.947 480.8761029.259
490.6891029.587
 500.5021029.738 510.3151028.701 520.1281023.012 529.9441019.774
539.7571019.147
  549.571019.045 559.3831022.618 569.1991029.875 579.0121031.627
588.8251031.896
 598.6381036.785 608.4551043.363 618.2681049.364 628.0811055.233

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 206.089     .07 520.128     .06 559.383     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
       520.128 559.383               75      75      75             .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1725

INPUT
Description:
Station Elevation Data    num=      50
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 195.8791052.874 205.673  1045.4 215.4661040.043 225.2591035.719
235.0521031.916
 244.8491030.735 254.6421030.236 264.4361029.931 274.2291029.846 284.022
1030.24
 293.8161030.374 303.6121030.525 313.4061030.981 323.1991031.857 332.992
1032.26
 342.7851032.526 352.5821031.821 362.375 1030.87 372.1691030.679
381.9621030.833
 391.7551030.833 401.552 1031.04 411.3451031.253 421.1381031.001
430.9321030.302
 440.7251029.741 450.5181029.298 460.315 1028.77 470.1081028.219
479.9021027.841
 489.6951027.677 499.4881027.674 509.2851027.543 519.0781027.428 528.871
1027.1
  532.841025.941 538.6651024.239  547.251017.822 548.4581016.919
558.2511016.535
 568.048 1016.67  577.841017.864 577.8411017.864 577.841  1030.3  602.84
1030
  606.34    1031 626.8111034.678 636.6041041.001 646.3981046.145
656.1911051.791

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
```

```
 195.879     .07 235.052    .035 528.871     .06 538.665    .045 548.458
.055
 577.841    .013  602.84     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        532.84  577.84               25      25      25             .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1700

INPUT
Description: copy of 1725 - at private bridge abutments. 12' u/s of bridge
Station Elevation Data    num=      57
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 195.8791052.874 205.673  1045.4 215.4661040.043 225.2591035.719
235.0521031.916
 244.8491030.735 254.6421030.236 264.4361029.931 274.2291029.846 284.022
1030.24
 293.8161030.374 303.6121030.525 313.4061030.981 323.1991031.857 332.992
1032.26
 342.7851032.526 352.5821031.821 362.375 1030.87 372.1691030.679
381.9621030.833
 391.7551030.833 401.552 1031.04 411.3451031.253 421.1381031.001
430.9321030.302
 440.7251029.741 450.5181029.298 460.315 1028.77 470.1081028.219
479.9021027.841
 489.6951027.677 499.4881027.674 509.2851027.543 519.0781027.428  519.84
1027
  520.84    1026  522.84    1024  524.84    1022  526.84    1020  527.84
1019
  528.84    1018   529.3 1017.54  529.84    1017  533.54 1016.05
534.841016.126
  548.46 1016.92  558.25 1016.53  568.05 1016.67  577.84 1017.86 577.841
1017.86
 577.841 1028.73  605.64 1029.27  606.34    1031 626.8111034.678
636.6041041.001
 646.3981046.145 656.1911051.791

Manning's n Values        num=       6
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 195.879     .07 235.052    .035 519.078     .06  533.54    .055 577.841
.013
  605.64     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         529.3  577.84               40      40      40             .3
.5

BRIDGE


RIVER: Rondout Creek
REACH: East Branch        RS: 1678

INPUT
Description: Unnamed bridge upstream of Sheely Road, private drive
Distance from Upstream XS =      12
Deck/Roadway Width        =      18
```

```
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=       4
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
  519.08 1027.43          527.34 1028.73          527.34 1028.73 1024.73
  577.84 1028.73 1024.73

Upstream Bridge Cross Section Data
Station Elevation Data    num=      57
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 195.8791052.874 205.673  1045.4 215.4661040.043 225.2591035.719
235.0521031.916
 244.8491030.735 254.6421030.236 264.4361029.931 274.2291029.846 284.022
1030.24
 293.8161030.374 303.6121030.525 313.4061030.981 323.1991031.857 332.992
1032.26
 342.7851032.526 352.5821031.821 362.375 1030.87 372.1691030.679
381.9621030.833
 391.7551030.833 401.552 1031.04 411.3451031.253 421.1381031.001
430.9321030.302
 440.7251029.741 450.5181029.298 460.315 1028.77 470.1081028.219
479.9021027.841
 489.6951027.677 499.4881027.674 509.2851027.543 519.0781027.428  519.84
1027
  520.84    1026  522.84    1024  524.84    1022  526.84    1020  527.84
1019
  528.84    1018   529.3 1017.54  529.84    1017  533.54 1016.05
534.841016.126
  548.46 1016.92  558.25 1016.53  568.05 1016.67  577.84 1017.86 577.841
1017.86
 577.841 1028.73  605.64 1029.27  606.34    1031 626.8111034.678
636.6041041.001
 646.3981046.145 656.1911051.791

Manning's n Values        num=       6
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 195.879     .07 235.052    .035 519.078     .06  533.54    .055 577.841
.013
  605.64     .07

Bank Sta: Left   Right    Coeff Contr.   Expan.
         529.3  577.84             .3       .5

Downstream  Deck/Roadway Coordinates
    num=       5
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
   559.5    1024           566.5    1028           566.5    1028    1024
   617.8 1029.44 1025.44   617.8 1029.44

Downstream Bridge Cross Section Data
Station Elevation Data    num=      65
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 175.7971051.663 185.5611042.467 195.3281033.169 205.0951025.617
214.8621023.832
 224.6291024.127 234.3931025.187  244.16 1025.81 253.9271026.316
263.6941026.736
 273.4611026.998 283.2251027.126 292.9921027.133 302.7591027.326
312.5261027.343
 322.2931027.021  332.061026.827 341.8241026.762 351.5911027.005
361.3581027.257
 371.1251027.516 380.8921027.582 390.6561027.497 400.4231027.431
410.191027.323
 419.9571027.293 429.724 1027.31 439.4881027.395 449.2551027.375
```

```
459.0221027.041
 468.7891026.309 478.556 1025.21  488.321024.252 498.0871023.819
507.8541023.665
 517.621 1023.51 527.3881023.593 537.1561024.022   549.7    1027   563.8
1028
   566.5    1028   566.5    1017  566.511016.994   568.3    1016   570.9
1014.79
   572.3    1015   590.3    1015   603.2    1016   608.1    1017   609.5
1018
   611.3    1019     614    1020   616.7    1021   617.8  1021.5   617.8
1029.44
   620.3 1029.44   621.8    1029   632.8    1029   646.7    1028   648.9
1028
  654.351031.965 664.1171035.981 673.885 1040.84 683.6521044.829
693.4191047.461

Manning's n Values        num=       6
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 175.797     .07 205.095    .035   549.7     .03   568.3     .06   617.8
.013
   648.9     .07

Bank Sta: Left   Right    Coeff Contr.   Expan.
        566.51   609.5             .3       .5

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1660

INPUT
Description: 10 feet d/s of private drive bridge
Station Elevation Data    num=      65
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 175.7971051.663 185.5611042.467 195.3281033.169 205.0951025.617
214.8621023.832
 224.6291024.127 234.3931025.187  244.16 1025.81 253.9271026.316
263.6941026.736
 273.4611026.998 283.2251027.126 292.9921027.133 302.7591027.326
```

```
312.5261027.343
 322.2931027.021  332.061026.827 341.8241026.762 351.5911027.005
361.3581027.257
 371.1251027.516 380.8921027.582 390.6561027.497 400.4231027.431
410.191027.323
 419.9571027.293 429.724 1027.31 439.4881027.395 449.2551027.375
459.0221027.041
 468.7891026.309 478.556 1025.21  488.321024.252 498.0871023.819
507.8541023.665
 517.621 1023.51 527.3881023.593 537.1561024.022   549.7    1027   563.8
1028
   566.5    1028   566.5    1017  566.511016.994   568.3    1016   570.9
1014.79
   572.3    1015   590.3    1015   603.2    1016   608.1    1017   609.5
1018
   611.3    1019     614    1020   616.7    1021   617.8  1021.5   617.8
1029.44
   620.3 1029.44   621.8    1029   632.8    1029   646.7    1028   648.9
1028
  654.351031.965 664.1171035.981 673.885 1040.84 683.6521044.829
693.4191047.461

Manning's n Values        num=       6
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 175.797     .07 205.095    .035   549.7     .03   568.3     .06   617.8
.013
   648.9     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        566.51   609.5               10      10      10             .3
.5

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1650

INPUT
Description: 20 feet d/s of private drive bridge
Station Elevation Data    num=      69
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 175.7971051.663 185.5611042.467 195.3281033.169 205.0951025.617
214.8621023.832
 224.6291024.127 234.3931025.187  244.16 1025.81 253.9271026.316
263.6941026.736
 273.4611026.998 283.2251027.126 292.9921027.133 302.7591027.326
312.5261027.343
 322.2931027.021  332.061026.827 341.8241026.762 351.5911027.005
361.3581027.257
 371.1251027.516 380.8921027.582 390.6561027.497 400.4231027.431
410.191027.323
 419.9571027.293 429.724 1027.31 439.4881027.395 449.2551027.375
459.0221027.041
 468.7891026.309 478.556 1025.21  488.321024.252 498.0871023.819
507.8541023.665
 517.621 1023.51 527.3881023.593 537.1561024.022 546.9191024.272   559.5
1024
   560.5    1023   561.2    1022   562.3    1021   563.3    1020   564.3
1019
   565.4    1018   566.5    1017   567.4    1016   569.3    1015   573.1
1014
   584.3    1014   599.3    1015   604.6    1016   608.1    1017   609.6
```

```
1018
   610.9    1019   612.5    1020   613.8    1021   615.5    1022   617.2
1023
   619.8 1023.07   619.8 1028.83   646.7    1028   648.9    1028
654.351031.965
 664.1171035.981 673.885 1040.84 683.6521044.829 693.4191047.461

Manning's n Values         num=       6
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 175.797     .07 205.095    .035   559.5     .04   565.4     .06   619.8
.013
   648.9     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         565.4   609.6               25      25      25              .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1625

INPUT
Description: Bankfull 43', BT 60'
Station Elevation Data    num=      71
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 175.7971051.663 185.5611042.467 195.3281033.169 205.0951025.617
214.8621023.832
 224.6291024.127 234.3931025.187  244.16 1025.81 253.9271026.316
263.6941026.736
 273.4611026.998 283.2251027.126 292.9921027.133 302.7591027.326
312.5261027.343
 322.2931027.021  332.061026.827 341.8241026.762 351.5911027.005
361.3581027.257
 371.1251027.516 380.8921027.582 390.6561027.497 400.4231027.431
410.191027.323
 419.9571027.293 429.724 1027.31 439.4881027.395 449.2551027.375
459.0221027.041
 468.7891026.309 478.556 1025.21  488.321024.252 498.0871023.819
507.8541023.665
 517.621 1023.51 527.3881023.593 537.1561024.022 546.9191024.272   559.5
1024
   560.5    1023   561.2    1022   562.3    1021   563.3    1020   564.3
1019
   565.4    1018   566.5    1017   567.4    1016   568.3    1015   569.2
1014
   572.8    1013   587.6    1013   599.3    1014   604.4    1015   607.6
1016
     609    1017   610.1    1018   611.6    1019   612.8    1020   614.1
1021
   615.4    1022   616.7    1023   618.2    1024   619.4    1025     623
1027
   648.1    1027  654.351031.965 664.1171035.981 673.885 1040.84
683.6521044.829
 693.4191047.461

Manning's n Values         num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 175.797     .07 205.095    .035   559.5     .05   565.4     .06   610.1
.07
     623    .013   648.1     .07
```

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         565.4   610.1               50      50      50             .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1575

INPUT
Description:
Station Elevation Data    num=      73
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 176.6211052.592 186.4341043.363 196.2471033.392  206.061025.407
215.8691021.316
 225.6821021.742 235.4951022.388 245.3081022.372 255.1211022.808
264.9311022.871
 274.7441022.858 284.5571022.943  294.371023.173 304.1831023.396
313.9931023.619
 323.806 1023.93 333.6191024.311 343.4321024.875 353.2411025.354 363.054
1025.6
 372.8671025.653  382.681025.846 392.4931026.152 402.3031026.355
412.1161026.096
 421.9291025.466 431.742 1025.23 441.5521025.305 451.3651025.476
461.1781025.266
 470.9911023.953 480.8041022.661 490.6171022.608 500.4271022.936
510.241023.366
 520.0521024.121 529.8651024.239 539.6751023.845 549.4881023.392   569.3
1023
     570    1022   571.1    1021   571.9    1020   573.2    1019   574.3
1018
   575.2    1017   576.6    1016   577.5    1015   578.6    1014   579.8
1013
   580.9    1012   585.1    1011   598.2    1011   607.2    1012   611.1
1013
   613.5    1014   615.4    1015   617.4    1016     619    1017   620.4
1018
   621.9    1019   623.5    1020   625.1    1021   626.5    1022   627.6
1023
   628.1    1024   631.5    1025     658    1025 667.237 1028.78
677.0511032.379
  686.86 1038.73 696.6731044.925 706.4861050.781

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 176.621     .07 215.869    .035   569.3     .07   577.5     .06   615.4
.065
   631.5    .013     658     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         577.5   615.4               50      50      50             .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1525

INPUT
```

```
Description: 37' bankfull width, 57' BT
Station Elevation Data    num=      72
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
   186.91052.867 196.7361044.816 206.5721036.565 216.411 1028.94
226.2471022.297
 236.0831019.163 245.9191020.171 255.7581021.608 265.5941022.011
275.431022.018
 285.2661021.896 295.1051021.814 304.9411021.818 314.7771021.893
324.6161021.991
 334.4521022.113 344.2881022.257 354.1241022.612 363.9631023.104
373.7991024.341
 383.6351025.627 393.4711026.073  403.311026.066 413.1461024.301
422.9821021.844
 432.8181021.365 442.6571021.289 452.4931020.994 462.3291021.168
472.1651021.401
 482.0051021.699 491.8411022.195 501.6761022.657 511.512  1023.1
521.3521023.619
 531.1881024.022 541.0241024.157  550.861024.127 560.6991023.927
570.5351022.756
   584.9    1022   586.1    1021   587.4    1020   588.7    1019   589.7
1018
     591    1017   592.1    1016   593.3    1015   594.3    1014   595.2
1013
   595.7    1012   599.6    1011   600.6    1010     604    1010   617.7
1010
   623.1    1011   630.3    1012     632    1013   633.2    1014   634.4
1015
   635.5    1016   636.6    1017   637.8    1018   638.9    1019   640.1
1020
   644.2    1023     647    1024   675.4    1024  678.741028.192
688.5761035.144
 698.412 1041.24 708.2511048.822

Manning's n Values        num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
   186.9     .07 226.247    .035   584.9     .07   592.1     .06   635.5
.065
     647    .013   675.4     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         594.3   633.2              50      50      50             .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1475

INPUT
Description: estimated 35' bankfull
Station Elevation Data    num=      74
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 195.463 1055.66 205.2361046.667  215.011037.034 224.7831029.029
234.5541022.969
 244.327 1019.56 254.1011017.621 263.8751016.096 273.6481016.079
283.4221017.513
 293.1961019.111 302.9661019.587  312.741019.928 322.5131020.682 332.287
1021.43
  342.061021.982 351.8341022.631 361.6081023.363 371.3781023.996
381.1521023.366
 390.9251021.227 400.6991019.035 410.4721018.406 420.246 1018.53
```

```
430.0161018.786
  439.791019.295 449.5641019.787 459.3371020.125 469.1111020.643
478.8851020.991
 488.6581021.427 498.4281022.211 508.202 1022.72 517.9761023.097
527.7491022.904
 537.5231022.382 547.2971022.621  557.071022.575 566.8411022.162
576.6141022.142
 586.3881022.936 596.161 1022.08   604.6    1022     607    1021   608.2
1020
   609.5    1019   610.9    1018     612    1017   613.6    1016     615
1015
   618.6    1014   621.1    1013   621.8    1012   623.5    1011   624.5
1010
   625.7    1009   635.8    1008     647    1009   651.7    1010   654.9
1011
   656.7    1012   658.1    1013   659.2    1014   660.3    1015   661.3
1016
   662.4    1017   663.4    1018   664.5    1019   665.6    1020   668.6
1023
   705.5    1023 713.4381034.774 723.2121040.095 732.9861047.247

Manning's n Values        num=       8
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 195.463     .07 234.554    .035   604.6     .07     615     .06   660.3
.065
   665.6     .04   668.6    .013   705.5     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         621.8   656.7              50      50      50             .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1425

INPUT
Description: bkfl=33', BT=60'
Station Elevation Data    num=      81
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 203.5661054.829 213.2581046.572 222.9531038.793 232.6441030.016
242.3391022.077
 252.0341018.068 261.7261016.739 271.4211015.958 281.1121015.545
290.8071015.328
 300.5021015.436 310.194 1016.07 319.8881018.488  329.581020.725
339.2751021.138
 348.9671021.805 358.661 1021.05 368.3561019.987 378.0481019.173
387.7431017.713
 397.4341017.405 407.1291017.671 416.8241017.759 426.5161018.264
436.2111018.721
 445.9061019.081 455.5971019.203 465.2921019.206 474.9841019.728
484.6781020.266
  494.371020.541 504.0651020.502  513.761020.331 523.4511020.433
533.0511020.502
 542.6511020.548 552.2511021.096  561.851021.549  571.451021.486  581.05
1021.47
  590.651021.926 600.2491021.686   603.6    1022   609.4    1021   611.3
1020
   612.4    1019   613.7    1018   614.7    1017   615.9    1016   617.3
1015
   618.9    1014   620.4    1013   626.3    1012     630    1011   631.9
1010
```

```
   633.6    1009      635    1008   640.7    1007      649    1007   658.1
1008
   661.8    1009  663.21    1010   664.5    1011   665.7    1012   667.2
1013
   668.2    1014   669.6    1015   671.1    1016   672.4    1017   673.6
1018
   674.2    1019   674.9    1020   675.6    1021   676.2    1022   702.5
1022
   729.7    1022 735.2621028.136 745.0161032.146  754.771038.025
764.5241043.901
 774.2781049.767

Manning's n Values        num=      10
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 203.566     .07 242.339    .035   609.4     .07   620.4     .05     630
.055
     635     .06   664.5    .065   676.2     .04   702.5    .013   729.7
.07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
           630   664.5               50      50      50             .1
.3
```

CROSS SECTION

RIVER: Rondout Creek
REACH: East Branch   RS: 1375

INPUT
Description: estimated bkfl=33'

```
Station Elevation Data    num=      74
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 222.9171047.871 232.6081038.999 242.3031031.302 251.9951024.032
261.6861018.894
 271.3781016.663  281.071015.856 290.761  1015.4 300.4531015.253
310.1481015.177
 319.839 1017.93 329.5311019.888 339.2221019.823 348.9141019.649
358.6061019.416
 368.297 1018.55 377.9921016.982 387.6841016.496 397.3751016.309
407.0671016.447
 416.7591016.499  426.45 1017.09 436.1421017.703 445.8371018.255 455.528
1018.97
  465.221019.209 474.9111019.314 484.603 1019.56 494.2951019.652
503.8161019.478
  513.341019.216 522.8611019.104 532.3821019.229 541.903 1019.39 551.427
1019.4
 560.9481019.183 570.4691020.059  579.991020.846 589.5141021.312
599.0351019.859
   607.1    1020   617.3    1018   619.9    1017   621.7    1016     623
1015
   624.6    1014   626.4    1013   627.9    1012   633.6    1011   634.4
1010
   635.6    1009   637.6    1008   639.7    1007   643.3    1006   661.5
1006
   666.8    1007   670.1    1008   671.2    1009   672.3    1010   673.2
1011
   674.1    1012   675.4    1013   676.4    1014   677.6    1015   683.6
1021
   734.4    1022   744.1    1022   760.4    1021 762.4411024.885
772.1331029.505
 781.8241035.489 791.5161040.295 801.2111043.875 810.9021049.823
```

```
Manning's n Values         num=       9
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 222.917     .07 261.686    .035   617.3     .07   627.9     .05   633.6
.055
   635.6     .06   673.2     .04   744.1    .013   760.4     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         635.6   671.2              50      50      50            .1
.3

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch         RS: 1325

INPUT
Description: bkfl=33', BT=53'
Station Elevation Data    num=      76
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 245.1511050.479 254.9571041.552 264.7641032.451  274.571023.802
284.3771016.772
 294.1831014.895  303.991014.934 313.7961014.915 323.599 1015.44
333.4061017.034
 343.2121017.799 353.0181017.572 362.8251016.722 372.6311016.129
382.4381015.771
 392.2441015.613 402.0471015.617 411.8541015.758  421.661016.142
431.4671017.024
 441.2831017.093 451.0961016.719 460.9121016.434 470.7281016.594
480.5411016.945
 490.3581016.854 500.1711016.923 509.9871017.057 519.8031016.785
529.6161016.798
 539.4321017.287 549.2451017.526 559.0621017.802 568.878  1018.1
578.6911018.038
 588.507 1017.94  598.321017.379   606.5    1017   618.6    1015   621.8
1014
   623.7    1013   625.7    1012     631    1011   633.3    1010   639.9
1009
     642    1008   642.3    1007   642.7    1006   644.6    1005   666.2
1005
   668.6    1006   669.1    1007   671.3    1007   673.9    1007   674.4
1008
   675.2    1009   675.7    1010   677.4    1011   678.9    1012   680.3
1013
     682    1014   683.6    1015   685.6    1017   688.2    1017     696
1013
   704.1    1013   708.8    1014   720.9    1018   761.5    1020   795.7
1019
 804.2521023.658 814.049 1028.14 823.8451032.769 833.6421036.991
843.4381041.877
 853.2351048.484

Manning's n Values         num=      11
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 245.151     .07 284.377    .035   606.5     .07   625.7     .05   639.9
.055
   642.7     .06   669.1    .055   675.2     .04   720.9      .1   761.5
.013
   795.7     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
```

```
           642   674.4                50      50      50              .1
.3
Ineffective Flow      num=       1
   Sta L   Sta R    Elev  Permanent
   688.2 853.235    1017       F
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   725.5   761.5    1030
```

CROSS SECTION

```
RIVER: Rondout Creek
REACH: East Branch        RS: 1275

INPUT
Description: estimated bkfl=33'
Station Elevation Data    num=      77
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 270.4431047.008 280.1021036.552  289.761026.811 299.419 1018.93
309.0781015.036
 318.737 1014.82 328.3961014.596 338.0541015.705 347.713 1016.88
357.3721017.142
 367.0311016.522 376.6861015.732 386.3451015.079 396.0041014.764
405.6631014.862
 415.3221015.135  424.981015.646 434.6391016.161 444.2981015.942
453.9571015.692
 463.6151015.745 473.2741015.778 482.9331016.073 492.4671016.207
501.9981016.319
 511.532 1016.06 521.0631015.167 530.594  1015.4 540.1281016.312
549.6591015.692
 559.1931015.361 568.7241015.581 578.2581016.266 587.7891016.198
597.3231015.404
 606.8541014.843   615.7    1015   625.3    1014  628.88    1013  632.72
1012
  636.57    1011  640.48    1010  641.79    1009  644.96    1008  647.93
1007
  649.43    1006  650.93    1005  653.03    1004   657.7    1003   663.1
1003
   671.2    1004   674.5    1005   679.4    1006   680.6    1007   681.7
1008
     683    1009   684.4    1010   685.6    1011   686.8    1012   688.1
1013
   690.8    1014   691.3    1015   742.5    1016   758.5    1017   776.7
1018
   811.3    1018   812.7    1018   812.7    1016   850.2    1015
856.6241019.603
 866.3161023.005  876.011026.398 885.7021030.971 895.3971035.837
905.0891040.361
  914.781044.751 924.4751050.102

Manning's n Values        num=      10
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 270.443     .07 299.419    .035   615.7     .07  640.48     .05  647.93
.055
  650.93     .06   679.4     .04   742.5      .1   812.7    .013   850.2
.07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        647.93   680.6                50      50      50              .1
.3
```

CROSS SECTION

```
RIVER: Rondout Creek
REACH: East Branch        RS: 1225

INPUT
Description: bkfl=32.5', BT=57'
Station Elevation Data    num=      75
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 280.3251051.762  289.991041.526 299.6591032.999 309.324 1025.24
318.991018.993
 328.6581016.319 338.3231016.325 347.9891016.355 357.657 1016.03
367.3231016.066
 376.9881016.818 386.6571016.355 396.3221014.731 405.9881014.147
415.6561014.229
 425.3221015.069 434.9871015.505  444.761015.322 454.5341014.816
464.3041014.334
 474.078 1013.98 483.8521013.826 493.6221013.829 503.3961013.314
513.1691013.245
  522.941013.425 532.713 1013.77 542.4871014.757 552.2571015.007
562.0311014.341
 571.8041012.208 581.5751013.173 591.3481013.576 601.1221013.983   606.8
1014
   624.4    1013  629.44    1012  633.73    1011  635.86    1010  640.38
1009
   642.7    1008   644.4    1007  646.04    1006  647.86    1005  649.13
1004
  650.82    1003   656.6    1002   663.1    1002   670.8    1003  674.11
1004
  675.79    1005  677.32    1006  678.75    1007  680.28    1008  681.74
1009
  683.29    1010  684.82    1011  686.42    1012     688    1013  689.83
1014
   732.7    1015   837.1    1015   852.1    1012   867.9    1011   882.8
1010
   894.4    1009   929.8    1008 933.5071011.742 943.2971015.197
953.0911020.223
 962.8841026.834 972.6741032.625 982.4671036.955 992.2611040.397
1002.051046.785

Manning's n Values        num=       9
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 280.325     .07  318.99    .035   624.4     .07  635.86     .05  640.38
.055
  678.75     .04   732.7      .1   894.4    .013   929.8     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        646.04  677.32              50      50      50              .1
.3
Right Levee     Station=   732.7      Elevation=    1015
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   765.4   818.3    1025

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1175

INPUT
Description: bankfull btwn 32.5' and 25'
Station Elevation Data    num=      83
```

```
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta
Elev
 302.707 1046.65  312.471037.989 322.2381029.177 332.0011021.371
341.7651017.634
 351.5291016.053 361.2961016.437  371.061015.873 380.8231015.266
390.5911015.121
 400.3541014.892 410.1181014.409 419.882 1014.16 429.6491014.147
439.4821014.665
 449.3181014.488 459.1541014.068 468.9861013.727 478.8221013.438
488.6581012.812
 498.4941011.739 508.3271012.041 518.1631012.664 527.9991013.038
537.8311013.091
 547.6671011.785 557.5031011.178 567.3361011.601 577.1721011.696
587.0081012.083
 596.8411012.529 606.6771013.222   614.6    1013   619.7    1014   620.3
1014
  622.51    1013  624.55    1012  626.69    1011  627.33    1010  629.77
1009
  632.05    1008  637.43    1007  638.67    1006  639.99    1005  641.21
1004
   642.6    1003  645.96    1002   652.7    1001   653.3    1001   664.4
1001
   674.5    1002  676.66    1003  678.72    1004  680.07    1005  681.52
1006
  682.81    1007   684.2    1008  685.59    1009  686.74    1010  688.09
1011
  689.51    1012  690.86    1013  692.24    1014  693.74    1015   697.4
1017
   698.6    1017   706.1    1014   738.6    1014   768.2    1015   823.7
1015
   835.1    1016   875.9    1010   944.7    1009   950.8    1007     976
1007
 979.2031012.566 988.9371014.941 998.6711019.0851008.4061024.229
1018.141029.236
1027.8771035.8171037.6121041.9911047.3461046.424

Manning's n Values        num=       8
     Sta   n Val      Sta   n Val      Sta   n Val      Sta   n Val      Sta   n
Val
 302.707     .07 332.001    .035   619.7     .07  637.43    .055  682.81
.04
   768.2      .1   950.8     .13     976     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        645.96   674.5               25      25      25             .1
.3
Right Levee     Station=   697.4      Elevation=    1017
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
   769.2   781.1    1025   840.7   871.9    1026

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1150

INPUT
Description: Bankfull 25'
Station Elevation Data    num=      80
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta
Elev
 320.9451049.895 330.6731043.724 340.3971034.183 350.1251025.935
359.8491019.341
 369.5741018.202 379.3011016.834 389.0261015.758  398.751015.279
```

```
408.4781014.737
 418.2021014.492  427.931014.354 437.6541013.858 447.3491013.753
457.0441013.727
 466.7391013.478 476.4341013.077 486.1291012.671 495.8231012.156
505.5181011.873
 515.2131011.923 524.9081012.569 534.603 1012.72 544.2981011.496
553.9961010.331
 563.6911010.151 573.386  1010.4 583.0811011.188 592.7761012.074
602.471011.955
 612.1651011.549   620.7    1011   633.1    1010   635.6    1010   636.7
1009
  638.16    1008  640.43    1007  643.28    1006  644.01    1005  645.13
1004
  646.52    1003     650    1002     658    1001   659.2    1001   674.3
1002
   675.3    1003   676.3    1004   677.3    1005   678.3    1006   679.3
1007
   680.3    1008   681.3    1009   682.3    1010   683.3    1011   685.1
1012
   687.3    1013   689.6    1014   690.7    1015   691.7    1016     695
1016
   701.4    1016   704.2    1017     708    1017   714.5    1013   747.1
1013
   833.2    1014   846.4    1015   853.9    1015   853.9    1012   858.2
1011
   872.7    1010   958.1    1006   991.6    10051008.6651010.951
1018.331015.771
1027.9991021.7091037.6641029.0811047.3331037.6941056.9981044.1171066.6671049.0
16

Manning's n Values        num=       8
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 320.945     .07 359.849    .035   635.6     .07     650    .055   674.3
.07
   679.3     .04   958.1    .013   991.6     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
           650   674.3              20      20      20             .1
.3
Right Levee     Station=   704.2      Elevation=    1017
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
 850.535 850.6821011.958

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch       RS: 1130

INPUT
Description: 9 feet upstream of Sheely Rd bridge
Station Elevation Data    num=      66
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 320.9451049.895 330.6731043.724 340.3971034.183 350.1251025.935
359.8491019.341
 369.5741018.202 379.3011016.834 389.0261015.758  398.751015.279
408.4781014.737
 418.2021014.492  427.931014.354 437.6541013.858 447.3491013.753
457.0441013.727
 466.7391013.478 476.4341013.077 486.1291012.671 495.8231012.156
505.5181011.873
 515.2131011.923 524.9081012.569 534.603 1012.72 544.2981011.496
```

```
553.9961010.331
 563.6911010.151 573.386  1010.4 583.0811011.188 592.7761012.074
602.471011.955
 612.1651011.549   620.7    1011   633.1    1010   635.6    1010   636.7
1009
  638.16    1008  640.43    1007  643.28    1006  644.01    1005  645.13
1004
  646.52    1003  650.02    1002   658.2    1001   659.3    1001   674.6
1001
   674.6    1002   674.6    1009   675.6    1009   677.9    1010   678.6
1011
   679.4    1012   680.4    1013   690.4    1013     774    1012     785
1012
   807.4    1012   871.1    1011   958.1    1006   991.6
10051008.6651010.951

1018.331015.7711027.9991021.7091037.6641029.0811047.3331037.6941056.9981044.11
7
1066.6671049.016

Manning's n Values        num=       9
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 320.945     .07 359.849    .035   635.6     .07  650.02    .055   674.6
.03
   675.6     .04     774    .013   871.1     .03   991.6     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        650.02   674.6               5       5       5             .1
.3
Right Levee     Station=   680.4      Elevation=    1013
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
 850.535 850.6821011.958

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1125

INPUT
Description: copy of 1125, 4' u/s of Sheely Road
Station Elevation Data    num=      58
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 320.9451049.895 330.6731043.724 340.3971034.183 350.1251025.935
359.8491019.341
 369.5741018.202 379.3011016.834 389.0261015.758  398.751015.279
408.4781014.737
 418.2021014.492  427.931014.354 437.6541013.858 447.3491013.753
457.0441013.727
 466.7391013.478 476.4341013.077 486.1291012.671 495.8231012.156
505.5181011.873
 515.2131011.923 524.9081012.569 534.603 1012.72 544.2981011.496
553.9961010.331
 563.6911010.151 573.386  1010.4 583.0811011.188 592.7761012.074
602.471011.955
 612.1651011.549     614    1011   629.5    1011   645.5    1011   646.2
1010.71
     650 1010.71     650    1002   656.7    1001   678.2    1001   678.2
1009.25
   678.8 1009.25   678.8 1011.15   680.8 1011.15     683 1013.43   690.4
1013
     774    1012     785    1012   807.4    1012   871.1    1011   958.1
```

```
1006
   991.6    10051008.6651010.951
1018.331015.7711027.9991021.7091037.6641029.081
1047.3331037.6941056.9981044.1171066.6671049.016

Manning's n Values        num=       8
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 320.945     .07 359.849    .035     650    .055   678.2     .03   680.8
.04
     774    .013   871.1     .03   991.6     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
           650   678.2              30      30      30             .3
.5
Right Levee     Station=     683      Elevation= 1013.43
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
 850.535 850.6821011.958

BRIDGE


RIVER: Rondout Creek
REACH: East Branch        RS: 1114

INPUT
Description: Sheely Road
Distance from Upstream XS =       9
Deck/Roadway Width        =      13
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=       6
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
   645.5    1011             650 1012.38             650 1012.38 1010.71
   678.8 1013.46 1011.15   678.8 1013.46 1009.25     683 1013.43

Upstream Bridge Cross Section Data
Station Elevation Data    num=      58
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 320.9451049.895 330.6731043.724 340.3971034.183 350.1251025.935
359.8491019.341
 369.5741018.202 379.3011016.834 389.0261015.758  398.751015.279
408.4781014.737
 418.2021014.492  427.931014.354 437.6541013.858 447.3491013.753
457.0441013.727
 466.7391013.478 476.4341013.077 486.1291012.671 495.8231012.156
505.5181011.873
 515.2131011.923 524.9081012.569 534.603 1012.72 544.2981011.496
553.9961010.331
 563.6911010.151 573.386  1010.4 583.0811011.188 592.7761012.074
602.471011.955
 612.1651011.549     614    1011   629.5    1011   645.5    1011   646.2
1010.71
     650 1010.71     650    1002   656.7    1001   678.2    1001   678.2
1009.25
   678.8 1009.25   678.8 1011.15   680.8 1011.15     683 1013.43   690.4
1013
     774    1012     785    1012   807.4    1012   871.1    1011   958.1
1006
   991.6    10051008.6651010.951
1018.331015.7711027.9991021.7091037.6641029.081
1047.3331037.6941056.9981044.1171066.6671049.016
```

```
Manning's n Values         num=        8
     Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val      Sta    n
Val
 320.945      .07 359.849     .035      650     .055    678.2      .03    680.8
.04
     774     .013    871.1      .03    991.6      .07

Bank Sta: Left    Right     Coeff Contr.    Expan.
           650    678.2              .3        .5
Right Levee      Station=      683      Elevation= 1013.43
Blocked Obstructions      num=        1
   Sta L   Sta R    Elev
 850.535 850.6821011.958

Downstream  Deck/Roadway Coordinates
    num=       5
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
   632.1    1008           644.45 1012.38           644.45 1012.38 1010.71
  680.45 1013.46 1011.46  691.48    1010

Downstream Bridge Cross Section Data
Station Elevation Data     num=       96
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta
Elev
 373.7071047.096  383.54 1042.52 393.3761038.337 403.2091034.186
413.0451029.616
 422.8771025.259 432.7131020.285 442.5461017.421 452.3821017.014
462.2181016.463
 472.0511015.039 481.8861012.946 491.5941011.913 501.3061011.942
511.0171011.785
 520.7281011.499  530.441011.326 540.1511011.014 549.8621009.154
559.5731009.121
 569.2851009.964 578.9961009.639 588.7071009.459 598.4151009.455   603.4
1009
   632.1    1008    635.2    1007    640.2    1006    641.5    1005    642.8
1004
  644.05    1003  645.54    1002  648.01    1001    649.3    1000    673.6
1000
  677.25    1001  678.27    1002    679.3    1003  680.07    1004  681.42
1005
  683.06    1006  684.79    1007    686.5    1008  688.77    1009  691.48
1010
   698.6    1011    705.5    1010 714.9481010.151 724.659 1010.42
734.371010.797
 744.0811010.764 753.7931010.669 763.5041010.623 773.2151010.564
782.9271010.597
 792.6381010.699 802.3491010.748 812.0571010.676 821.7681010.564
831.481010.532
 841.1911010.548 850.902 1010.65 860.6141010.673 870.3251010.538
880.0361010.177
 889.7471009.692 899.4591009.183  909.171008.484 918.881 1007.47
928.5891006.519
   938.31005.797 948.0121005.187 957.7231004.583 967.4341004.068
977.1461003.484
 986.8571002.782 996.5681001.9981006.2791001.4861015.9911001.3191025.702
1001.04
1035.4131000.4791045.1251000.1611054.8331000.3311064.5441000.6531074.2551000.7
78
1083.9671000.6661093.6251000.0891103.2811002.018
1112.941010.6531122.5951016.243
1132.2541020.9061141.9091026.9551151.5681032.0471161.2241036.6311170.8831041.2
99
1180.5411047.546

Manning's n Values         num=        8
     Sta    n Val      Sta    n Val      Sta    n Val      Sta    n Val      Sta    n
```

```
Val
 373.707     .07 432.713    .035   603.4    .013   632.1     .07  648.01
.055
  677.25     .07   698.6    .0451093.625     .07

Bank Sta: Left   Right    Coeff Contr.   Expan.
        648.01  677.25             .3       .5
Right Levee     Station=   698.6      Elevation=    1011

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1095

INPUT
Description: 12 feet downstream of Sheely Rd bridge
Station Elevation Data    num=      96
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 373.7071047.096  383.54 1042.52 393.3761038.337 403.2091034.186
413.0451029.616
 422.8771025.259 432.7131020.285 442.5461017.421 452.3821017.014
462.2181016.463
 472.0511015.039 481.8861012.946 491.5941011.913 501.3061011.942
511.0171011.785
 520.7281011.499  530.441011.326 540.1511011.014 549.8621009.154
559.5731009.121
 569.2851009.964 578.9961009.639 588.7071009.459 598.4151009.455   603.4
1009
   632.1    1008   635.2    1007   640.2    1006   641.5    1005   642.8
1004
  644.05    1003  645.54    1002  648.01    1001   649.3    1000   673.6
1000
  677.25    1001  678.27    1002   679.3    1003  680.07    1004  681.42
1005
  683.06    1006  684.79    1007   686.5    1008  688.77    1009  691.48
1010
   698.6    1011   705.5    1010 714.9481010.151 724.659 1010.42
734.371010.797
 744.0811010.764 753.7931010.669 763.5041010.623 773.2151010.564
782.9271010.597
```

```
 792.6381010.699 802.3491010.748 812.0571010.676 821.7681010.564
831.481010.532
 841.1911010.548 850.902 1010.65 860.6141010.673 870.3251010.538
880.0361010.177
 889.7471009.692 899.4591009.183  909.171008.484 918.881 1007.47
928.5891006.519
   938.31005.797 948.0121005.187 957.7231004.583 967.4341004.068
977.1461003.484
 986.8571002.782 996.5681001.9981006.2791001.4861015.9911001.3191025.702
1001.04
1035.4131000.4791045.1251000.1611054.8331000.3311064.5441000.6531074.2551000.7
78
1083.9671000.6661093.6251000.0891103.2811002.018
1112.941010.6531122.5951016.243
1132.2541020.9061141.9091026.9551151.5681032.0471161.2241036.6311170.8831041.2
99
1180.5411047.546

Manning's n Values        num=        8
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 373.707     .07 432.713    .035   603.4    .013   632.1     .07  648.01
.055
  677.25     .07   698.6    .0451093.625     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        648.01  677.25               20      20      20             .3
.5
Right Levee     Station=   698.6      Elevation=    1011

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1075

INPUT
Description:
Station Elevation Data    num=       99
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
 373.7071047.096  383.54 1042.52 393.3761038.337 403.2091034.186
413.0451029.616
 422.8771025.259 432.7131020.285 442.5461017.421 452.3821017.014
462.2181016.463
 472.0511015.039 481.8861012.946 491.5941011.913 501.3061011.942
511.0171011.785
 520.7281011.499  530.441011.326 540.1511011.014 549.8621009.154
559.5731009.121
 569.2851009.964 578.9961009.639 588.7071009.459 598.4151009.455   603.4
1009
   620.5 1008.47   627.8 1008.85   630.7 1008.67   632.1    1008   635.2
1007
   640.2    1006   641.5    1005   642.8    1004  644.05    1003  645.54
1002
  648.01    1001   649.3    1000   673.6    1000  677.25    1001  679.11
1002
  680.89    1003  682.82    1004  684.49    1005  686.32    1006  688.22
1007
  689.99    1008  691.76    1009   693.5    1010   698.6    1011   705.5
1010
 714.9481010.151 724.659 1010.42  734.371010.797 744.0811010.764
753.7931010.669
 763.5041010.623 773.2151010.564 782.9271010.597 792.6381010.699
802.3491010.748
```

```
 812.0571010.676 821.7681010.564  831.481010.532 841.1911010.548 850.902
1010.65
 860.6141010.673 870.3251010.538 880.0361010.177 889.7471009.692
899.4591009.183
  909.171008.484 918.881 1007.47 928.5891006.519   938.31005.797
948.0121005.187
 957.7231004.583 967.4341004.068 977.1461003.484 986.8571002.782
996.5681001.998
1006.2791001.4861015.9911001.3191025.702
1001.041035.4131000.4791045.1251000.161
1054.8331000.3311064.5441000.6531074.2551000.7781083.9671000.6661093.6251000.0
89
1103.2811002.018
1112.941010.6531122.5951016.2431132.2541020.9061141.9091026.955
1151.5681032.0471161.2241036.6311170.8831041.2991180.5411047.546

Manning's n Values        num=       8
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n
Val
 373.707     .07 442.546    .035   603.4    .013   620.5     .07  648.01
.055
  677.25     .07   698.6    .0451093.625     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
        648.01  677.25               75      75      75             .1
.3
Right Levee     Station=   698.6      Elevation=    1011

CROSS SECTION


RIVER: Rondout Creek
REACH: East Branch        RS: 1000

INPUT
Description:
Station Elevation Data    num=      87
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta
Elev
  385.83 1048.74 395.4721046.057 405.1211042.884 414.7671039.347
424.4131035.617
 434.0581031.201 443.7041026.864  453.351023.281 462.9951017.881
472.6411016.542
 482.4251013.051 492.2081010.827 501.9951009.026 511.7781006.594 521.562
1006.03
 531.3451007.057 541.1321007.014 550.9151007.051 560.6991007.254
570.4861006.716
 580.2691005.331 590.0521000.896     5921000.455 599.839 998.681 609.623
998.461
 619.406 999.321     6221000.005   623.91000.506  629.19  1001.9
638.9761005.013
  648.761006.604 658.5431007.044  668.331007.549 678.1141006.522 687.897
1006.27
 697.684 1006.44 707.467 1006.68 717.2511007.103 727.0341007.356
736.8211007.461
 746.6041007.536 756.3881007.782 766.1751008.071 775.9581008.248
785.7411008.258
 795.5281008.166 805.3121008.064 815.0951008.058 824.8791008.028
834.6651007.828
 844.4491007.526 854.232 1007.27 864.0191007.014 873.8021006.739
883.5861006.493
 893.3731006.289 903.1561006.076  912.941005.643 922.723 1004.36
932.511002.723
 942.2931001.631 952.0771001.293 961.8641001.119 971.6471000.709
981.431000.335
```

991.217 999.8651001.001 999.561010.784 999.4131020.571 999.2911030.354
998.947
1040.138 998.6841049.925 998.3961059.708 998.151069.491 998.0911079.278
998.176
1089.062 998.1661098.845 997.9721108.629
997.4771118.3461000.7321128.0611009.636
1137.7761017.388
1147.491023.4971157.2081028.6941166.9231034.0291176.6371039.239
1186.3521045.203 1196.071049.006

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
385.83	.07	592	.055	623.9	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
592	623.9	0	0	0	.1	.3

Right Levee Station= 668.33 Elevation= 1007.55

SUMMARY OF MANNING'S N VALUES

River:Rondout Creek

Reach	River Sta.	n1	n2	n3	n4	n5	n6	n7	n8	n9	n10	n11
East Branch	1800	.07	.06	.07								
East Branch	1725	.07	.035	.06	.045	.055	.013	.07				
East Branch	1700	.07	.035	.06	.055	.013	.07					
East Branch	1678	Bridge										
East Branch	1660	.07	.035	.03	.06	.013	.07					
East Branch	1650	.07	.035	.04	.06	.013	.07					
East Branch	1625	.07	.035	.05	.06	.07	.013	.07				
East Branch	1575	.07	.035	.07	.06	.065	.013	.07				
East Branch	1525	.07	.035	.07	.06	.065	.013	.07				
East Branch	1475	.07	.035	.07	.06	.065	.04	.013	.07			
East Branch	1425	.07	.035	.07	.05	.055	.06	.065	.04	.013	.07	
East Branch	1375	.07	.035	.07	.05	.055	.06	.04	.013	.07		
East Branch	1325	.07	.035	.07	.05	.055	.06	.055	.04	.1	.013	.07
East Branch	1275	.07	.035	.07	.05	.055	.06	.04	.1	.013	.07	
East Branch	1225	.07	.035	.07	.05	.055	.04	.1	.013	.07		
East Branch	1175	.07	.035	.07	.055	.04	.1	.13	.07			
East Branch	1150	.07	.035	.07	.055	.07	.04	.013	.07			

East Branch	1130		.07	.035	.07	.055
.03	.04	.013	.03	.07		
East Branch	1125		.07	.035	.055	.03
.04	.013	.03	.07			
East Branch	1114	Bridge				
East Branch	1095		.07	.035	.013	.07
.055	.07	.045	.07			
East Branch	1075		.07	.035	.013	.07
.055	.07	.045	.07			
East Branch	1000		.07	.055	.07	

SUMMARY OF REACH LENGTHS

River: Rondout Creek

Reach	River Sta.	Left	Channel	Right
East Branch	1800	75	75	75
East Branch	1725	25	25	25
East Branch	1700	40	40	40
East Branch	1678	Bridge		
East Branch	1660	10	10	10
East Branch	1650	25	25	25
East Branch	1625	50	50	50
East Branch	1575	50	50	50
East Branch	1525	50	50	50
East Branch	1475	50	50	50
East Branch	1425	50	50	50
East Branch	1375	50	50	50
East Branch	1325	50	50	50
East Branch	1275	50	50	50
East Branch	1225	50	50	50
East Branch	1175	25	25	25
East Branch	1150	20	20	20
East Branch	1130	5	5	5
East Branch	1125	30	30	30
East Branch	1114	Bridge		
East Branch	1095	20	20	20
East Branch	1075	75	75	75
East Branch	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Rondout Creek

Reach	River Sta.	Contr.	Expan.
East Branch	1800	.1	.3
East Branch	1725	.1	.3
East Branch	1700	.3	.5
East Branch	1678	Bridge	
East Branch	1660	.3	.5
East Branch	1650	.1	.3
East Branch	1625	.1	.3
East Branch	1575	.1	.3

East Branch	1525	.1	.3
East Branch	1475	.1	.3
East Branch	1425	.1	.3
East Branch	1375	.1	.3
East Branch	1325	.1	.3
East Branch	1275	.1	.3
East Branch	1225	.1	.3
East Branch	1175	.1	.3
East Branch	1150	.1	.3
East Branch	1130	.1	.3
East Branch	1125	.3	.5
East Branch	1114	Bridge	
East Branch	1095	.3	.5
East Branch	1075	.1	.3
East Branch	1000	.1	.3

HEC-RAS Plan: XC-17B   River: Rondout Creek   Reach: East Branch

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East Branch	1000	PK1.5(Bkfl)	682.00	998.46	1001.56	1001.56	1002.68	0.030745	8.55	82.68	39.31	0.96
East Branch	1000	PK2	834.00	998.46	1001.92	1001.92	1003.15	0.028435	9.02	97.32	41.47	0.95
East Branch	1000	PK5	1145.00	998.46	1002.55	1002.55	1004.01	0.026149	9.89	124.43	44.83	0.94
East Branch	1000	PK10	1348.00	998.46	1002.91	1002.91	1004.50	0.025328	10.40	140.93	46.76	0.94
East Branch	1000	PK20	1541.00	998.46	1003.24	1003.24	1004.94	0.024568	10.82	156.45	48.50	0.94
East Branch	1000	PK50	1795.00	998.46	1003.65	1003.65	1005.49	0.023574	11.29	176.84	50.70	0.93
East Branch	1000	PK100	1984.00	998.46	1003.92	1003.92	1005.86	0.023282	11.66	190.75	52.15	0.94
East Branch	1000	PK200	2175.00	998.46	1004.19	1004.19	1006.23	0.022886	11.99	204.99	53.59	0.94
East Branch	1000	PK500	2431.00	998.46	1004.55	1004.55	1006.70	0.022140	12.34	224.77	55.53	0.93
East Branch	1075	PK1.5(Bkfl)	682.00	1000.00	1003.45	1002.66	1004.09	0.012009	6.58	110.22	38.27	0.63
East Branch	1075	PK2	834.00	1000.00	1003.80	1003.02	1004.57	0.012668	7.21	123.78	39.38	0.66
East Branch	1075	PK5	1145.00	1000.00	1004.42	1003.67	1005.44	0.013750	8.33	148.91	41.27	0.71
East Branch	1075	PK10	1348.00	1000.00	1004.78	1004.06	1005.95	0.014359	8.98	163.82	42.33	0.73
East Branch	1075	PK20	1541.00	1000.00	1005.08	1004.40	1006.40	0.014984	9.56	176.80	43.24	0.75
East Branch	1075	PK50	1795.00	1000.00	1005.43	1004.83	1006.96	0.015902	10.31	192.21	44.34	0.79
East Branch	1075	PK100	1984.00	1000.00	1005.68	1005.14	1007.35	0.016489	10.82	203.30	45.12	0.81
East Branch	1075	PK200	2175.00	1000.00	1005.90	1005.43	1007.73	0.017190	11.34	213.48	45.82	0.83
East Branch	1075	PK500	2431.00	1000.00	1006.15	1005.81	1008.22	0.018430	12.07	225.06	47.18	0.86
East Branch	1095	PK1.5(Bkfl)	682.00	1000.00	1003.79	1002.66	1004.33	0.008750	5.99	120.38	36.85	0.55
East Branch	1095	PK2	834.00	1000.00	1004.17	1003.02	1004.82	0.009348	6.60	134.35	37.72	0.58
East Branch	1095	PK5	1145.00	1000.00	1004.85	1003.68	1005.72	0.010242	7.66	160.72	39.53	0.62
East Branch	1095	PK10	1348.00	1000.00	1005.24	1004.07	1006.25	0.010754	8.27	176.36	40.63	0.64
East Branch	1095	PK20	1541.00	1000.00	1005.58	1004.42	1006.72	0.011195	8.81	190.42	41.64	0.66
East Branch	1095	PK50	1795.00	1000.00	1006.00	1004.87	1007.30	0.011703	9.46	208.08	42.87	0.69
East Branch	1095	PK100	1984.00	1000.00	1006.30	1005.19	1007.71	0.011961	9.89	221.35	44.91	0.70
East Branch	1095	PK200	2175.00	1000.00	1006.59	1005.47	1008.11	0.012257	10.31	234.26	46.80	0.71
East Branch	1095	PK500	2431.00	1000.00	1006.99	1005.88	1008.63	0.012329	10.76	253.51	49.49	0.72
East Branch	1114		Bridge									
East Branch	1125	PK1.5(Bkfl)	682.00	1001.00	1004.76	1003.76	1005.44	0.014295	6.64	102.64	28.20	0.61
East Branch	1125	PK2	834.00	1001.00	1005.24	1004.12	1006.04	0.014639	7.17	116.25	28.20	0.62
East Branch	1125	PK5	1145.00	1001.00	1006.13	1004.82	1007.15	0.015401	8.11	141.18	28.20	0.64
East Branch	1125	PK10	1348.00	1001.00	1006.65	1005.26	1007.81	0.015882	8.64	155.98	28.20	0.65
East Branch	1125	PK20	1541.00	1001.00	1007.14	1005.65	1008.42	0.016195	9.08	169.72	28.20	0.65
East Branch	1125	PK50	1795.00	1001.00	1007.74	1006.14	1009.17	0.016664	9.62	186.62	28.20	0.66
East Branch	1125	PK100	1984.00	1001.00	1008.17	1006.48	1009.72	0.016941	9.98	198.87	28.20	0.66
East Branch	1125	PK200	2175.00	1001.00	1008.58	1006.83	1010.24	0.017313	10.34	210.41	28.20	0.67
East Branch	1125	PK500	2431.00	1001.00	1009.11	1007.26	1010.92	0.017802	10.79	225.27	28.20	0.67

HEC-RAS Plan: XC-17B River: Rondout Creek Reach: East Branch (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East Branch	1130	PK1.5(Bkfl)	682.00	1001.00	1004.77	1004.02	1005.55	0.015831	7.25	98.48	30.33	0.67
East Branch	1130	PK2	834.00	1001.00	1005.26	1004.40	1006.14	0.015463	7.71	113.50	30.78	0.67
East Branch	1130	PK5	1145.00	1001.00	1006.18	1005.13	1007.23	0.014909	8.49	142.09	31.82	0.67
East Branch	1130	PK10	1348.00	1001.00	1006.73	1005.56	1007.89	0.014622	8.91	160.14	33.39	0.67
East Branch	1130	PK20	1541.00	1001.00	1007.28	1005.93	1008.50	0.013951	9.16	179.04	34.81	0.65
East Branch	1130	PK50	1795.00	1001.00	1007.98	1006.42	1009.26	0.013188	9.43	203.95	36.40	0.64
East Branch	1130	PK100	1984.00	1001.00	1008.50	1006.79	1009.81	0.012576	9.57	223.15	37.17	0.62
East Branch	1130	PK200	2175.00	1001.00	1009.00	1007.13	1010.35	0.012099	9.71	241.95	38.91	0.61
East Branch	1130	PK500	2431.00	1001.00	1009.66	1007.57	1011.03	0.011249	9.87	268.06	41.13	0.60
East Branch	1150	PK1.5(Bkfl)	682.00	1001.00	1005.11	1004.30	1005.83	0.012153	7.03	105.29	33.49	0.65
East Branch	1150	PK2	834.00	1001.00	1005.61	1004.69	1006.41	0.011572	7.47	122.09	34.34	0.65
East Branch	1150	PK5	1145.00	1001.00	1006.55	1005.37	1007.49	0.010575	8.18	155.30	37.12	0.64
East Branch	1150	PK10	1348.00	1001.00	1007.12	1005.79	1008.14	0.010007	8.54	177.10	39.25	0.63
East Branch	1150	PK20	1541.00	1001.00	1007.67	1006.17	1008.74	0.009316	8.77	199.34	41.06	0.62
East Branch	1150	PK50	1795.00	1001.00	1008.37	1006.65	1009.49	0.008536	9.02	228.87	43.05	0.61
East Branch	1150	PK100	1984.00	1001.00	1008.89	1006.99	1010.03	0.007975	9.15	251.52	44.33	0.59
East Branch	1150	PK200	2175.00	1001.00	1009.39	1007.30	1010.55	0.007507	9.27	274.06	45.42	0.58
East Branch	1150	PK500	2431.00	1001.00	1010.04	1007.74	1011.23	0.006972	9.42	304.17	49.76	0.57
East Branch	1175	PK1.5(Bkfl)	682.00	1001.00	1005.72	1003.87	1006.04	0.004145	4.68	155.66	42.08	0.39
East Branch	1175	PK2	834.00	1001.00	1006.26	1004.21	1006.62	0.004077	5.01	178.69	43.51	0.40
East Branch	1175	PK5	1145.00	1001.00	1007.27	1004.82	1007.70	0.003897	5.54	223.91	47.18	0.40
East Branch	1175	PK10	1348.00	1001.00	1007.87	1005.20	1008.34	0.003769	5.81	253.77	51.29	0.40
East Branch	1175	PK20	1541.00	1001.00	1008.44	1005.53	1008.94	0.003602	6.00	283.69	53.77	0.40
East Branch	1175	PK50	1795.00	1001.00	1009.15	1005.93	1009.68	0.003396	6.21	322.93	56.37	0.39
East Branch	1175	PK100	1984.00	1001.00	1009.67	1006.24	1010.21	0.003240	6.32	352.66	58.23	0.39
East Branch	1175	PK200	2175.00	1001.00	1010.18	1006.51	1010.73	0.003102	6.43	382.42	59.76	0.38
East Branch	1175	PK500	2431.00	1001.00	1010.83	1006.87	1011.40	0.002935	6.56	421.80	61.06	0.37
East Branch	1225	PK1.5(Bkfl)	682.00	1002.00	1005.56	1005.46	1006.74	0.030464	8.70	78.43	29.82	0.94
East Branch	1225	PK2	834.00	1002.00	1006.09	1005.85	1007.30	0.026272	8.83	94.51	31.55	0.89
East Branch	1225	PK5	1145.00	1002.00	1007.03	1006.55	1008.34	0.019988	9.22	125.44	34.43	0.82
East Branch	1225	PK10	1348.00	1002.00	1007.60	1006.95	1008.97	0.017456	9.43	145.65	36.28	0.78
East Branch	1225	PK20	1541.00	1002.00	1008.14	1007.36	1009.53	0.015388	9.54	165.85	38.11	0.75
East Branch	1225	PK50	1795.00	1002.00	1008.83	1007.84	1010.24	0.013275	9.65	193.11	40.72	0.71
East Branch	1225	PK100	1984.00	1002.00	1009.34	1008.18	1010.75	0.011922	9.68	214.60	43.45	0.68
East Branch	1225	PK200	2175.00	1002.00	1009.85	1008.51	1011.25	0.010788	9.69	237.20	46.50	0.66
East Branch	1225	PK500	2431.00	1002.00	1010.51	1008.92	1011.88	0.009480	9.67	268.94	49.29	0.62

HEC-RAS Plan: XC-17B   River: Rondout Creek   Reach: East Branch (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East Branch	1275	PK1.5(Bkfl)	682.00	1003.00	1007.20	1006.57	1007.96	0.018991	7.00	97.46	33.50	0.71
East Branch	1275	PK2	834.00	1003.00	1007.55	1006.93	1008.46	0.019723	7.67	109.16	34.89	0.74
East Branch	1275	PK5	1145.00	1003.00	1008.17		1009.37	0.020624	8.80	131.84	37.51	0.78
East Branch	1275	PK10	1348.00	1003.00	1008.58		1009.91	0.020343	9.33	147.38	39.32	0.79
East Branch	1275	PK20	1541.00	1003.00	1008.98		1010.41	0.019442	9.68	163.56	41.12	0.78
East Branch	1275	PK50	1795.00	1003.00	1009.54		1011.03	0.017613	9.92	187.10	42.68	0.76
East Branch	1275	PK100	1984.00	1003.00	1009.97		1011.47	0.016224	10.02	205.52	43.83	0.74
East Branch	1275	PK200	2175.00	1003.00	1010.40		1011.91	0.014928	10.09	224.74	45.94	0.72
East Branch	1275	PK500	2431.00	1003.00	1010.97		1012.48	0.013364	10.13	251.90	48.87	0.69
East Branch	1325	PK1.5(Bkfl)	682.00	1005.00	1008.22	1007.86	1009.13	0.026807	7.64	89.34	33.04	0.81
East Branch	1325	PK2	834.00	1005.00	1008.58	1008.20	1009.64	0.026537	8.25	101.47	34.09	0.82
East Branch	1325	PK5	1145.00	1005.00	1009.23	1008.89	1010.58	0.026404	9.33	124.24	36.93	0.85
East Branch	1325	PK10	1348.00	1005.00	1009.60	1009.32	1011.12	0.026396	9.94	138.51	39.58	0.86
East Branch	1325	PK20	1541.00	1005.00	1009.94	1009.70	1011.60	0.026260	10.44	152.10	41.95	0.87
East Branch	1325	PK50	1795.00	1005.00	1010.36	1010.20	1012.18	0.025616	10.96	170.41	43.85	0.87
East Branch	1325	PK100	1984.00	1005.00	1010.69	1010.54	1012.58	0.024730	11.23	184.76	45.14	0.87
East Branch	1325	PK200	2175.00	1005.00	1011.02	1010.84	1012.97	0.023590	11.43	200.01	46.52	0.86
East Branch	1325	PK500	2431.00	1005.00	1011.48	1011.23	1013.46	0.021672	11.56	222.47	49.69	0.83
East Branch	1375	PK1.5(Bkfl)	682.00	1006.00	1009.55		1010.19	0.016476	6.43	106.32	36.86	0.66
East Branch	1375	PK2	834.00	1006.00	1009.95		1010.69	0.016153	6.93	121.21	37.78	0.66
East Branch	1375	PK5	1145.00	1006.00	1010.69		1011.61	0.015566	7.76	149.62	39.06	0.67
East Branch	1375	PK10	1348.00	1006.00	1011.12		1012.16	0.015371	8.24	166.59	40.36	0.68
East Branch	1375	PK20	1541.00	1006.00	1011.49		1012.64	0.015303	8.66	182.13	42.82	0.69
East Branch	1375	PK50	1795.00	1006.00	1011.92	1010.88	1013.21	0.015520	9.22	201.03	45.64	0.70
East Branch	1375	PK100	1984.00	1006.00	1012.20	1011.20	1013.60	0.015771	9.62	214.16	46.76	0.71
East Branch	1375	PK200	2175.00	1006.00	1012.46	1011.52	1013.98	0.016112	10.02	226.37	47.48	0.73
East Branch	1375	PK500	2431.00	1006.00	1012.76	1011.94	1014.44	0.016797	10.58	240.77	48.32	0.75
East Branch	1425	PK1.5(Bkfl)	682.00	1007.00	1010.39	1010.18	1011.42	0.032022	8.16	83.54	32.55	0.90
East Branch	1425	PK2	834.00	1007.00	1010.74	1010.56	1011.93	0.032422	8.75	95.30	33.68	0.92
East Branch	1425	PK5	1145.00	1007.00	1011.38	1011.22	1012.86	0.031936	9.79	117.28	36.34	0.94
East Branch	1425	PK10	1348.00	1007.00	1011.74	1011.64	1013.41	0.031284	10.37	130.97	38.14	0.94
East Branch	1425	PK20	1541.00	1007.00	1012.07	1012.01	1013.90	0.030822	10.88	143.59	39.89	0.95
East Branch	1425	PK50	1795.00	1007.00	1012.49	1012.49	1014.48	0.029620	11.39	161.19	43.03	0.95
East Branch	1425	PK100	1984.00	1007.00	1012.82	1012.82	1014.89	0.028283	11.66	175.52	45.43	0.94
East Branch	1425	PK200	2175.00	1007.00	1013.14	1013.14	1015.27	0.026822	11.86	190.70	47.15	0.92
East Branch	1425	PK500	2431.00	1007.00	1013.51	1013.51	1015.76	0.025974	12.22	208.25	48.07	0.92
East Branch	1475	PK1.5(Bkfl)	682.00	1008.00	1012.00	1011.42	1012.76	0.021785	7.02	97.19	34.88	0.74

HEC-RAS Plan: XC-17B River: Rondout Creek Reach: East Branch (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East Branch	1475	PK2	834.00	1008.00	1012.38	1011.79	1013.26	0.021232	7.54	110.67	35.69	0.75
East Branch	1475	PK5	1145.00	1008.00	1013.05	1012.44	1014.18	0.020982	8.53	135.16	37.18	0.77
East Branch	1475	PK10	1348.00	1008.00	1013.44	1012.80	1014.72	0.021024	9.10	149.80	38.57	0.78
East Branch	1475	PK20	1541.00	1008.00	1013.78	1013.16	1015.20	0.021075	9.60	163.20	39.80	0.79
East Branch	1475	PK50	1795.00	1008.00	1014.16	1013.61	1015.78	0.021712	10.27	178.63	41.35	0.81
East Branch	1475	PK100	1984.00	1008.00	1014.39	1013.91	1016.18	0.022694	10.82	188.16	42.42	0.84
East Branch	1475	PK200	2175.00	1008.00	1014.55	1014.23	1016.57	0.024510	11.48	195.05	43.17	0.88
East Branch	1475	PK500	2431.00	1008.00	1014.79	1014.63	1017.07	0.026174	12.22	205.72	44.32	0.91
East Branch	1525	PK1.5(Bkfl)	682.00	1010.00	1013.18		1014.04	0.028910	7.45	91.55	37.17	0.84
East Branch	1525	PK2	834.00	1010.00	1013.53		1014.51	0.028448	7.95	104.89	37.92	0.84
East Branch	1525	PK5	1145.00	1010.00	1014.19	1013.81	1015.39	0.027228	8.79	130.31	39.32	0.85
East Branch	1525	PK10	1348.00	1010.00	1014.57	1014.17	1015.91	0.026377	9.29	145.37	40.15	0.85
East Branch	1525	PK20	1541.00	1010.00	1014.91	1014.50	1016.38	0.025770	9.73	159.07	40.89	0.85
East Branch	1525	PK50	1795.00	1010.00	1015.32	1014.89	1016.95	0.025228	10.27	176.18	41.84	0.86
East Branch	1525	PK100	1984.00	1010.00	1015.64	1015.18	1017.37	0.024478	10.59	189.49	42.56	0.85
East Branch	1525	PK200	2175.00	1010.00	1015.98	1015.48	1017.78	0.023269	10.81	204.19	43.35	0.84
East Branch	1525	PK500	2431.00	1010.00	1016.42	1015.84	1018.31	0.021938	11.09	223.50	44.32	0.83
East Branch	1575	PK1.5(Bkfl)	682.00	1011.00	1014.55	1013.93	1015.25	0.020226	6.75	101.09	36.54	0.71
East Branch	1575	PK2	834.00	1011.00	1014.92		1015.74	0.020716	7.26	114.83	37.65	0.73
East Branch	1575	PK5	1145.00	1011.00	1015.54		1016.60	0.021186	8.27	138.75	39.46	0.76
East Branch	1575	PK10	1348.00	1011.00	1015.89		1017.11	0.021551	8.87	152.84	40.48	0.78
East Branch	1575	PK20	1541.00	1011.00	1016.21		1017.57	0.021787	9.39	165.78	41.42	0.80
East Branch	1575	PK50	1795.00	1011.00	1016.60		1018.14	0.022004	10.00	182.25	42.59	0.81
East Branch	1575	PK100	1984.00	1011.00	1016.86	1016.33	1018.54	0.022280	10.43	193.69	43.39	0.82
East Branch	1575	PK200	2175.00	1011.00	1017.12	1016.62	1018.93	0.022595	10.86	204.73	44.07	0.84
East Branch	1575	PK500	2431.00	1011.00	1017.48	1016.98	1019.44	0.022390	11.30	220.87	44.90	0.84
East Branch	1625	PK1.5(Bkfl)	682.00	1013.00	1015.72	1015.72	1016.78	0.042881	8.28	82.39	39.03	1.00
East Branch	1625	PK2	834.00	1013.00	1016.08	1016.04	1017.23	0.039517	8.62	96.74	40.37	0.98
East Branch	1625	PK5	1145.00	1013.00	1016.69	1016.62	1018.06	0.036591	9.40	121.86	41.78	0.97
East Branch	1625	PK10	1348.00	1013.00	1017.05	1016.97	1018.55	0.035236	9.82	137.31	42.62	0.96
East Branch	1625	PK20	1541.00	1013.00	1017.38	1017.27	1018.99	0.034190	10.18	151.44	43.34	0.96
East Branch	1625	PK50	1795.00	1013.00	1017.79	1017.67	1019.54	0.033080	10.60	169.39	44.24	0.95
East Branch	1625	PK100	1984.00	1013.00	1018.08	1017.92	1019.92	0.032289	10.89	182.14	44.90	0.95
East Branch	1625	PK200	2175.00	1013.00	1018.34	1018.17	1020.30	0.031481	11.22	194.07	45.59	0.95
East Branch	1625	PK500	2431.00	1013.00	1018.68	1018.52	1020.78	0.030524	11.62	209.80	46.48	0.95
East Branch	1650	PK1.5(Bkfl)	682.00	1014.00	1016.49	1016.75	1017.85	0.064064	9.34	73.03	39.36	1.21
East Branch	1650	PK2	834.00	1014.00	1016.78	1017.06	1018.29	0.061694	9.87	84.51	40.63	1.21

HEC-RAS Plan: XC-17B   River: Rondout Creek   Reach: East Branch (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East Branch	1650	PK5	1145.00	1014.00	1017.29	1017.64	1019.11	0.058469	10.81	105.90	42.36	1.21
East Branch	1650	PK10	1348.00	1014.00	1017.59	1017.97	1019.60	0.057134	11.36	118.66	43.14	1.21
East Branch	1650	PK20	1541.00	1014.00	1017.86	1018.27	1020.03	0.056151	11.83	130.26	43.83	1.21
East Branch	1650	PK50	1795.00	1014.00	1018.19	1018.64	1020.57	0.054178	12.39	144.92	44.65	1.21
East Branch	1650	PK100	1984.00	1014.00	1018.43	1018.89	1020.96	0.052462	12.77	155.54	45.22	1.20
East Branch	1650	PK200	2175.00	1014.00	1018.66	1019.15	1021.33	0.050902	13.13	166.10	45.78	1.20
East Branch	1650	PK500	2431.00	1014.00	1018.96	1019.50	1021.81	0.048851	13.55	180.22	46.51	1.19
East Branch	1660	PK1.5(Bkfl)	682.00	1014.79	1017.44	1017.44	1018.46	0.041588	8.08	84.41	42.22	1.01
East Branch	1660	PK2	834.00	1014.79	1017.73	1017.73	1018.89	0.040096	8.62	96.75	42.63	1.01
East Branch	1660	PK5	1145.00	1014.79	1018.29	1018.29	1019.69	0.036769	9.49	120.69	43.52	1.00
East Branch	1660	PK10	1348.00	1014.79	1018.61	1018.61	1020.17	0.035694	10.04	134.51	44.09	1.00
East Branch	1660	PK20	1541.00	1014.79	1018.90	1018.90	1020.61	0.034448	10.48	147.63	44.62	1.00
East Branch	1660	PK50	1795.00	1014.79	1019.29	1019.29	1021.15	0.032446	10.93	165.28	45.59	0.99
East Branch	1660	PK100	1984.00	1014.79	1019.56	1019.56	1021.53	0.031603	11.28	177.41	46.30	0.99
East Branch	1660	PK200	2175.00	1014.79	1019.81	1019.81	1021.90	0.031045	11.64	189.05	46.98	0.99
East Branch	1660	PK500	2431.00	1014.79	1020.15	1020.15	1022.37	0.029894	12.01	205.32	47.90	0.98
East Branch	1678		Bridge									
East Branch	1700	PK1.5(Bkfl)	682.00	1016.05	1019.40	1018.54	1019.82	0.010338	5.22	131.69	50.40	0.56
East Branch	1700	PK2	834.00	1016.05	1019.72	1018.81	1020.22	0.010593	5.69	147.81	50.72	0.58
East Branch	1700	PK5	1145.00	1016.05	1020.26	1019.30	1020.93	0.011502	6.62	175.01	51.26	0.62
East Branch	1700	PK10	1348.00	1016.05	1020.59	1019.61	1021.36	0.011797	7.11	191.97	51.59	0.64
East Branch	1700	PK20	1541.00	1016.05	1020.90	1019.86	1021.77	0.011815	7.50	208.35	51.90	0.65
East Branch	1700	PK50	1795.00	1016.05	1019.28	1020.20	1022.48	0.083480	14.38	125.68	50.28	1.59
East Branch	1700	PK100	1984.00	1016.05	1019.43	1020.45	1022.92	0.084532	15.02	133.08	50.43	1.61
East Branch	1700	PK200	2175.00	1016.05	1019.58	1020.68	1023.34	0.085174	15.62	140.44	50.58	1.63
East Branch	1700	PK500	2431.00	1016.05	1019.77	1020.97	1023.90	0.085784	16.36	150.00	50.77	1.65
East Branch	1725	PK1.5(Bkfl)	682.00	1016.54	1019.37	1019.37	1020.57	0.033337	8.80	77.47	32.66	1.01
East Branch	1725	PK2	834.00	1016.54	1019.70	1019.72	1021.08	0.032432	9.42	88.58	33.11	1.01
East Branch	1725	PK5	1145.00	1016.54	1020.31	1020.37	1022.03	0.031703	10.52	108.84	33.92	1.03
East Branch	1725	PK10	1348.00	1016.54	1020.69	1020.76	1022.59	0.030614	11.05	121.99	34.43	1.03
East Branch	1725	PK20	1541.00	1016.54	1021.04	1021.13	1023.09	0.029720	11.50	134.03	34.90	1.03
East Branch	1725	PK50	1795.00	1016.54	1021.47	1021.57	1023.72	0.028732	12.02	149.30	35.48	1.03
East Branch	1725	PK100	1984.00	1016.54	1021.78	1021.87	1024.16	0.028097	12.38	160.30	35.89	1.03
East Branch	1725	PK200	2175.00	1016.54	1022.08	1022.17	1024.59	0.027519	12.71	171.16	36.29	1.03
East Branch	1725	PK500	2431.00	1016.54	1022.50	1022.58	1025.14	0.026404	13.05	186.32	36.85	1.02
East Branch	1800	PK1.5(Bkfl)	682.00	1019.05	1022.22	1022.19	1023.33	0.040745	8.45	80.73	35.77	0.99

HEC-RAS Plan: XC-17B   River: Rondout Creek   Reach: East Branch (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
East Branch	1800	PK2	834.00	1019.05	1022.56	1022.56	1023.81	0.040843	8.97	93.02	37.71	1.01
East Branch	1800	PK5	1145.00	1019.05	1023.16	1023.18	1024.66	0.038601	9.84	116.52	40.24	1.01
East Branch	1800	PK10	1348.00	1019.05	1023.46	1023.51	1025.17	0.038603	10.50	128.87	41.17	1.02
East Branch	1800	PK20	1541.00	1019.05	1023.73	1023.85	1025.63	0.038606	11.08	140.14	42.01	1.04
East Branch	1800	PK50	1795.00	1019.05	1024.07	1024.25	1026.21	0.038611	11.77	154.38	43.04	1.05
East Branch	1800	PK100	1984.00	1019.05	1024.30	1024.51	1026.62	0.038617	12.24	164.61	43.76	1.06
East Branch	1800	PK200	2175.00	1019.05	1024.53	1024.79	1027.02	0.038621	12.69	174.68	44.46	1.07
East Branch	1800	PK500	2431.00	1019.05	1024.82	1025.16	1027.53	0.038628	13.26	187.80	45.36	1.09

APPENDIX E

SHEAR STRESS CALCULATIONS

Hydraulic Conditions in Study Reach
January, 2011

		Bankfull Discharge (682 cfs)	100-year Discharge (1,984 cfs)	
XS 15+25	Maximum Shear (lb-ft/s)[1]	5.7	8.6	
	Average Shear (lb-ft/s)[2]	4.3	6.3	RAS
	Average Velocity (ft/s)[2]	7.5	10.6	RAS
XS 12+25	Maximum Shear (lb-ft/s)[1]	6.8	5.5	
	Average Shear (lb-ft/s)[2]	4.8	3.4	
	Average Velocity (ft/s)[2]	8.7	9.7	

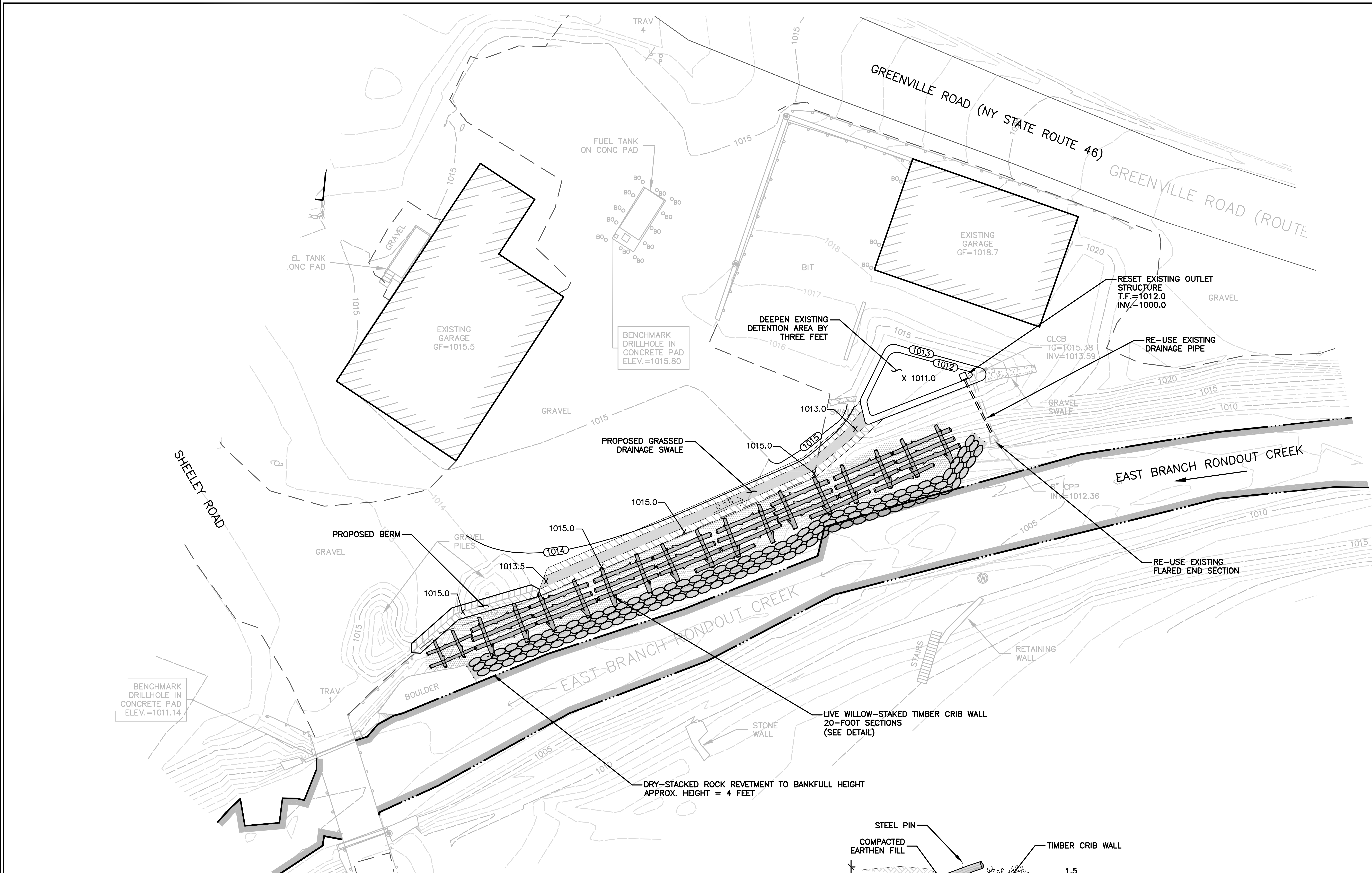
[1] Calculated with maximum depth and EGL slope
[2] RAS output

Critical Shear (Tc = 9*D50)	**3.2**	Johnson et al 1999
D50	0.358	ft
D50	109.0	mm (see Appendix B)

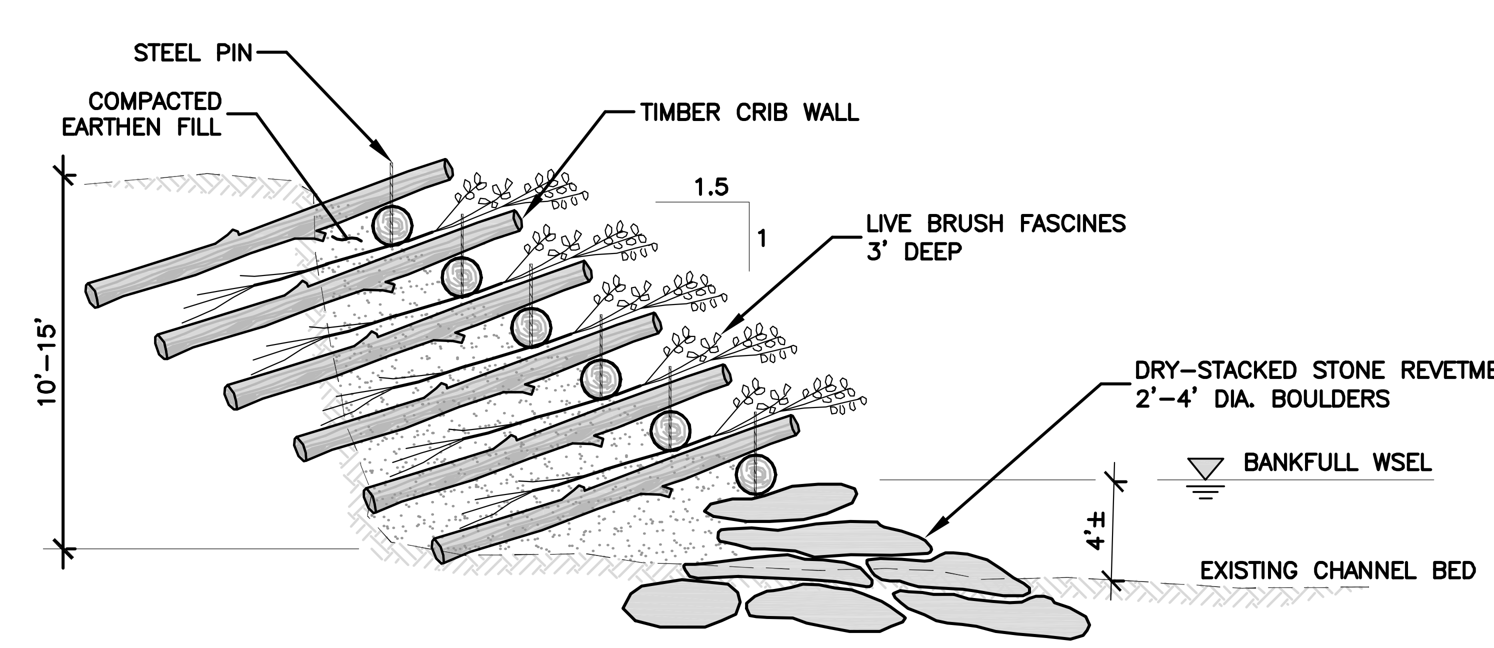
15+25	Tbf/Tc	1.321	"some particles move"
	T100/Tc	1.949	Johnson et al 1999
12+25	Tbf/Tc	1.479	
	T100/Tc	1.057	

APPENDIX F

CONCEPT DESIGN SKETCH



BANK STABILIZATION REPAIRS – PLAN VIEW
(SCALE: 1"=20')



BANK STABILIZATION REPAIRS – TYPICAL SECTION
N.T.S.

SCALE IN FEET
0' 10' 20'
SCALE 1" =20'

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PROPOSED BANK STABILIZATION - CONCEPTUAL DESIGN

EAST BRANCH RONDOUT CREEK
ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46)
DENNING, ULSTER COUNTY, NEW YORK

DESIGNED	DRAWN	CHECKED
JCM/JBH	JCM	JAG

SCALE: JAN. 25, 2011
DATE: FEB. 11, 2008
PROJECT NO. 3597-07
SHEET NO. **APP. F**

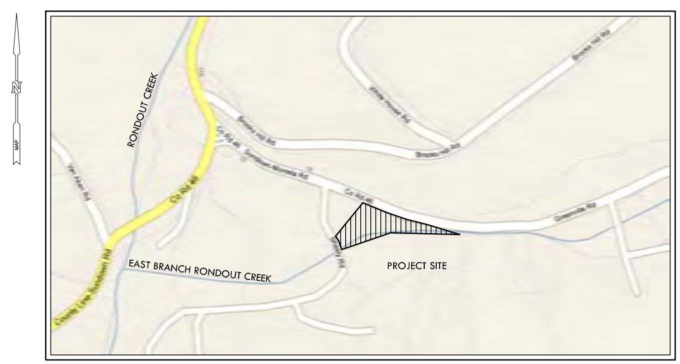
Appendix G

MMI Project Designs

BANK STABILIZATION
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE

GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
NEVERSINK, SULLIVAN COUNTY, NEW YORK

90% DESIGN
MAY 27, 2011



PROJECT SITE VICINITY MAP:
NOT TO SCALE

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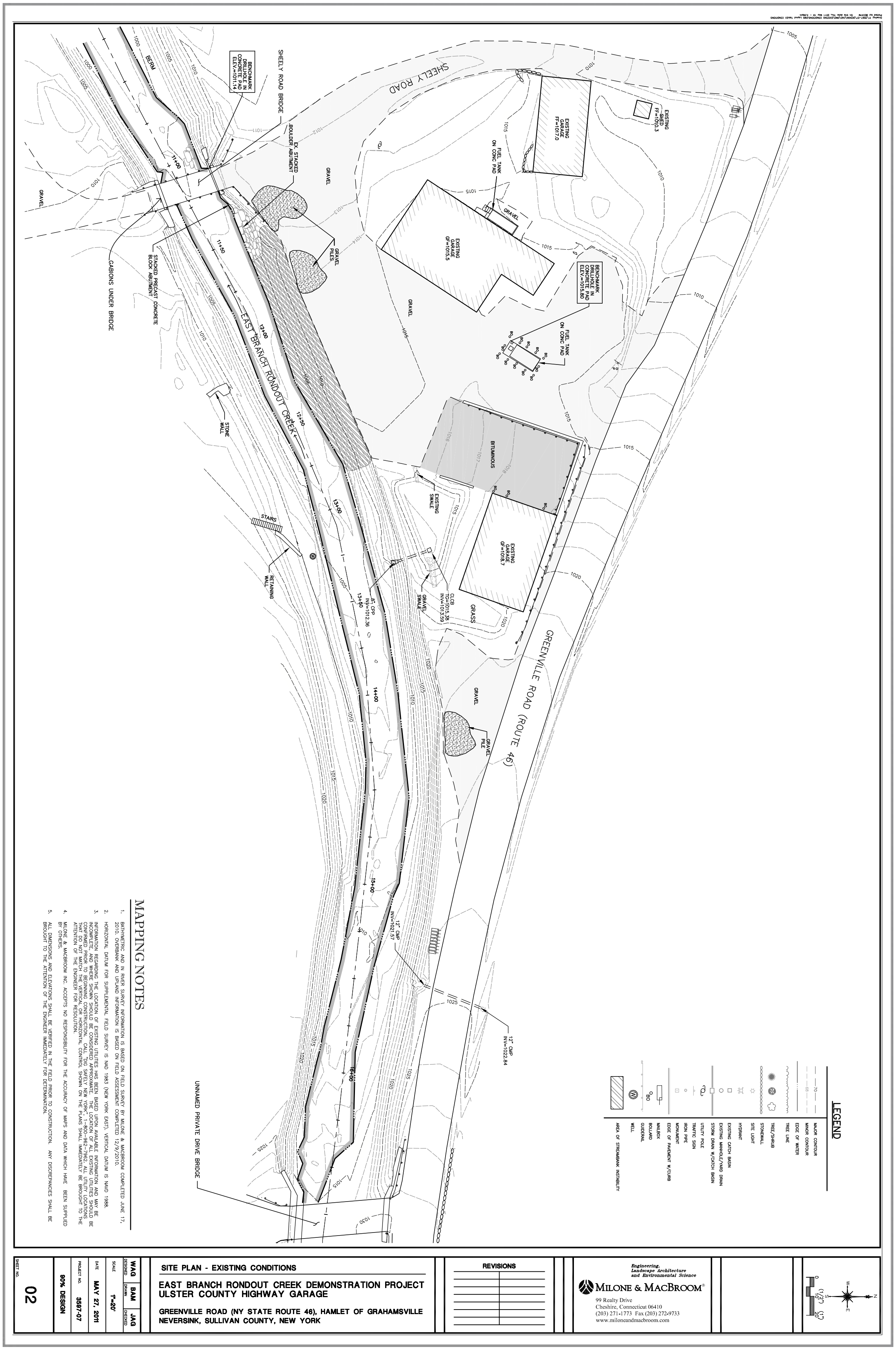
LIST OF DRAWINGS:

01 TITLE SHEET
02 GENERAL NOTES AND LEGEND
03 SITE PLAN - EXISTING CONDITIONS
04 SITE PLAN - GRADING & DRAINAGE
05 SITE PLAN - EROSION AND SEDIMENT CONTROL PLAN
06 SITE PLAN - PLANTING
07 STRUCTURAL IMPROVEMENTS - WALL PLAN & ELEVATION
08 PROPOSED SECTIONS
09 DETAILS


SITE PLAN - EXISTING CONDITIONS
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
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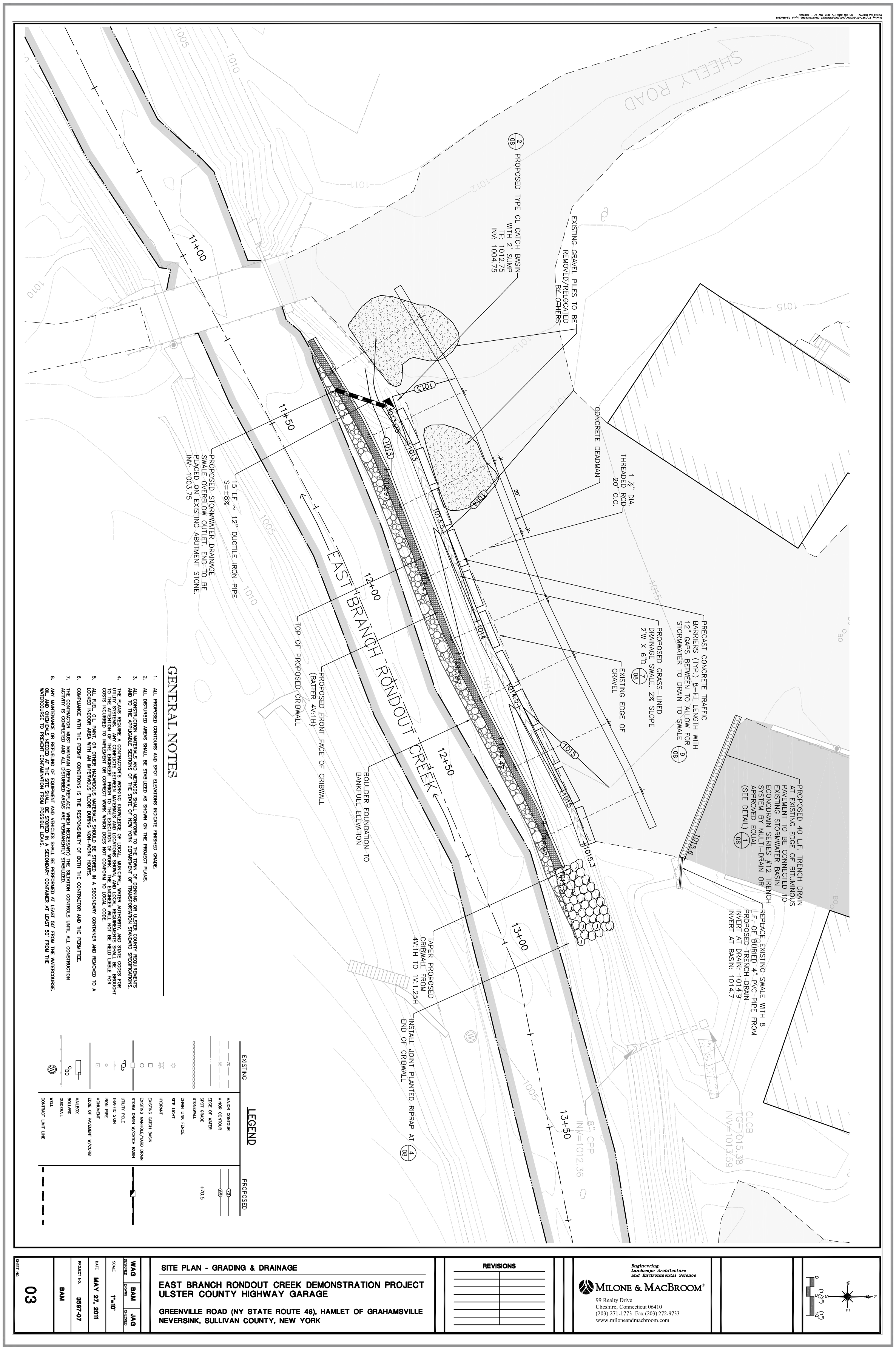
WAG
BAM
JAG
1"=20'
MAY 27, 2011
3587-07
90% DESIGN
02
MAPPING NOTES
LEGEND
SHEELY ROAD
GREENVILLE ROAD (ROUTE 46)
EAST BRANCH RONDOUT CREEK


SHEELY ROAD
EAST BRANCH RONDOUT CREEK
PROPOSED TYPE CL CATCH BASIN WITH 2' SUMP TF: 1012.75 INV: 1004.75
EXISTING GRAVEL PILES TO BE REMOVED/RELOCATED BY OTHERS
CONCRETE DEADMAN
1 ½" DIA. THREADED ROD 20' O.C.
PRECAST CONCRETE TRAFFIC BARRIERS (TYP.) 8-FT LENGTH WITH 12" GAPS BETWEEN TO ALLOW FOR STORMWATER TO DRAIN TO SWALE
PROPOSED GRASS-LINED DRAINAGE SWALE, 2% SLOPE 2'W X 6"D
EXISTING EDGE OF GRAVEL
15 LF ~ 12" DUCTILE IRON PIPE S=±8%
PROPOSED STORMWATER DRAINAGE SWALE OVERFLOW OUTLET, END TO BE PLACED ON EXISTING ABUTMENT STONE. INV: 1003.75
TOP OF PROPOSED CRIBWALL
PROPOSED FRONT FACE OF CRIBWALL (BATTER 4V:1H)
BOULDER FOUNDATION TO BANKFULL ELEVATION
TAPER PROPOSED CRIBWALL FROM 4V:1H TO 1V:1.25H
INSTALL JOINT PLANTED RIPRAP AT END OF CRIBWALL
REPLACE EXISTING SWALE WITH 8 L.F. OF BURIED 4" PVC PIPE FROM PROPOSED TRENCH DRAIN INVERT AT DRAIN: 1014.9 INVERT AT BASIN: 1014.7
8" CPP INV=1012.36
CLCB TG=1015.38 INV=1013.59
GENERAL NOTES
LEGEND
EXISTING
PROPOSED
SITE PLAN - GRADING & DRAINAGE
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
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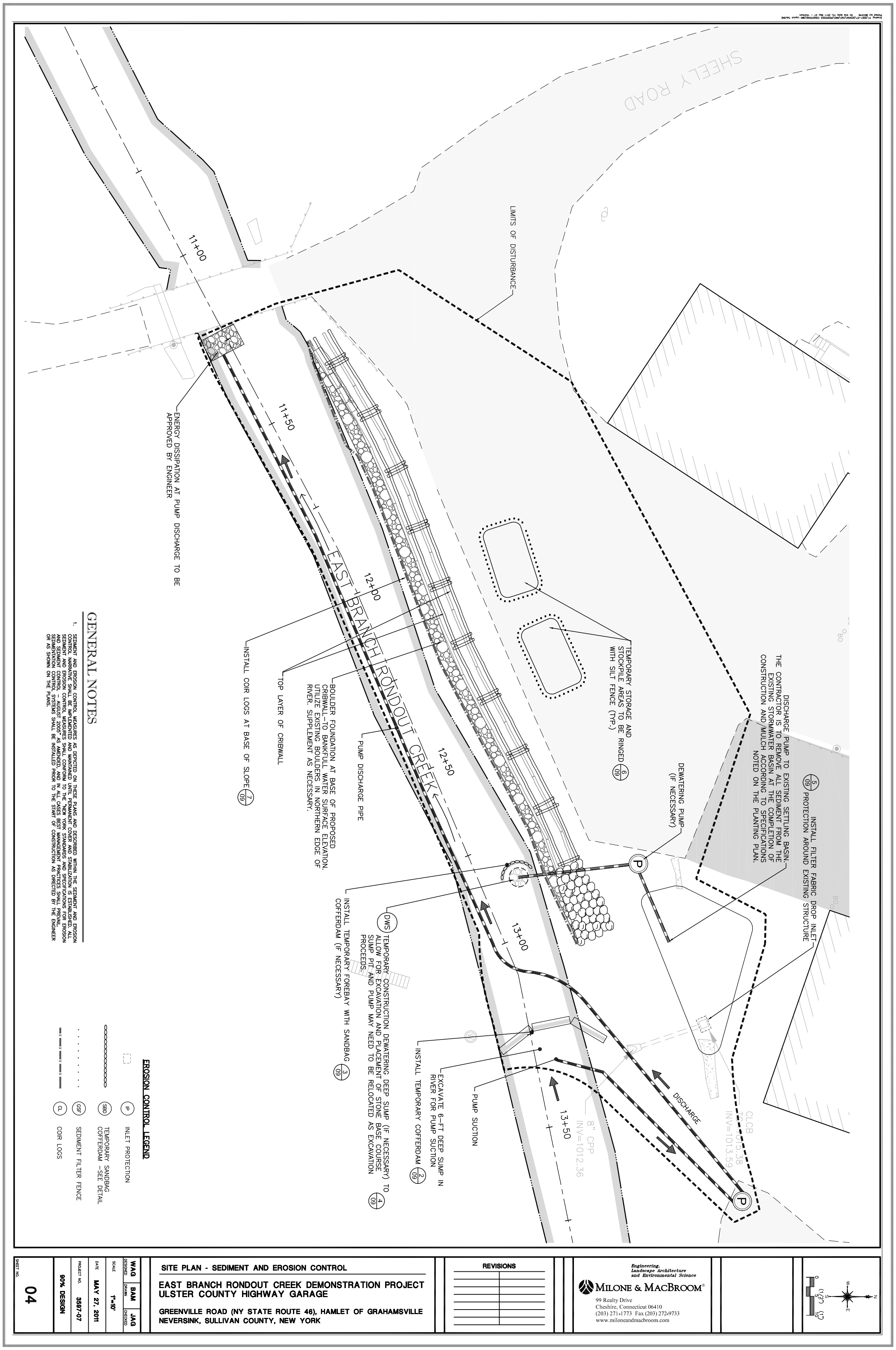
3597-07
1"=10'
03


SHEELY ROAD
LIMITS OF DISTURBANCE
11+00
11+50
12+00
12+50
13+00
13+50
EAST BRANCH RONDOUT CREEK
ENERGY DISSIPATION AT PUMP DISCHARGE TO BE APPROVED BY ENGINEER
INSTALL COIR LOGS AT BASE OF SLOPE
TOP LAYER OF CRIBWALL
BOULDER FOUNDATION AT BASE OF PROPOSED CRIBWALL—TO BANKFULL WATER SURFACE ELEVATION. UTILIZE EXISTING BOULDERS IN NORTHERN EDGE OF RIVER. SUPPLEMENT AS NECESSARY.
PUMP DISCHARGE PIPE
TEMPORARY STORAGE AND STOCKPILE AREAS TO BE RINGED WITH SILT FENCE (TYP.)
DEWATERING PUMP (IF NECESSARY)
DISCHARGE PUMP TO EXISTING SETTLING BASIN. THE CONTRACTOR IS TO REMOVE ALL SEDIMENT FROM THE EXISTING STORMWATER BASIN AT THE COMPLETION OF CONSTRUCTION AND MULCH ACCORDING TO SPECIFICATIONS NOTED ON THE PLANTING PLAN.
INSTALL FILTER FABRIC DROP INLET PROTECTION AROUND EXISTING STRUCTURE
TEMPORARY CONSTRUCTION DEWATERING DEEP SUMP (IF NECESSARY) TO ALLOW FOR EXCAVATION AND PLACEMENT OF STONE BASE COURSE. SUMP PIT AND PUMP MAY NEED TO BE RELOCATED AS EXCAVATION PROCEEDS.
INSTALL TEMPORARY FOREBAY WITH SANDBAG COFFERDAM (IF NECESSARY)
INSTALL TEMPORARY COFFERDAM
EXCAVATE 6-FT DEEP SUMP IN RIVER FOR PUMP SUCTION
PUMP SUCTION
DISCHARGE
8" CPP
INV=1012.36
CLCB
INV=1013.56
GENERAL NOTES
EROSION CONTROL LEGEND
INLET PROTECTION
TEMPORARY SANDBAG COFFERDAM - SEE DETAIL
SEDIMENT FILTER FENCE
COIR LOGS
SITE PLAN - SEDIMENT AND EROSION CONTROL
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
NEVERSINK, SULLIVAN COUNTY, NEW YORK
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BAM
JAG
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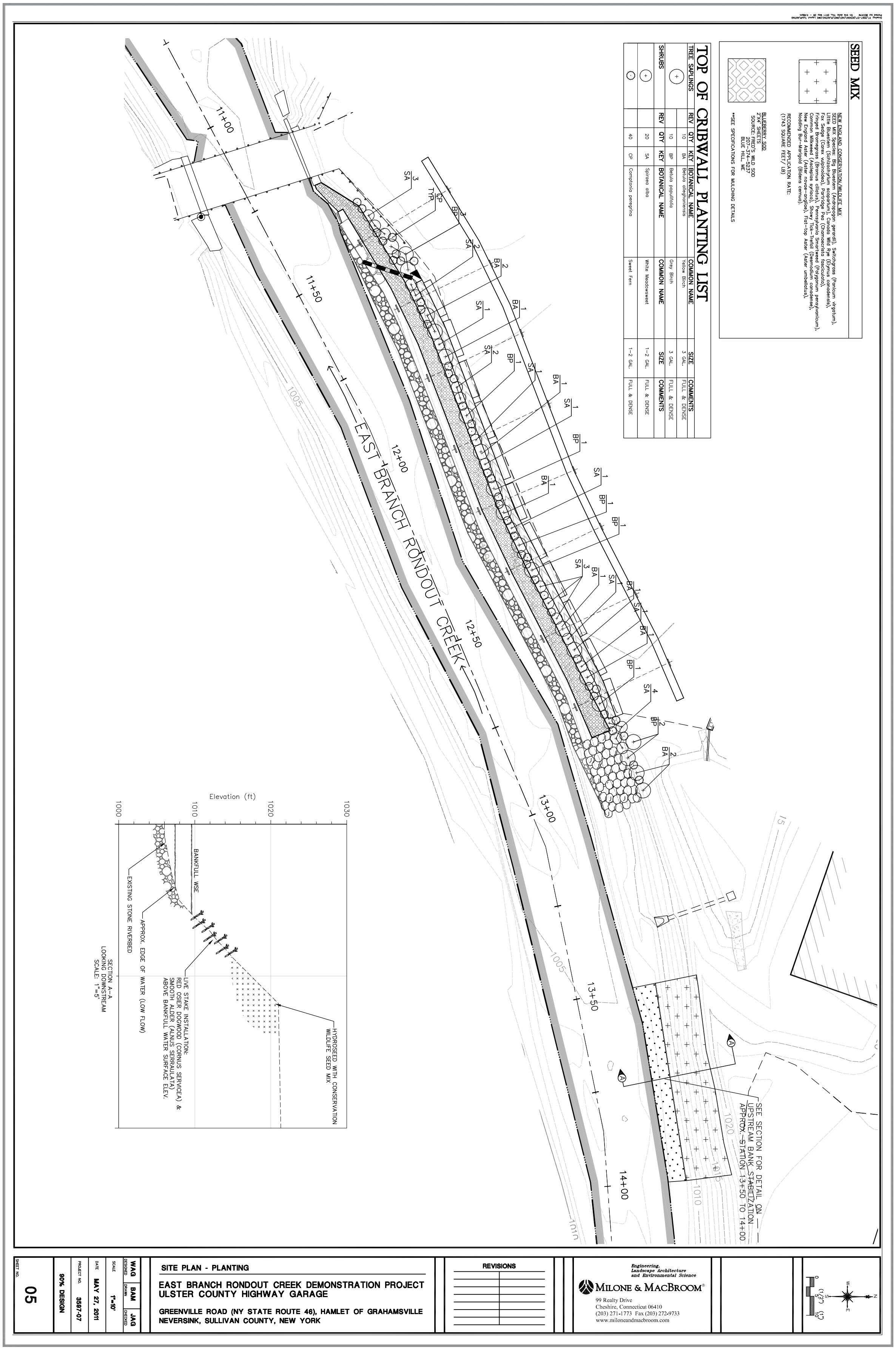
SEED MIX
TOP OF CRIBWALL PLANTING LIST
TREE SAPLINGS
REV QTY KEY BOTANICAL NAME COMMON NAME SIZE COMMENTS
10 BA Betula alleghaniensis Yellow Birch 3 GAL. FULL & DENSE
10 BP Betula populifolia Grey Birch 3 GAL. FULL & DENSE
SHRUBS
20 SA Spiraea alba White Meadowsweet 1-2 GAL. FULL & DENSE
40 CP Comptonia peregrina Sweet Fern 1-2 GAL. FULL & DENSE
EAST BRANCH RONDOUT CREEK
11+00
11+50
12+00
12+50
13+00
13+50
14+00
Elevation (ft)
BANKFULL WSE
EXISTING STONE RIVERBED
APPROX. EDGE OF WATER (LOW FLOW)
HYDROSEED WITH CONSERVATION WILDLIFE SEED MIX
SECTION A-A
LOOKING DOWNSTREAM
SEE SECTION FOR DETAIL ON UPSTREAM BANK STABILIZATION APPROX. STATION 13+50 TO 14+00
SITE PLAN - PLANTING
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE
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WAG BAM JAG
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1"=10'
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90% DESIGN
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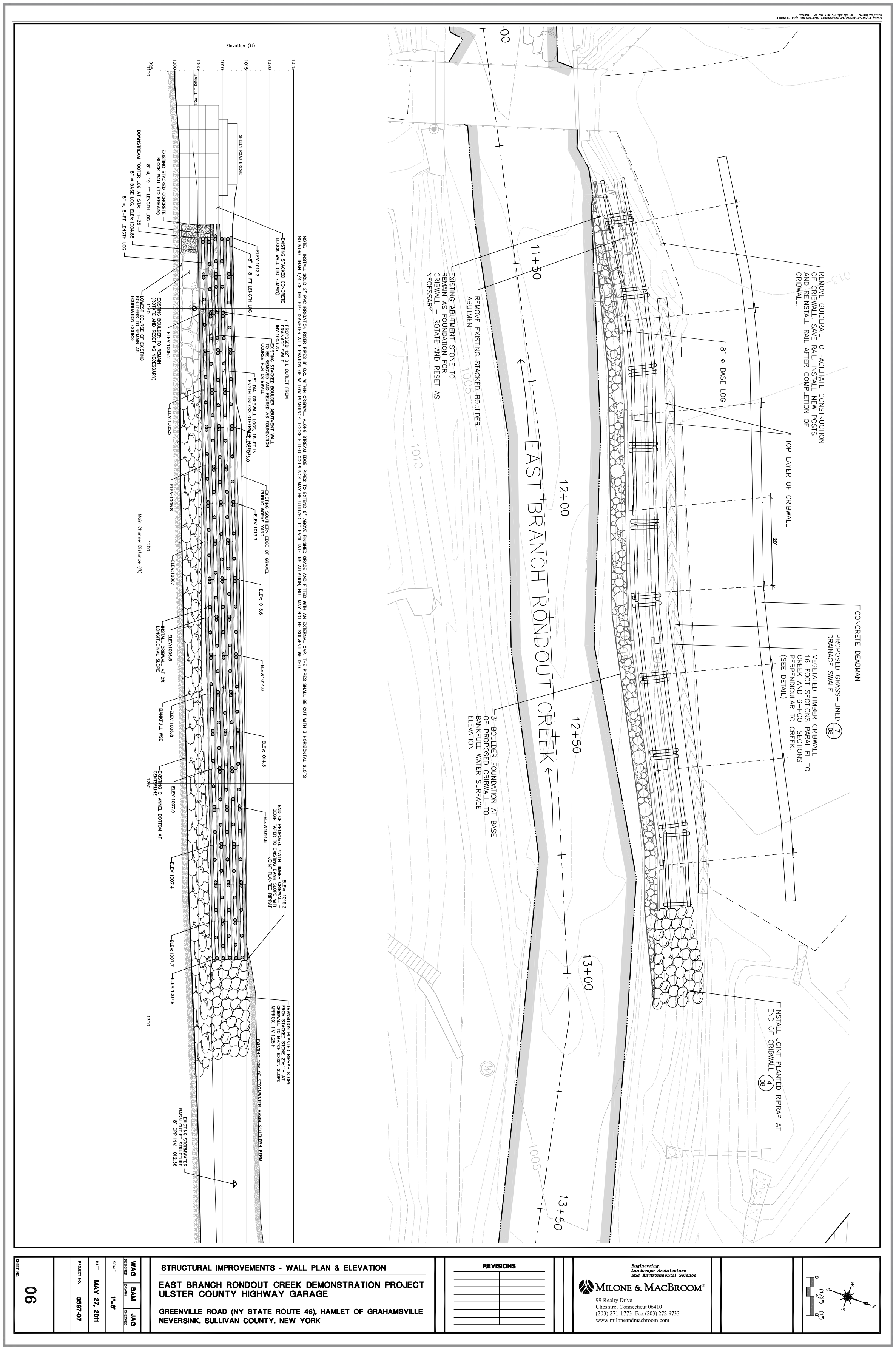
STRUCTURAL IMPROVEMENTS - WALL PLAN & ELEVATION
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
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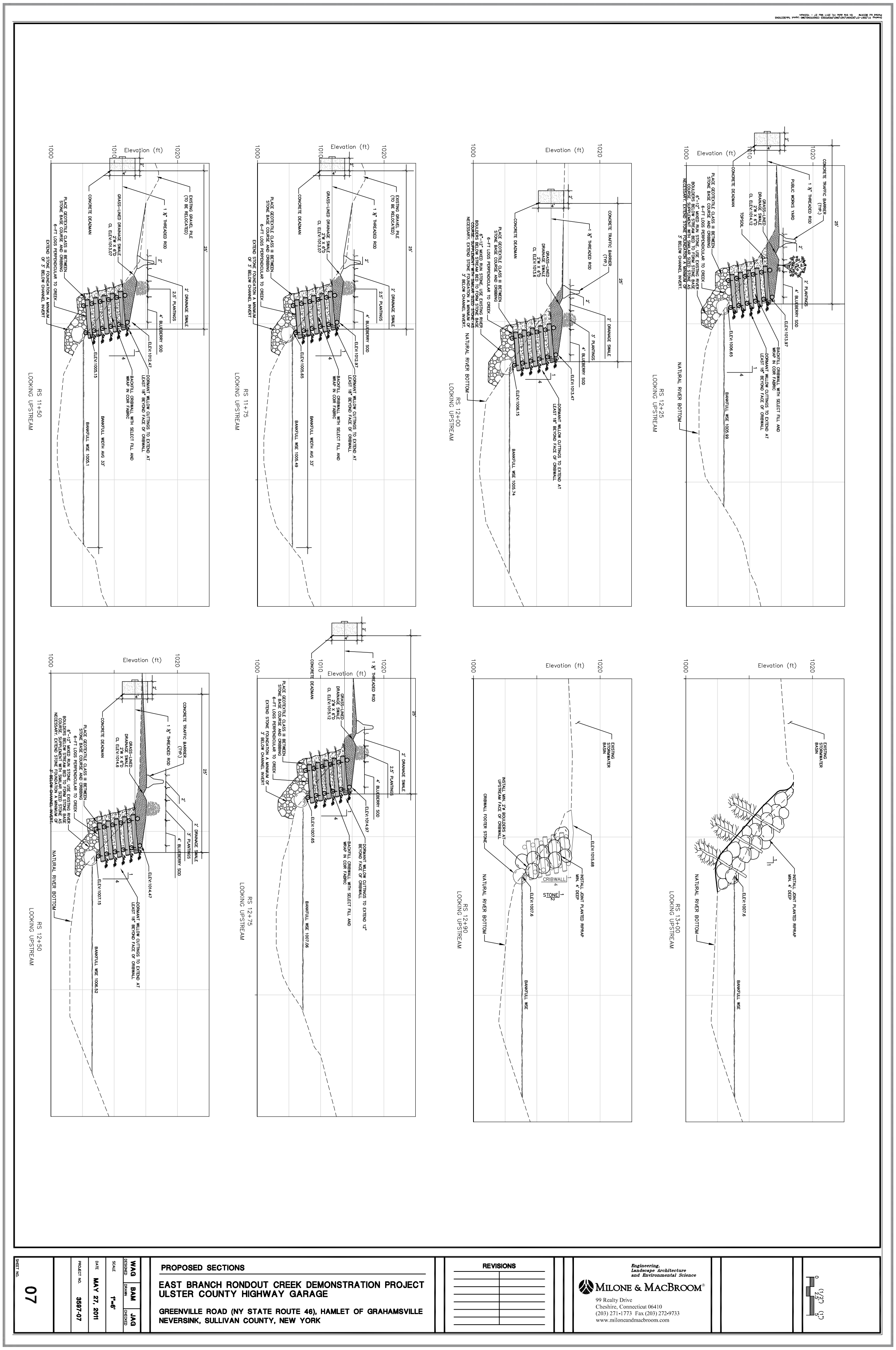
PROPOSED SECTIONS
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
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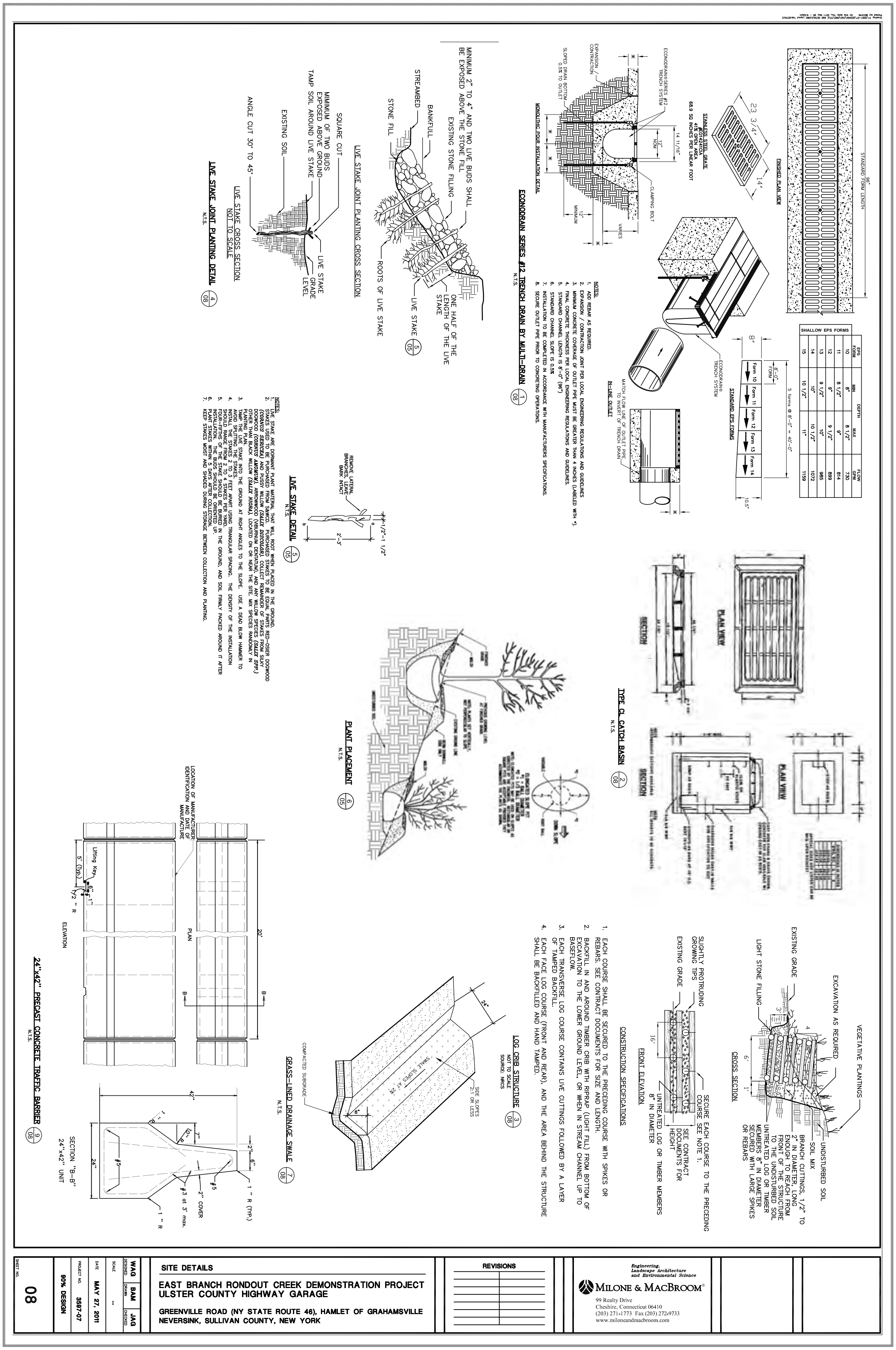
ECONORAIN SERIES #12 TRENCH DRAIN BY MULTI-DRAIN
LIVE STAKE JOINT PLANTING CROSS SECTION
LIVE STAKE CROSS SECTION
LIVE STAKE JOINT PLANTING DETAIL
LIVE STAKE DETAIL
TYPE CL CATCH BASIN
PLANT PLACEMENT
LOG CRIB STRUCTURE
CONSTRUCTION SPECIFICATIONS
GRASS-LINED DRAINAGE SWALE
24"x42" PRECAST CONCRETE TRAFFIC BARRIER
SITE DETAILS
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
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90% DESIGN
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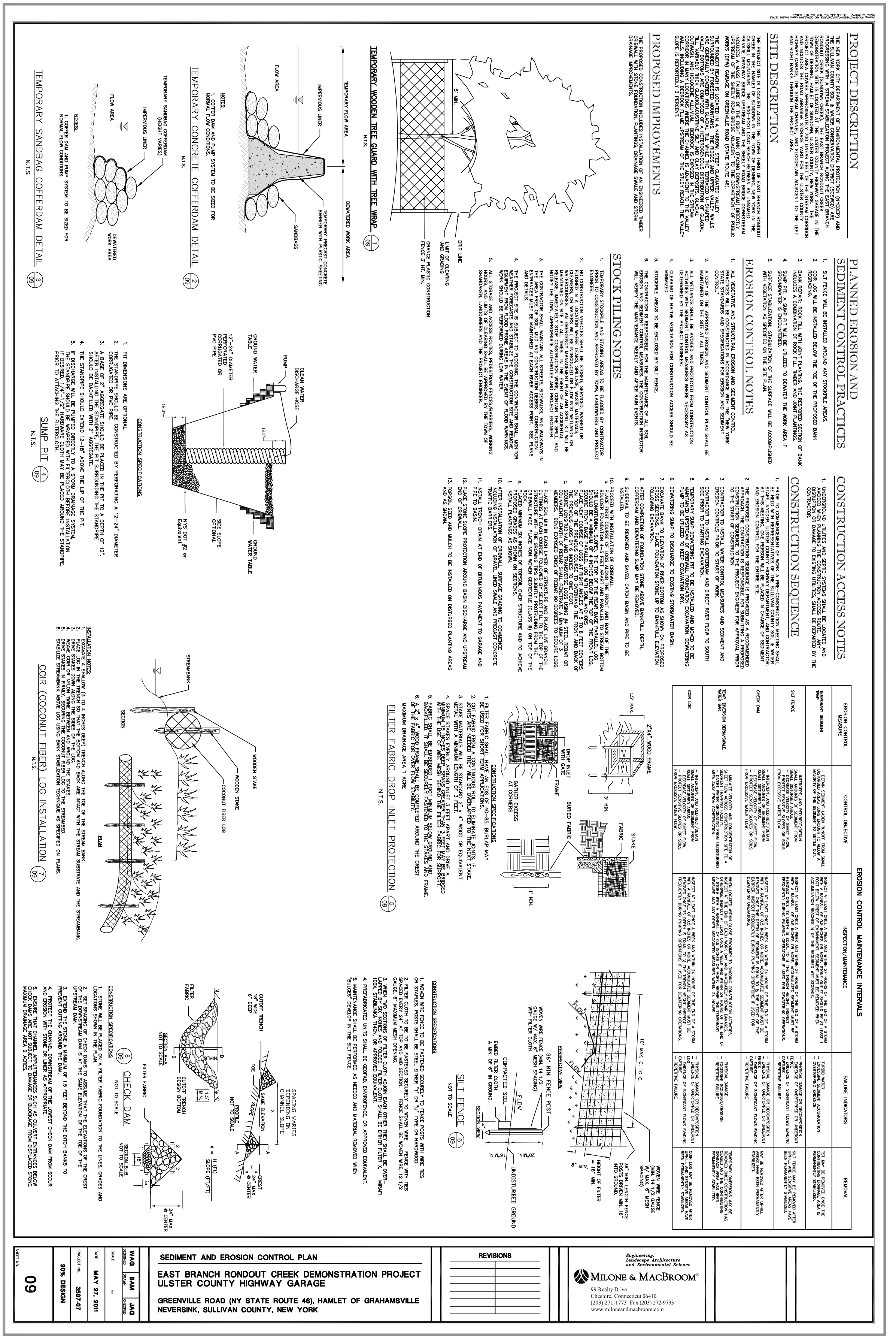
PROJECT DESCRIPTION
SITE DESCRIPTION
PROPOSED IMPROVEMENTS
PLANNED EROSION AND SEDIMENT CONTROL PRACTICES
EROSION CONTROL NOTES
STOCK PILING NOTES
CONSTRUCTION ACCESS NOTES
CONSTRUCTION SEQUENCE
EROSION CONTROL MAINTENANCE INTERVALS
TEMPORARY WOODEN TREE GUARD WITH TREE WRAP
TEMPORARY CONCRETE COFFERDAM DETAIL
TEMPORARY SANDBAG COFFERDAM DETAIL
SUMP PIT
FILTER FABRIC DROP INLET PROTECTION
COIR (COCONUT FIBER) LOG INSTALLATION
SILT FENCE
CHECK DAM
REVISIONS
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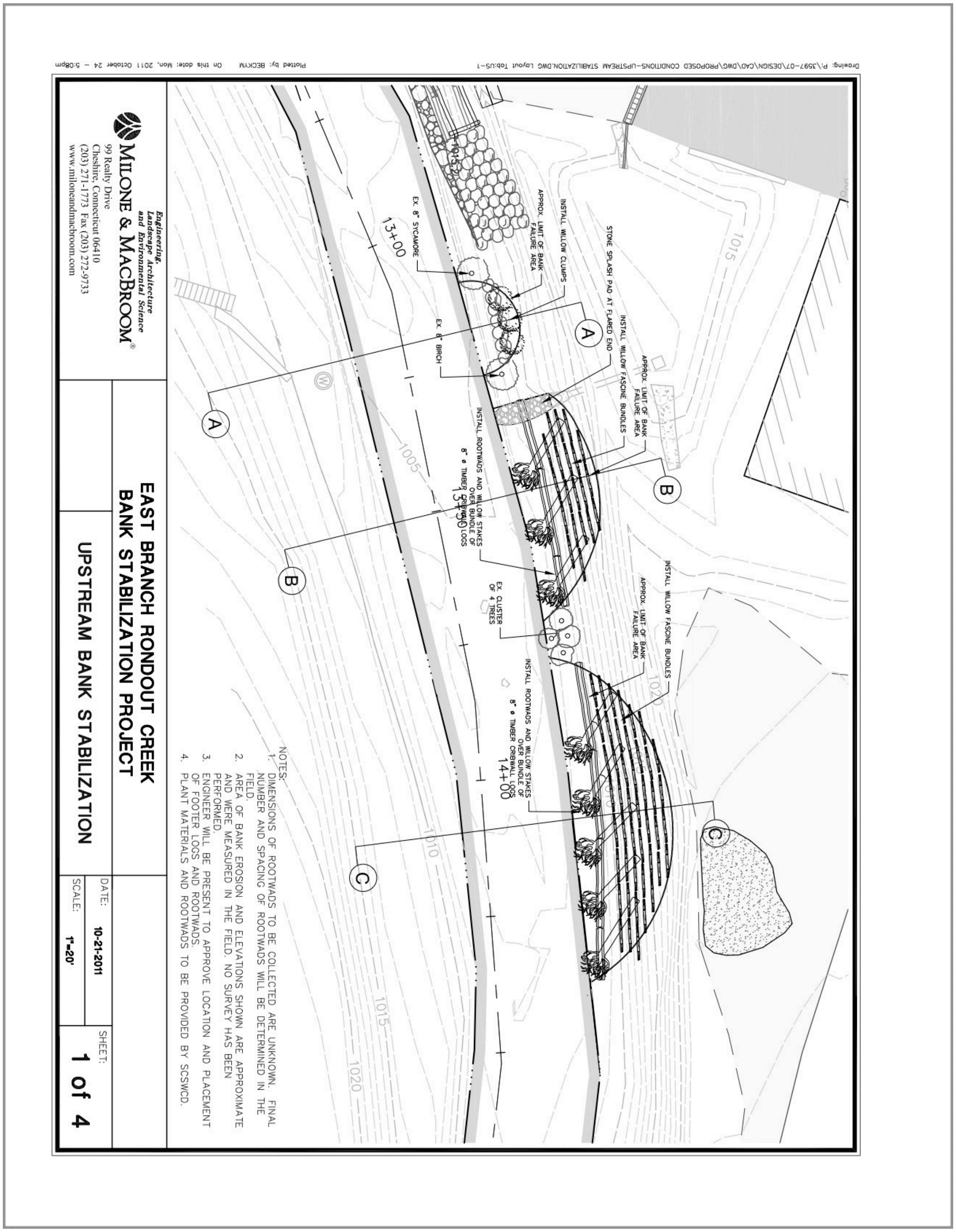
SEDIMENT AND EROSION CONTROL PLAN
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
NEVERSINK, SULLIVAN COUNTY, NEW YORK
WAG BAM JAG
MAY 27, 2011
3597-07
90% DESIGN
09


EAST BRANCH RONDOUT CREEK
BANK STABILIZATION PROJECT
UPSTREAM BANK STABILIZATION
DATE: 10-21-2011
SCALE: 1"=20'
SHEET: 1 of 4
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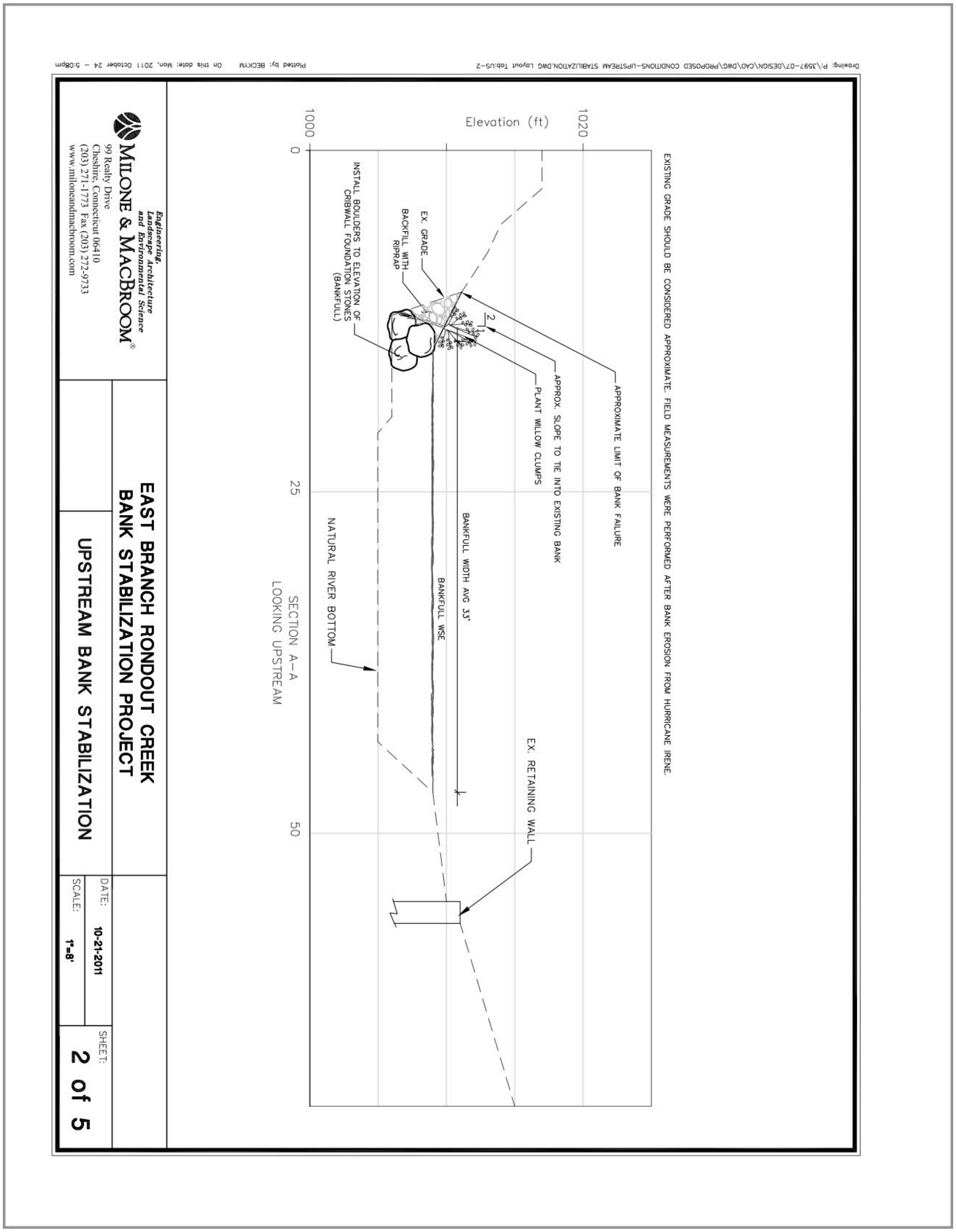
NOTES:
1. DIMENSIONS OF ROOTWADS TO BE COLLECTED ARE UNKNOWN. FINAL NUMBER AND SPACING OF ROOTWADS WILL BE DETERMINED IN THE FIELD.
2. AREA OF BANK EROSION AND ELEVATIONS SHOWN ARE APPROXIMATE AND WERE MEASURED IN THE FIELD. NO SURVEY HAS BEEN PERFORMED.
3. ENGINEER WILL BE PRESENT TO APPROVE LOCATION AND PLACEMENT OF FOOTER LOGS AND ROOTWADS.
4. PLANT MATERIALS AND ROOTWADS TO BE PROVIDED BY SCSWCD.
INSTALL WILLOW CLUMPS
APPROX. LIMIT OF BANK FAILURE AREA
STONE SPLASH PAD AT FLARED END
INSTALL WILLOW FASCINE BUNDLES
EX. 8" SYCAMORE
EX. 8" BIRCH
INSTALL ROOTWADS AND WILLOW STAKES OVER BUNDLE OF 8" ø TIMBER CRIBWALL LOGS
EX. CLUSTER OF 4 TREES
13+00
14+00
1005
1010
1015
1020


EXISTING GRADE SHOULD BE CONSIDERED APPROXIMATE. FIELD MEASUREMENTS WERE PERFORMED AFTER BANK EROSION FROM HURRICANE IRENE.
Elevation (ft)
1020
1000
0
25
50
APPROXIMATE LIMIT OF BANK FAILURE
APPROX. SLOPE TO TIE INTO EXISTING BANK
PLANT WILLOW CLUMPS
EX. GRADE
BACKFILL WITH RIPRAP
INSTALL BOULDERS TO ELEVATION OF CRIBWALL FOUNDATION STONES (BANKFULL)
BANKFULL WIDTH AVG 33'
BANKFULL WSE
NATURAL RIVER BOTTOM
EX. RETAINING WALL
SECTION A-A
LOOKING UPSTREAM
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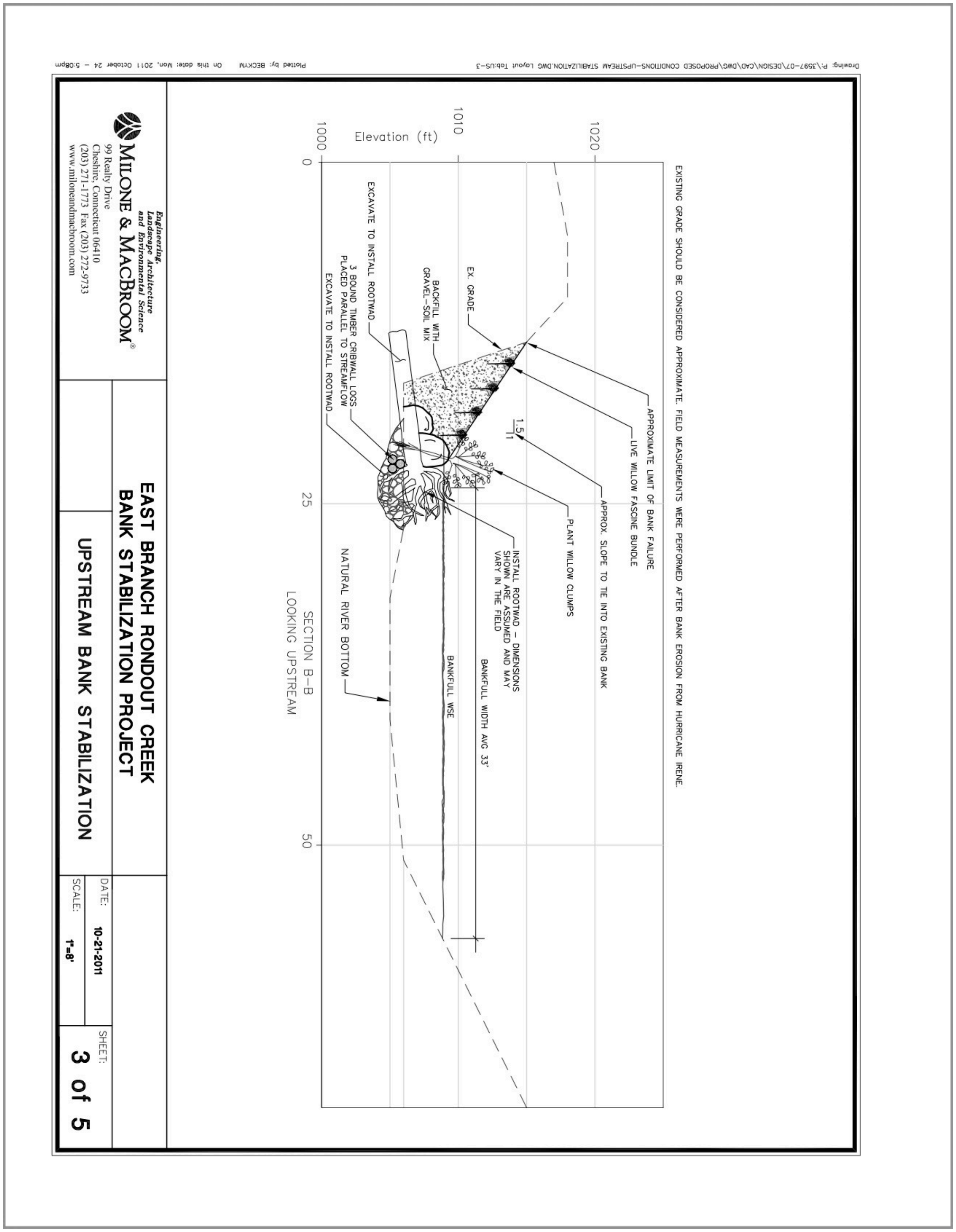
EAST BRANCH RONDOUT CREEK
BANK STABILIZATION PROJECT
UPSTREAM BANK STABILIZATION
DATE: 10-21-2011
SCALE: 1"=8'
SHEET: 2 of 5


EXISTING GRADE SHOULD BE CONSIDERED APPROXIMATE. FIELD MEASUREMENTS WERE PERFORMED AFTER BANK EROSION FROM HURRICANE IRENE.
Elevation (ft)
1020
1010
1000
0
25
50
APPROXIMATE LIMIT OF BANK FAILURE
LIVE WILLOW FASCINE BUNDLE
APPROX. SLOPE TO TIE INTO EXISTING BANK
1.5
1
PLANT WILLOW CLUMPS
INSTALL ROOTWAD – DIMENSIONS SHOWN ARE ASSUMED AND MAY VARY IN THE FIELD
BANKFULL WIDTH AVG 33'
BANKFULL WSE
NATURAL RIVER BOTTOM
SECTION B-B
LOOKING UPSTREAM
EX. GRADE
BACKFILL WITH GRAVEL-SOIL MIX
EXCAVATE TO INSTALL ROOTWAD
3 BOUND TIMBER CRIBWALL LOGS PLACED PARALLEL TO STREAMFLOW
EXCAVATE TO INSTALL ROOTWAD
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EAST BRANCH RONDOUT CREEK
BANK STABILIZATION PROJECT
UPSTREAM BANK STABILIZATION
DATE: 10-21-2011
SCALE: 1"=8'
SHEET: 3 of 5

Appendix H

Cost Summaries

COST OF CRIB WALL BROKEN DOWN BY CATEGORY

This table is a cost summary of the East Branch Rondout Creek Demonstration Project at the Ulster County Highway Garage. H. Osterhoudt Excavating, Inc., 11 Spring Street, Ellenville, NY 12428 won the bid to construct the project. The following table lists the various construction categories followed by the cost of each element and the total amount paid to the contractor. All work was completed in a satisfactory manner.

Item #	Work Description	Amount
1	Site Preparation	38,000.00
2	Maintenance & Protection of Traffic	2,500.00
3	Stream Channel Dewatering	60,000.00
4	Earthwork	69,800.00
5	Dust, Soil Erosion & Sedimentation	1,800.00
6	Bank Slope Treatment	89,313.00
7	Storm Drainage System	16,700.00
8	Guardrail	4,200.00
9	Concrete Traffic Barriers	12,500.00
10	Site Restoration	5,500.00
11	Cast in Place Concrete	18,500.00
12	Change Order #1: Deduct for Coir	(1.200.00)
13	Change Order #2: Additional 18” of Stone	21,600.00
14	Change Order #3: Additional Top Soil	12,507.00
	Total	351,720.00

UPSTREAM WORK COST STRUCTURE

The up stream work at the Sundown site was performed on a time and material basis. This table shows the labor and material rates used to calculate the cost of the upstream work at the East Branch Rondout Creek Demonstration Project at the Ulster County Highway Garage. H. Osterhoudt Excavating, Inc., 11 Spring Street, Ellenville, NY 12428 performed the basic construction work. All work was completed in a satisfactory manner. Additional planting and seeding was done by Sullivan County Soil and Water.

East Branch Rondout Creek- Upstream Bank Stabilization
Billing Date: 12/14/11
Submitted By: H. Osterhoudt Excavating, Inc.
Change Order #4

Upstream Bank Stabilization:

Description:	*Qty(+/-):*	*Unit:*	*Unit Price:*	*Total:*
All Labor & Equipment (See attached Breakdown)	1	LS	$ 17,765.88	$ 17,765.88
Rootwads (Delivered)- 4'-5' Diameter	8	EA	$ 1,250.00	$ 10,000.00
16' Long x 8" Diameter Oak Logs	12	EA	$ 60.00	$ 720.00
Heavy Stone Fill/ Stackable Stone	135	TN	$ 48.00	$ 6,480.00
Light Stone Fill		CY	$ 38.00	
Bank Backfill Material		CY	$ 32.00	
Topsoil	86	CY	$ 42.00	$ 3,612.00
Bond Premium	1	LS	$ 1,212.00	$ 1,212.00
			ESTIMATED TOTAL:	$ 39,789.88
			7% OVERHEAD:	$ 2,785.23
			8% PROFIT:	$ 3,405.94
			TOTAL:	**$ 45,981.05**

The document below shows the final cost of Osterhoudt Excavating Inc. work on the upstream bank remediation at the Sundown site.

Item	Unit Cost
Root Wads	1,250.00
Oak Logs	60.00
Heavy Stackable Stone	48.00/TON
Top Soil	42.00/CY
Excavator	108.98/HR
Loader	43.63/HR
Operator	90.24/HR
Laborer	71.09/HR
Supervisor	90-.00/HR

East Branch Rondout Creek- Upstream Bank Stabilization
Billing Date: 12/14/11
Submitted By: H. Osterhoudt Excavating, Inc.
Change Order #4

Labor & Equipment Pricing:

Excavator	$108.98/Hr
Loader	$43.63/Hr
Operator	$90.24/Hr
Laborer	$71.09/Hr
Superviser	$90.00/Hr

12/1/2011 Crew:				
Operator	$90.24/Hr	(4) Hrs.	$	360.96
Excavator	$108.98/Hr	(4) Hrs.	$	435.92
Loader	$43.63/Hr	(4) Hrs.	$	174.52
12/2/2011 Crew:				
Superviser	$90.00/Hr	(9) Hrs.	$	855.00
Operator	$90.24/Hr	(9) Hrs.	$	857.28
Laborer	$71.09/Hr	(5) Hrs.	$	355.45
Excavator	$108.98/Hr	(9) Hrs.	$	1,035.31
Loader	$43.63/Hr	(9) Hrs.	$	444.49
12/5/2011 Crew:				
Superviser	$90.00/Hr	(8) Hrs.	$	720.00
Operator	$90.24/Hr	(8) Hrs.	$	721.92
Operator	$90.24/Hr	(8) Hrs.	$	721.92
Laborer	$71.09/Hr	(4) Hrs.	$	284.36
Excavator	$108.98/Hr	(8) Hrs.	$	871.84
Loader	$43.63/Hr	(8) Hrs.	$	349.04
12/6/2011 Crew:				
Superviser	$90.00/Hr	(7) Hrs.	$	630.00
Operator	$90.24/Hr	(7) Hrs.	$	631.68
Operator	$90.24/Hr	(7) Hrs.	$	631.68
Excavator	$108.98/Hr	(7) Hrs.	$	762.86
Loader	$43.63/Hr	(7) Hrs.	$	305.41
12/7/2011 Crew:				
Superviser	$90.00/Hr	(8) Hrs.	$	720.00
Operator	$90.24/Hr	(8) Hrs.	$	721.92
Laborer	$71.09/Hr	(4) Hrs.	$	284.36
Excavator	$108.98/Hr	(8) Hrs.	$	871.84
Loader	$43.63/Hr	(8) Hrs.	$	349.04
12/8/2011 Crew:				
Superviser	$90.00/Hr	(8) Hrs.	$	720.00
Operator	$90.24/Hr	(8) Hrs.	$	721.92
Operator	$90.24/Hr	(8) Hrs.	$	721.92
Laborer	$71.09/Hr	(6.5) Hrs.	$	284.36
Excavator	$108.98/Hr	(8) Hrs.	$	871.84
Loader	$43.63/Hr	(8) Hrs.	$	349.04
		Labor & Equipment Total:	$	17,765.88

Appendix I

Contract Approval and Change Order

Bid Summary Sheet

Sullivan County Soil & Water Conservation District
Neversink/Rondout Sundown Garage Project
Bid Opening - 7/25/2011 3:00 p.m.

Contractor	Bid Bond	Comments
Victor Zugive Inc., 66 West Railroad Ave, Garnerville, NY 10923-1218		
Maple Ridge Ent, Inc. PO Box 305 Round Top, NY 12473	398,970 -	
The Delaney Group, Inc. PO Box 219 Mayfield, NY 12117		
Grant Street Construction Inc. 48 Grant Street Cortland, NY 13045		
New Paltz Gardens 92 North Chestnut Street New Paltz, NY 12561		
A. Servidone/B Anthony Const. Corp. 1364 Route 9 Castleton, NY 12033		
Boyce Excavating Co. 88 Monhagen Ave. Middletown, NY 10940		
Arold Construction Co., Inc. 51 Powder Mill Bridge Rd. Kingston, NY 12401		
CFI Construction, Inc. 286 Sacandaga Road Johnstown, NY 12095		
Jorrey Excavating Inc. 160 Bart Bull Rd Middletown, NY 10941	328,800 -	
RMS GRAVEL Dryden, N.Y.	387,194 -	rmsgravel@yahoo.com
HOWARD OSTERHOUDT 11 SPRING ST ELLENVILLE NY	318,813 -	

Notice of Contract Award

Notice of Award

Date: August 9, 2011

Project: East Branch Rondout Creek Stream Restoration Project	
Owner: Sullivan County Soil & Water Conservation District	Owner's Contract No.: CAT-389-D1
Contract: Sundown Highway Garage Demo No. 1	Engineer's Project No.: 3597-07
Bidder: Osterhoudt Excavating	
Bidder's Address: *[send Notice of Award Certified Mail, Return Receipt Requested]*	
11 Spring Street Ellenville, NY 12428	

You are notified that your Bid dated 7/25/11 for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for East Branch Rondout Creek Restoration Project

[Indicate total Work, alternates, or sections of Work awarded.]

The Contract Price of your Contract is Three hundred eighteen thousand dollars eight hundred thirteen _____ Dollars ($318,813).

[Insert appropriate data if unit prices are used. Change language for cost-plus contracts.]

x copies of the proposed Contract Documents (except Drawings) accompany this Notice of Award.

_____ sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within [15] days of the date you receive this Notice of Award.

1. Deliver to the Owner [Sullivan County Soil and Water Conservation District] fully executed counterparts of the Contract Documents.
2. Deliver with the executed Contract Documents the Contract security [Bonds] as specified in the Instructions to Bidders (Article 20), General Conditions (Paragraph 5.01), and Supplementary Conditions (Paragraph SC-5.01).
3. Other conditions precedent:

   ______

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Contract Documents.

Sullivan County Soil & Water Conservation District
Owner

By: Brian Brustman
Authorized Signature

District Manager
Title

Copy to Engineer

c-510 3597-07-3-jn3011-spec notice of award.doc

EJCDC C-510 Notice of Award
Prepared by the Engineers Joint Contract Documents Committee and endorsed by the Construction Specifications Institute.
Page 1 of 1

Notice to Proceed

Notice to Proceed

Date: August 12, 2011

Project: East Branch Rondout Creek Stream Restoration Project

Owner: Sullivan County Soil & Water Conservation District	Owner's Contract No.: CAT-389-D1
Contract: Sundown Highway Garage Demo No. 1	Engineer's Project No.: 3597-07
Bidder: Osterhoudt Excavating Inc.	

Bidder's Address: *[send Notice of Award Certified Mail, Return Receipt Requested]*

11 Spring Street Ellenville, NY 12428

You are notified that the Contract Times under the above Contract will commence to run on August 12, 2011. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement the number of days to achieve Substantial Completion is 120 and the number of days to achieve readiness for final payment is 180.

Before you may start any Work at the Site, Paragraph 2.01.B of the General Conditions provides that you and Owner must each deliver to the other (with copies to Engineer and other identified additional insureds and loss payees) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must:

1. Notify us asap of intended start date
2. Attend on-site meeting with MMI Engineer before commencing site work.

Sullivan County Soil & Water Conservation District
Owner

By: Brian Brustman
Authorized Signature

District Manager
Title

8/12/11
Date

Copy to Engineer

c-510 3597-07-3-jn3011-spec notice of proceedd.doc

EJCDC C-510 Notice of Award
Prepared by the Engineers Joint Contract Documents Committee and endorsed by the Construction Specifications Institute.
Page 1 of 1

11/23/2011 09:37 8456478304 H OSTERHOUDT EXCAVAT PAGE 01/02
Nov 23 2011 8:48AM RONDOUT NEVERSINK STREAMS 8459857950 page 1

H. Osterhoudt Excavating

PROPOSED CHANGE ORDER

11 Spring Street
Ellenville, NY 12428

Phone: 845-647-9084
Fax: 845-647-8304

No. 5

TITLE: Proposed Change Order **DATE:** 11/21/2011

PROJECT: Rondout Creek Stream Project
East Branch Rondout Creek Stream Restoration Project

TO: Attn: Karen Rauter
Sullivan County Soil & Water Conservation District
273 Main St, PO Box 256
Grahamsville, NY 12740
Phone:845/985-2581 Fax:845/985-7950

CONTRACT/PO: CAT-389-D1

SUBMITTED: 11/21/2011

COMPLETED:

REQUIRED: 11/21/2011

DESCRIPTION

The following change order is to be issued on a time and material basis with a overhead & profit rate of 15%.

All units are listed below to show the cost per unit. All quantities will be measured based on delivery tickets or cubic yards measured in the truck. Final change order will be issued based on actual marerial and labor used in the field.

Num	Item	Description	Ref	Qty	Unit	Unit Price	Amount
1	TIME	Crew Price/ Day		0.000	Day	3,231.53	0.00
2	ROOTWAD	Rootwads (Delivered): 4'-5' Diameter		0.000	Each	1,250.00	0.00
3	LOGS	16' Long x 8" Dia Oak Logs		0.000	Each	80.00	0.00
4	HEAVY	Heavy Stone Fill/ Stackable Stone (As Previously Approved)		0.000	Ton	48.00	0.00
5	LIGHT	Light Stone Fill (As Previously Approved)		0.000	Cu. Yd.	38.00	0.00
6	BANK	Bank Run Backfill Material		0.000	Cu. Yd.	32.00	0.00
7	TOPSOIL	Topsoil (As Previously Approved)		0.000	Cu. Yd.	42.00	0.00
8	BOND	Additional Bond Premium		0.000	LS	1,800.00	0.00
9	OVERHD	7% Overhead		0.000	LS	0.00	0.00
10	PROFIT	8% Profit		0.000	LS	0.00	0.00

Item Total: $0.00

Total: $0.00

APPROVAL

By: Kristen O. Walsh (signature)
Kristen O. Walsh

Date: 11/23/11

By: Karen Rauter (signature)

Date: 11/23/11

Page 1 of 2

H. Osterhoudt Excavating

PROPOSED CHANGE ORDER

No. **5**

11 Spring Street
Ellenville, NY 12428

Phone: 845-647-9084
Fax: 845-647-8304

TITLE: Proposed Change Order

DATE: 11/21/2011

PROJECT: Rondout Creek Stream Project
East Branch Rondout Creek Stream Restoration Project

TO: Attn: Karen Rauter
Sullivan County Soil & Water Conservation District
273 Main St, PO Box 256
Grahamsville, NY 12740
Phone:845/985-2581 Fax:845/985-7950

CONTRACT/PO: CAT-389-D1

SUBMITTED: 11/21/2011

COMPLETED:

REQUIRED: 11/21/2011

DESCRIPTION

The following change order is to be issued on a time and material basis with a overhead & profit rate of 15%.

All units are listed below to show the cost per unit. All quantities will be measured based on delivery tickets or cubic yards measured in the truck. Final change order will be issued based on actual marerial and labor used in the field.

Num	Item	Description	Ref	Qty	Unit	Unit Price	Amount
1	TIME	Crew Price/ Day		0.000	Day	3,231.53	0.00
2	ROOTWAD	Rootwads (Delivered): 4'-5' Diameter		0.000	Each	1,250.00	0.00
3	LOGS	16' Long x 8" Dia Oak Logs		0.000	Each	60.00	0.00
4	HEAVY	Heavy Stone Fill/ Stackable Stone (As Previously Approved)		0.000	Ton	48.00	0.00
5	LIGHT	Light Stone Fill (As Previously Approved)		0.000	Cu. Yd.	38.00	0.00
6	BANK	Bank Run Backfill Material		0.000	Cu. Yd.	32.00	0.00
7	TOPSOIL	Topsoil (As Previously Approved)		0.000	Cu. Yd.	42.00	0.00
8	BOND	Additional Bond Premium		0.000	LS	1,800.00	0.00
9	OVERHD	7% Overhead		0.000	LS	0.00	0.00
10	PROFIT	8% Profit		0.000	LS	0.00	0.00

Item Total: $0.00

Total: $0.00

APPROVAL

By: ____________________
Kristen O. Walsh

Date: ____________________

By: Karl Brown

Date: 11/23/11

Page 1 of 2

Appendix J

MMI Observation Report

Construction Observation Report from Andrew Green of engineering firm Milone & MacBroom

Construction Observation Report
Bank Stabilization East Branch Rondout Creek Demonstration Project
Ulster County Highway Garage
Hamlet of Grahamsville, Town of Neversink, Sullivan County, New York

Date: Friday, November 18, 2011

MMI Staff: W. Andrew Greene, P.E.

Time on site: 1:00 p.m. **Time off site:** 2:30 p.m.

Weather: cloudy - 50°

People On Site:
- Howard Osterhoudt
- Kristen Walsh
- Kirk Peters
- Karen Rauter
- John Perrella

Activity:
- No Activity on site. The Cribwall installation has been completed.

Design / Construction Notes:
- The following items remain to be completed:
- The portable John remains on site and is scheduled for removal soon.
- The area just west of Sheely Road, where the storage trailer was parked, has been disturbed and remains bare earth. Osterhoudt will seed and mulch this area when they are back on site.
- Soil Material and Timbers are stockpiled adjacent to the stormwater basin. The soil material will be used to create a pad for the machine during bank stabilization work upstream of the cribwall.
- There is also excess mulch in the swale behind the precast concrete traffic barriers. The excess mulch should be removed in the spring to facilitate grass growth. SCSWCD staff performed plant installation and will take care of this.
- The tie rod nuts may need to be tightened in 6 months or periodically as the lumber shrinks slightly. Kirk Peter's staff at the highway garage will check the nuts and tighten as necessary to keep them snug.
- The 2 lifting holes in each precast concrete barrier collect water. Some consideration was given to patching these holes with non-shrink grout. This would be additional work for Osterhoudt.
- Kristen is to provide the Change Order paper work for the additional bank stabilization work upstream of the cribwall.
- It was agreed that the base contract work is substantially complete and all that remains is the Change Order Work. It was agreed that the retainage would be held until after the Change Order work was complete.

Tentative Schedule:
- The remaining work upstream of the Cribwall, the Change Order work, is expected to start the week after Thanksgiving, 11/28.

Site Photos:

Milone & MacBroom, Inc. • 99 Realty Drive • Cheshire, CT 06410
Telephone 203-271-1773 • Fax 20-272-9733 • Email AndieG@miloneandmacbroom.com

MILONE & MACBROOM

Appendix K

DEC Permit

DEC Permit Approval

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Facility DEC ID 3-5120-00106

PERMIT

Under the Environmental Conservation Law (ECL)

Permittee and Facility Information

Permit Issued To:
ULSTER COUNTY
244 FAIR ST
KINGSTON, NY 12401-3806

Facility:
ULSTER COUNTY HIGHWAY GARAGE
30 GREENVILLE RD
SUNDOWN, NY

Facility Location: in DENNING in ULSTER COUNTY
Facility Principal Reference Point: NYTM-E: 544.6 NYTM-N: 4637.1
Latitude: 42°53'04.5" Longitude: 74°27'44.8"
Project Location: Sundown Creek [WIN# H-139-14-53; Class B (ts)] at 30 Greenville Road
Authorized Activity: Construct 170 linear feet of timber cribbing wall with stone rip-rap streambank protection on the northern embankment of Sundown Creek, in accordance with the plans referenced in Natural Resources Condition No. 1 and as conditioned in this permit.

See Natural Resources Condition No. 2 for time of year restriction.

Permit Authorizations

Stream Disturbance - Under Article 15, Title 5
Permit ID 3-5120-00106/00001
New Permit Effective Date: 7/29/2011 Expiration Date: 9/30/2013
Water Quality Certification - Under Section 401 - Clean Water Act
Permit ID 3-5120-00106/00002
New Permit Effective Date: 7/29/2011 Expiration Date: 9/30/2013

NYSDEC Approval

By acceptance of this permit, the permittee agrees that the permit is contingent upon strict compliance with the ECL, all applicable regulations, and all conditions included as part of this permit.

Permit Administrator: R SCOTT BALLARD, Deputy Regional Permit Administrator
Address: NYSDEC REGION 3 HEADQUARTERS
21 SOUTH PUTT CORNERS RD
NEW PALTZ, NY 12561-1620

Authorized Signature: R. Scott Ballard Date 7/29/11

Page 1 of 6

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Facility DEC ID 3-5120-00106

Distribution List

D. Sheeley, Commissioner - UC DPW
B. Brustman, Sullivan Cty. Soil & Water
K. Rauter - Rondout Neversink
B. Drumm

Permit Components

NATURAL RESOURCE PERMIT CONDITIONS

WATER QUALITY CERTIFICATION SPECIFIC CONDITION

GENERAL CONDITIONS, APPLY TO ALL AUTHORIZED PERMITS

NOTIFICATION OF OTHER PERMITTEE OBLIGATIONS

Permit Attachments

Permit Sign

NATURAL RESOURCE PERMIT CONDITIONS - Apply to the Following Permits: STREAM DISTURBANCE; WATER QUALITY CERTIFICATION

1. **Conformance With Plans** All activities authorized by this permit must be in strict conformance with the approved plans submitted by the applicant or applicant's agent as part of the permit application. Such approved plans were prepared by Milone & MacBroom Engineers, dated 3/7/11 with revisions through 4/15/11, including Drawing Nos. 01 - 09 (9 sheets).

2. **Prohibition Period for Trout** All instream work, as well as any work that may result in the suspension of sediment, is prohibited during the trout spawning and incubation period commencing October 1 and ending April 30.

3. **Divert Stream Flow** Prior to the start of construction, the permittee shall divert the flow of water around the work area by either a system with watertight coffer dam and pump around as shown on approved plans, or other method, so that work is performed in dry conditions. Alternative water diversion methods must be approved by Bureau of Habitat staff prior to being implemented.

4. **Notify DEC** The permittee must provide notification to the Department at least 48 hours prior to the start of construction activities affecting Sundown Creek. Such notification shall be provided via electronic mail to Brian Drumm, Bureau of Habitat Protection Manager, at this web address: brdrumm@gw.dec.state.ny.us.

5. **Work During Low Flow** All instream work shall be performed only during periods of low stream flow or no stream flow.

6. **Precautions Against Contamination of Waters** All necessary precautions shall be taken to preclude contamination of any wetland or waterway by suspended solids, sediments, fuels, solvents, lubricants, epoxy coatings, paints, concrete, leachate or any other environmentally deleterious materials associated with the project.

7. **Materials Removed from Bed and Banks** Any debris or excess materials from construction of this project shall be immediately and completely removed from the bed and banks of all water areas to an appropriate upland area for disposal.

8. **State May Require Site Restoration** If upon the expiration or revocation of this permit, the project hereby authorized has not been completed, the applicant shall, without expense to the State, and to such extent and in such time and manner as the Department of Environmental Conservation may lawfully require, remove all or any portion of the uncompleted structure or fill and restore the site to its former condition. No claim shall be made against the State of New York on account of any such removal or alteration.

9. **State Not Liable for Damage** The State of New York shall in no case be liable for any damage or injury to the structure or work herein authorized which may be caused by or result from future operations undertaken by the State for the conservation or improvement of navigation, or for other purposes, and no claim or right to compensation shall accrue from any such damage.

10. **State May Order Removal or Alteration of Work** If future operations by the State of New York require an alteration in the position of the structure or work herein authorized, or if, in the opinion of the Department of Environmental Conservation it shall cause unreasonable obstruction to the free navigation of said waters or flood flows or endanger the health, safety or welfare of the people of the State, or cause loss or destruction of the natural resources of the State, the owner may be ordered by the Department to remove or alter the structural work, obstructions, or hazards caused thereby without expense to the State, and if, upon the expiration or revocation of this permit, the structure, fill, excavation, or other modification of the watercourse hereby authorized shall not be completed, the owners, shall, without expense to the State, and to such extent and in such time and manner as the Department of Environmental Conservation may require, remove all or any portion of the uncompleted structure or fill and restore to its former condition the navigable and flood capacity of the watercourse. No claim shall be made against the State of New York on account of any such removal or alteration.

WATER QUALITY CERTIFICATION SPECIFIC CONDITIONS

1. **Water Quality Certification** The NYS Department of Environmental Conservation hereby certifies that the subject project will not contravene effluent limitations or other limitations or standards under Sections 301, 302, 303, 306 and 307 of the Clean Water Act of 1977 (PL 95-217) provided that all of the conditions listed herein are met.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Facility DEC ID 3-5120-00106

GENERAL CONDITIONS - Apply to ALL Authorized Permits:

1. **Facility Inspection by The Department** The permitted site or facility, including relevant records, is subject to inspection at reasonable hours and intervals by an authorized representative of the Department of Environmental Conservation (the Department) to determine whether the permittee is complying with this permit and the ECL. Such representative may order the work suspended pursuant to ECL 71- 0301 and SAPA 401(3).

The permittee shall provide a person to accompany the Department's representative during an inspection to the permit area when requested by the Department.

A copy of this permit, including all referenced maps, drawings and special conditions, must be available for inspection by the Department at all times at the project site or facility. Failure to produce a copy of the permit upon request by a Department representative is a violation of this permit.

2. **Relationship of this Permit to Other Department Orders and Determinations** Unless expressly provided for by the Department, issuance of this permit does not modify, supersede or rescind any order or determination previously issued by the Department or any of the terms, conditions or requirements contained in such order or determination.

3. **Applications For Permit Renewals, Modifications or Transfers** The permittee must submit a separate written application to the Department for permit renewal, modification or transfer of this permit. Such application must include any forms or supplemental information the Department requires. Any renewal, modification or transfer granted by the Department must be in writing. Submission of applications for permit renewal, modification or transfer are to be submitted to:

Regional Permit Administrator
NYSDEC REGION 3 HEADQUARTERS
21 SOUTH PUTT CORNERS RD
NEW PALTZ, NY12561 -1620

4. **Submission of Renewal Application** The permittee must submit a renewal application at least 30 days before permit expiration for the following permit authorizations: Stream Disturbance, Water Quality Certification.

5. **Permit Modifications, Suspensions and Revocations by the Department** The Department reserves the right to exercise all available authority to modify, suspend or revoke this permit. The grounds for modification, suspension or revocation include:

a. materially false or inaccurate statements in the permit application or supporting papers;

b. failure by the permittee to comply with any terms or conditions of the permit;

c. exceeding the scope of the project as described in the permit application;

d. newly discovered material information or a material change in environmental conditions, relevant technology or applicable law or regulations since the issuance of the existing permit;

e. noncompliance with previously issued permit conditions, orders of the commissioner, any provisions of the Environmental Conservation Law or regulations of the Department related to the permitted activity.

6. **Permit Transfer** Permits are transferrable unless specifically prohibited by statute, regulation or another permit condition. Applications for permit transfer should be submitted prior to actual transfer of ownership.

NOTIFICATION OF OTHER PERMITTEE OBLIGATIONS

Item A: Permittee Accepts Legal Responsibility and Agrees to Indemnification
The permittee, excepting state or federal agencies, expressly agrees to indemnify and hold harmless the Department of Environmental Conservation of the State of New York, its representatives, employees, and agents ("DEC") for all claims, suits, actions, and damages, to the extent attributable to the permittee's acts or omissions in connection with the permittee's undertaking of activities in connection with, or operation and maintenance of, the facility or facilities authorized by the permit whether in compliance or not in compliance with the terms and conditions of the permit. This indemnification does not extend to any claims, suits, actions, or damages to the extent attributable to DEC's own negligent or intentional acts or omissions, or to any claims, suits, or actions naming the DEC and arising under Article 78 of the New York Civil Practice Laws and Rules or any citizen suit or civil rights provision under federal or state laws.

Item B: Permittee's Contractors to Comply with Permit
The permittee is responsible for informing its independent contractors, employees, agents and assigns of their responsibility to comply with this permit, including all special conditions while acting as the permittee's agent with respect to the permitted activities, and such persons shall be subject to the same sanctions for violations of the Environmental Conservation Law as those prescribed for the permittee.

Item C: Permittee Responsible for Obtaining Other Required Permits
The permittee is responsible for obtaining any other permits, approvals, lands, easements and rights-of-way that may be required to carry out the activities that are authorized by this permit.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Facility DEC ID 3-5120-00106

Item D: No Right to Trespass or Interfere with Riparian Rights
This permit does not convey to the permittee any right to trespass upon the lands or interfere with the riparian rights of others in order to perform the permitted work nor does it authorize the impairment of any rights, title, or interest in real or personal property held or vested in a person not a party to the permit.

Item E: SEQR Unlisted Action, No Lead Agency, No Significant Impact Under the State Environmental Quality Review Act (SEQR), the project associated with this permit is classified as an Unlisted Action and the Department of Environmental Conservation has determined that it will not have a significant effect on the environment. Other involved agencies may reach an independent determination of environmental significance for this project.

New York State Department of Environmental Conservation
Division of Environmental Permits, Region 3
21 South Putt Corners Road, New Paltz, New York 12561-1620
FAX: (845) 255-4659
Website: www.dec.ny.gov

IMPORTANT NOTICE TO ALL PERMITTEES

The permit you requested is enclosed. Please read it carefully and note the conditions that are included in it. The permit is valid for only that activity expressly authorized therein; work beyond the scope of the permit may be considered a violation of law and be subject to appropriate enforcement action. Granting of this permit does not relieve the permittee of the responsibility of obtaining any other permission, consent or approval from any other federal, state, or local government which may be required.

Please note the expiration date of the permit. Applications for permit renewal should be made well in advance of the expiration date (minimum of 30 days) and submitted to the Regional Permit Administrator at the above address. For SPDES, Solid Waste and Hazardous Waste Permits, renewals must be made at least 180 days prior to the expiration date.

☑ Applicable only if checked. Please note all work authorized under this permit is prohibited during trout spawning season commencing October 1 and ending April 30.

> The DEC permit number & program ID number noted on page 1 under "Permit Authorization" of the permit are important and should be retained for your records. These numbers should be referenced on all correspondence related to the permit, and on any future applications for permits associated with this facility/project area.

'f a permit notice sign is enclosed, you must post it at the work site with appropriate weather protection, as well as a copy of the permit per General Condition 1.

If the permit is associated with a project that will entail construction of new water pollution control facilities or modifications to existing facilities, plan approval for the system design will be required from the appropriate Department's regional Division of Water or delegated local Health Department, as specified in the State Pollutant Discharge Elimination System (SPDES) permit.

If you have any questions on the extent of work authorized or your obligations under the permit, please contact the staff person indicated below or the Division of Environmental Permits at the above address.

Scott Ballard SB
Division of Environmental Permits, Region 3
Telephone (845) 256-3055

☐ Applicable Only if Checked for **STORMWATER SPDES INFORMATION**: We have determined that your project qualifies for coverage under the General Stormwater SPDES Permit. You must now file a Notice of Intent to obtain coverage under the General Permit. This form can be downloaded at: http://www.dec.ny.gov/chemical/43133.html

☐ Applicable Only if Checked **MS4 Areas**: This site is within an MS4 area (Municipal Separate Storm Sewer System), therefore the SWPPP must be reviewed and accepted by the municipality. The MS-4 Acceptance Form must be submitted in addition to the Notice of Intent.

Send the completed form(s) to: NYS DEC, Stormwater Permitting, Division of Water, 625 Broadway, Albany, New York 12233-3505

ı addition, DEC requests that you provide one electronic copy of the approved SWPPP directly to Natalie Browne at NYS DEC, 100 Hillside Avenue - Suite 1W, White Plains, NY 10603-2860.

New York State
Department of Environmental Conservation

NOTICE
EMERGENCY
AUTHORIZATION

The Department of Environmental Conservation (DEC) has authorized, pursuant to the Environmental Conservation Law, work being conducted at this site. For further information regarding the nature and extent of work approved and any Department conditions on it, contact the DEC Division of Environmental Permits at (845) 256-3054.

Authorized Person: Ulster County DPW

Effective Date: 7/29/11 Expiration Date: 9/30/13

✓ Applicable if checked. No instream work allowed between October 1 and April 30.

Appendix L

As-Built Survey

EAST BRANCH RONDOUT CREEK - PLAN VIEW

(SCALE: 1"=10')

LEGEND

- UNTREATED BANK AS OF DATE OF SURVEY ON 12/20/2011.
- RIPRAP BANK ARMORING (BOULDER FOUNDATION OF CRIBWALL)
- CRIBWALL
- EROSION MATTING WITH PLANTINGS
- STACKED STONE REVETMENT
- GUARDRAIL
- DRAINAGE SWALE

MAPPING NOTES

1. BATHYMETRIC AND IN RIVER SURVEY INFORMATION IS BASED ON FIELD SURVEY BY MILONE & MACBROOM COMPLETED JUNE 17, 2010. OVERBANK AND UPLAND INFORMATION IS BASED ON FIELD ASSESSMENT COMPLETED 12/9/2010.
2. HORIZONTAL DATUM FOR SUPPLEMENTAL FIELD SURVEY IS NAD 1983 (NEW YORK EAST). VERTICAL DATUM IS NAVD 1988.
3. SPOT ELEVATIONS REPRESENT FIELD CONDITIONS AS SURVEYED ON 12/20/2011 BY MILONE & MACBROOM, INC.

MILONE & MACBROOM®
Engineering, Landscape Architecture, and Environmental Science
99 Realty Drive
Cheshire, Connecticut 06410
(203) 271-1773 Fax (203) 272-9733
www.miloneandmacbroom.com

DESCRIPTION	DATE	BY

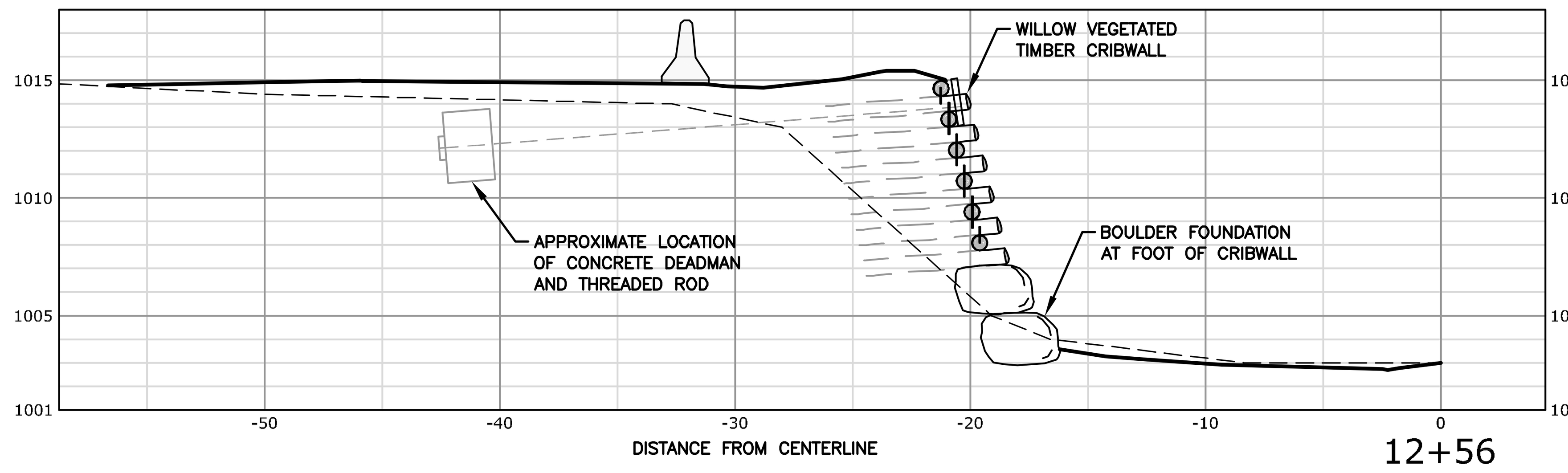
POST CONSTRUCTION

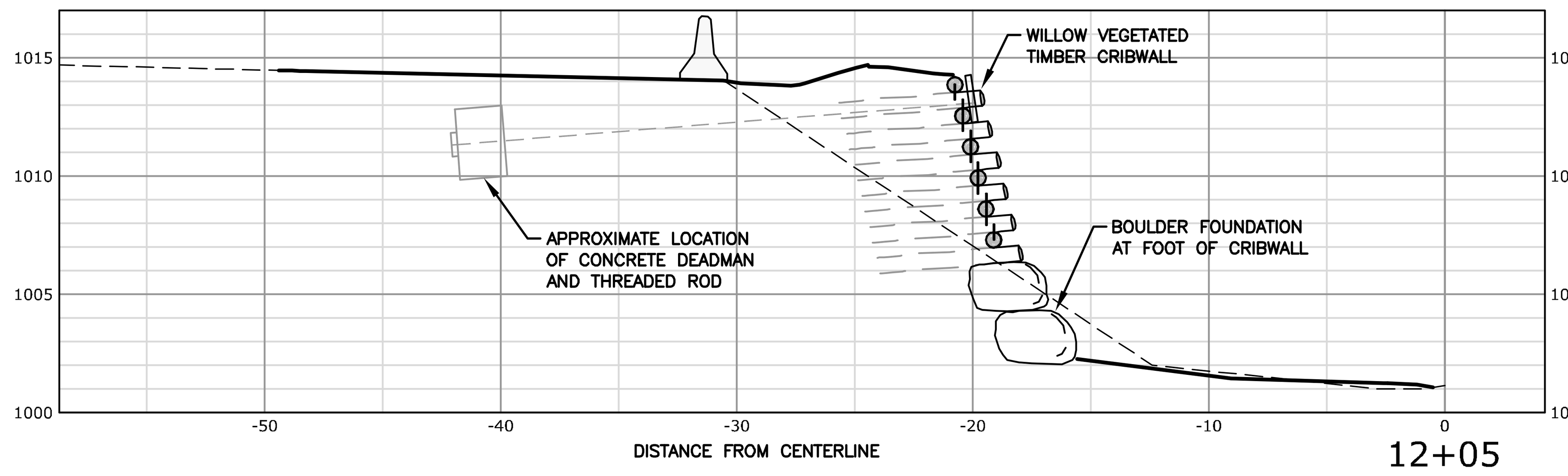
SITE PLAN - POST CONSTRUCTION

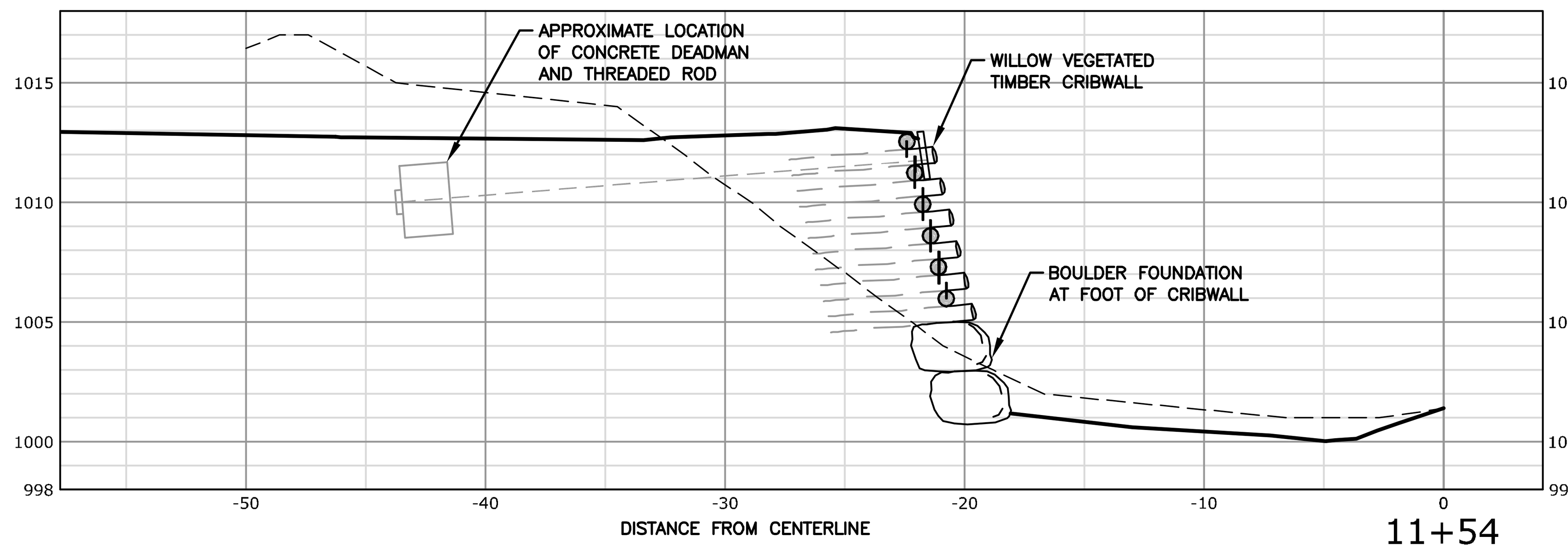
EAST BRANCH RONDOUT CREEK DEMONSTRATION PROJECT
ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
NEVERSINK, SULLIVAN COUNTY, NEW YORK

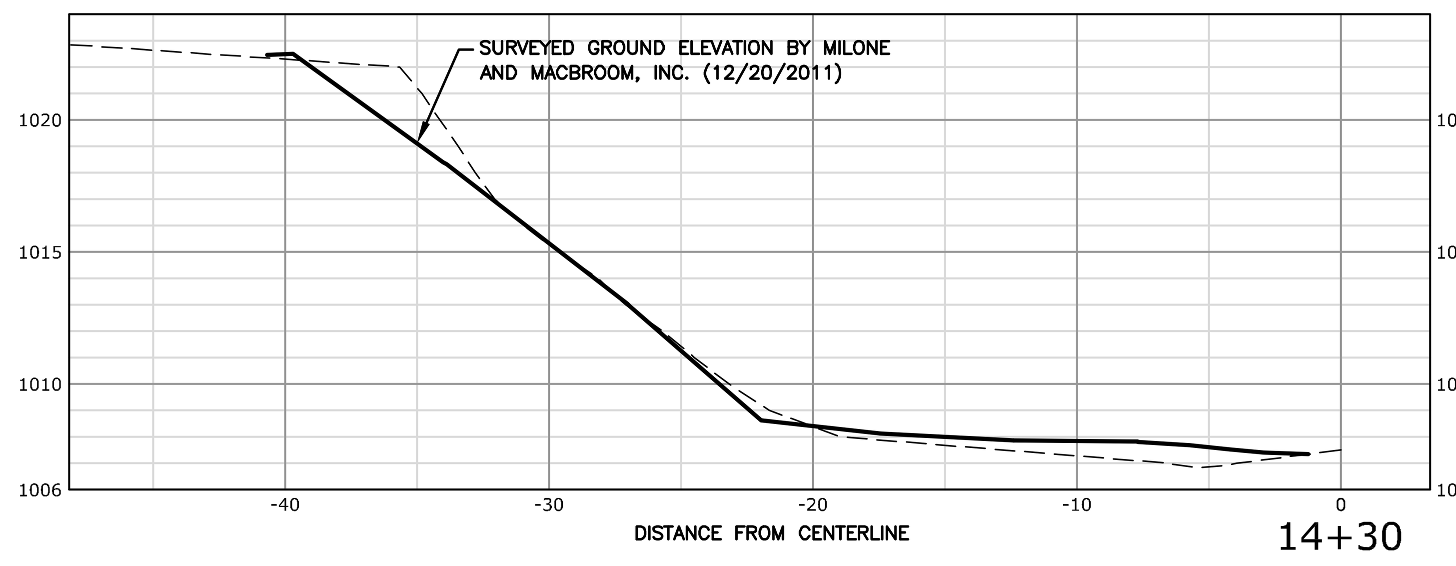
JCM	DRM	WAG
DESIGNED	DRAWN	CHECKED

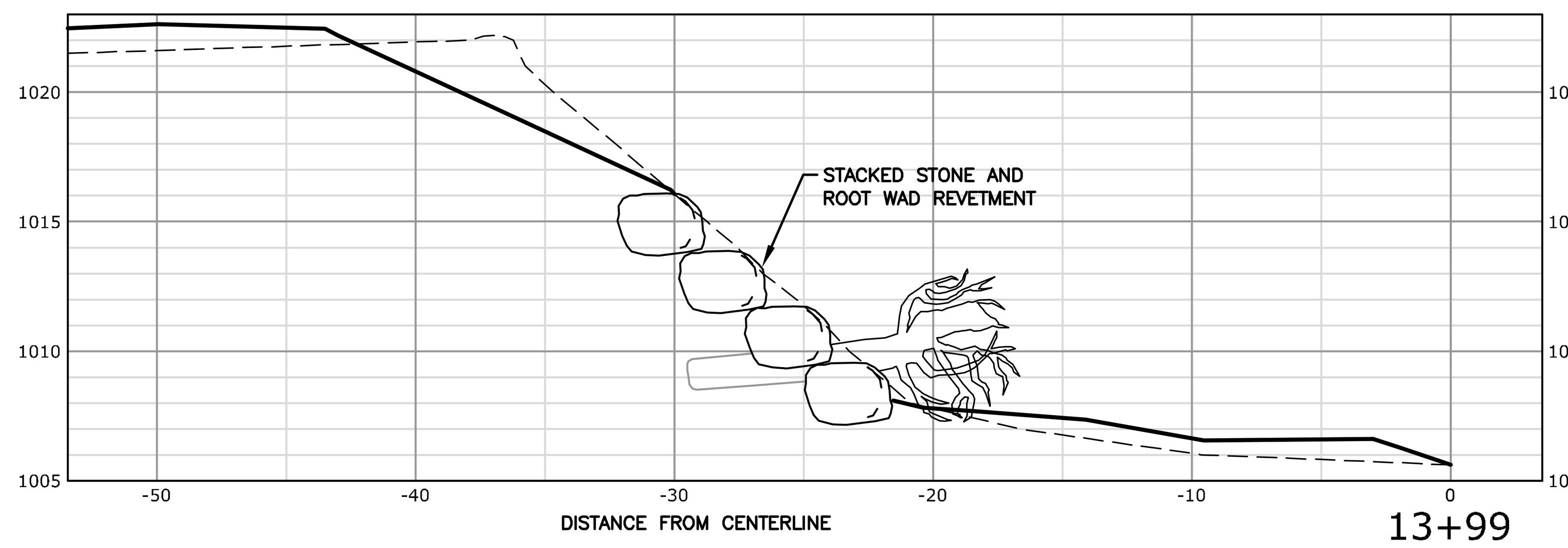
SCALE: AS NOTED
DATE: JANUARY 2012
PROJECT NO.: 3597-07
SHEET NO.: 01 OF 02
SHEET NAME: AS-1

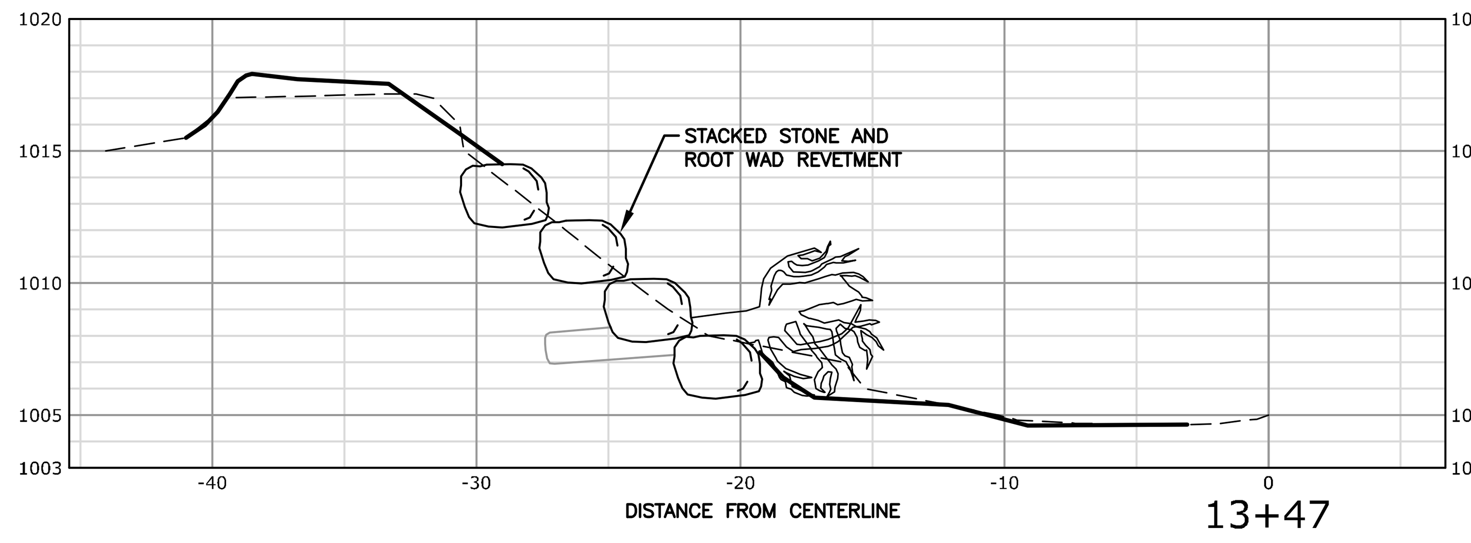










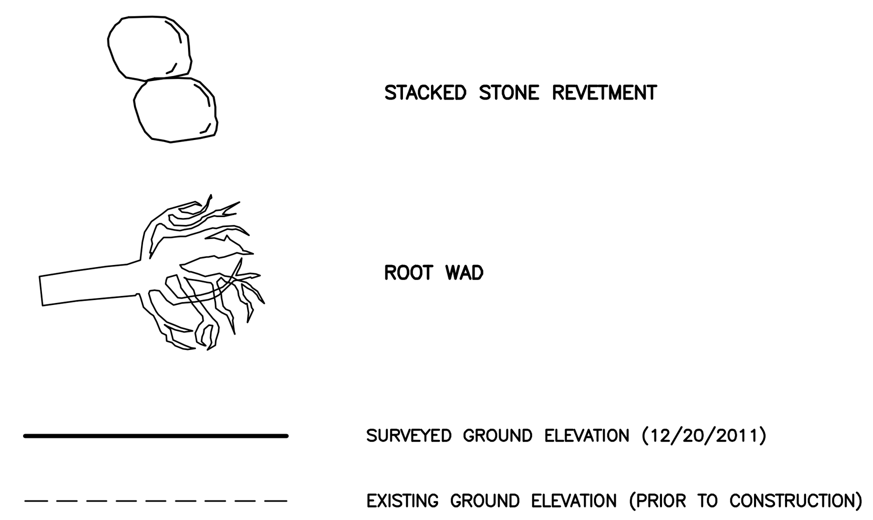


EAST BRANCH RONDOUT CREEK - SECTIONS

(SCALE: 1"=6')
(LOOKING UPSTREAM)

SCALE IN FEET 0' 3' 6' SCALE 1"=6'

BANK STABILIZATION FEATURES LEGEND



GRAPHIC SCALE (IN FEET) 0' 3' 6' SCALE 1" = 6'

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CROSS SECTIONS - POST CONSTRUCTION

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ULSTER COUNTY HIGHWAY GARAGE
GREENVILLE ROAD (NY STATE ROUTE 46), HAMLET OF GRAHAMSVILLE
NEVERSINK, SULLIVAN COUNTY, NEW YORK

JGM	DRM	WAG
DESIGNED	DRAWN	CHECKED

SCALE: AS NOTED
DATE: JANUARY 2012
PROJECT NO.: 3597-07
SHEET NO.: 02 OF 02
SHEET NAME: AS-2