Appendix F

Project Status

F.1 Project Status: Post-construction 2000

F.2 Project Status: Flood Event Inspection (December 17-18, 2000)

F.3 Project Status: Summer 2001 Inspection - Survey

F.4 Project Status: Project Modification/Repair (Summer 2001)

F.5 Project Status: Summer 2002 Inspection - Survey

F.6 Project Status: Fisheries and Habitat 2002

F.7 Project Status: Summer 2003 Inspection - Survey

F.8 Project Status: Summer 2004 Inspection - Survey

F.9 Project Status: Flood Event Inspection (April 2-3, 2005)

F.10 Project Status: Summer 2005 Inspection - Survey

F.11 Project Status: 2007 Inspection - Survey

Appendix F

Project Status

F.1 Project Status: Post-construction 2000

F.2 Project Status: Flood Event Inspection (December 17-18, 2000)

F.3 Project Status: Summer 2001 Inspection - Survey

F.4 Project Status: Project Modification/Repair (Summer 2001)

F.5 Project Status: Summer 2002 Inspection - Survey

F.6 Project Status: Fisheries and Habitat 2002

F.7 Project Status: Summer 2003 Inspection - Survey

F.8 Project Status: Summer 2004 Inspection - Survey

F.9 Project Status: Flood Event Inspection (April 2-3, 2005)

F.10 Project Status: Summer 2005 Inspection - Survey

F.1 Project Status: Post-construction 2000

The as-built survey was performed on November of 2000 to display modifications made to the project design during construction and to document survey benchmarks for future monitoring. The survey encompassed the as-built condition of the constructed channel and the adjoining floodplain area to include 1' contour finish grade topography, rock structures, relief wells, sheet pile wall, thalweg profile, water surface, location of monumented cross section pins, and installed bioengineering components. The survey was overlayed with portions of the existing topographic survey to include roads, bridges, and homes.

Cross Section Survey

At the time of the as-built survey, ten monumented cross sections were installed for use in future detailed monitoring efforts. Cross sections were monumented using capped rebar pins which are located in the topographic survey as well as recorded using GPS. Cross sections were stationed at various locations along the channel profile in order to provide monitoring for stream process and stability. The cross sections were installed through various stream features (pools, riffles, etc.) and structures in order to document stream classification, potential erosion and scour, and to document the overall channel stability. The cross section plots were sampled from a (TIN) surface, created from the post-construction topographic survey of the site. The cross sections created from the TIN surface do not provide the detail necessary to perform a direct comparison between the project design and the constructed channel. The values presented below are averages taken through multiple riffle cross sections. Values for riffle comparisons were obtained from cross sections 5 and 8 while values for pool comparisons were obtained from cross sections 2, 4, and 10.

Variables	Existing Channel	Proposed Reach	As-Built
Stream Type	F3b	B3	B3
Bankfull Width (ft.)	39	28.2	28.4
Bankfull Mean Depth (ft.)	1.9	1.45	1.8
Bankfull Max. Depth (ft.)	2.6	2.6	2.7
Bankfull Cross Sectional Area (ft^2)	72.5	41.0	51.2
Maximum Pool Depth (ft.)	3.0	3.69	4.25
Pool Width (ft.)	----	30.7	30.6
Pool Width / Bankfull Width	----	1.09	1.07

Longitudinal Profile

The longitudinal profile survey included the sampling of ground and water surface elevations along the slope breaks of the thalweg. The profile plot was sampled from a (TIN) surface, created from the post-construction topographic survey of the site. Bankfull elevations were added by reviewing cross sectional data and transposing the bankfull elevation and station to the longitudinal profile. The sampling was tied to the original pre-restoration datum and topographic survey.

Broadstreet Hollow - Project Site
Summary of Cross Section Data
Updated 03/30/06

Broadstreet Hollow - Post Construction Survey								**Updated 01/28/03**
Cross Section	Station	Feature	BF Area	Width	Max Depth	Mean Depth	W/d	Notes
1	1+00.97	riffle	43.16	25.72	2.59	1.68	15.3	
2	1+99.55	pool	79.88	35.62	3.65	2.24	15.9	Section cuts across cross vane
3	3+18.21	glide	84.20	38.37	3.43	2.19	17.5	
4	4+13.14	pool	73.57	26.00	4.14	2.83	9.2	
5	4+99.24	riffle	55.20	28.98	2.73	1.90	15.3	
6	5+80.17	riffle	69.67	32.80	3.15	2.12	15.5	Section not perpindicular to channel
7	6+38.54	pool - tail	54.16	31.25	2.61	1.73	18.1	
8	6+67.89	riffle	55.36	30.46	2.82	1.82	16.7	
9	8+07.62	pool - tail	65.19	36.05	3.65	1.81	19.9	
10	8+84.37	pool	63.58	30.07	4.97	2.11	14.3	Section cuts across cross vane
Average Riffles			51.24	28.39	2.71	1.80	15.8	Using cross section #1, 5, 8
Average Riffles			55.85	29.49	2.82	1.88	15.7	Using all riffle features
Average Pools			72.34	30.56	4.25	2.39	13.1	Using cross section #2, 4, 10
Average Pools			67.3	31.8	3.8	2.1	15.5	Using all pool features
Total Average			64.40	31.53	3.37	2.04	15.8	Using all sections

Broadstreet Hollow - Summer 2001 Survey (Pre-repair)								**Updated 01/29/03**
Cross Section	Station	Feature	BF Area	Width	Max Depth	Mean Depth	W/d	Notes
1	0+99.87	pool - tail	77.17	29.59	4.09	2.61	11.3	
2	1+98.41	pool	94.47	39.51	4.88	2.39	16.5	Section cuts across cross vane
3	3+22.01	glide	95.28	43.26	3.84	2.20	19.6	
4	4+23.28	pool	139.64	33.18	7.47	4.21	7.9	
5	5+12.46	riffle	118.90	38.69	4.13	3.07	12.6	
6	5+95.50	riffle	120.32	38.97	4.07	3.09	12.6	Section not perpindicular to channel
7	6+54.99	pool - tail	99.09	32.77	3.69	3.02	10.8	
8	6+86.42	riffle	82.59	34.06	3.47	2.42	14.0	
9	8+31.60	pool - tail	87.09	41.09	3.94	2.12	19.4	
10	9+08.05	pool	80.98	30.86	5.62	2.62	11.8	Section cuts across cross vane
Average Riffles			100.75	36.37	3.80	2.75	13.3	Using cross section #5, 8
Average Riffles			107.27	37.24	3.89	2.86	12.6	Using all riffle features
Average Pools			105.03	34.52	5.99	3.07	12.1	Using cross section #2, 4, 10
Average Pools			100.3	35.5	5.1	2.9	13.3	Using all pool features
Total Average			99.55	36.20	4.52	2.78	13.7	Using all sections

Broadstreet Hollow - Summer 2002 Survey (Post - repair)								**Updated 01/25/04**
Cross Section	Station	Feature	BF Area	Width	Max Depth	Mean Depth	W/d	Notes
1	0+94.32	riffle	59.86	29.02	3.18	2.06	14.1	
2	1+90.81	pool	93.57	38.67	4.56	2.42	16.0	Section cuts across cross vane
3	3+07.67	glide	98.24	46.22	3.86	2.13	21.7	
4	4+03.11	pool	82.24	31.00	4.20	2.65	11.7	
5	4+94.05	riffle	113.28	46.29	3.78	2.45	18.9	
6	5+71.68	riffle	85.23	37.91	3.24	2.25	16.9	Section not perpindicular to channel
7	6+30.75	pool - tail	72.91	32.11	3.97	2.27	14.1	
8	6+60.13	riffle	74.24	33.30	3.38	2.23	14.9	
9	8+03.06	pool - tail	76.36	37.63	3.69	2.03	18.5	
10	8+80.54	pool	74.06	28.85	5.18	2.57	11.2	Section cuts across cross vane
Average Riffles			93.76	39.80	3.58	2.34	16.9	Using cross section #5, 8
Average Riffles			83.15	36.63	3.40	2.25	16.2	Using all riffle features
Average Pools			83.29	32.84	4.65	2.55	13.0	Using cross section #2, 4, 10
Average Pools			79.8	33.7	4.3	2.4	14.3	Using all pool features
Total Average			83.00	36.10	3.90	2.31	15.8	Using all sections

Broadstreet Hollow - Summer 2003 Survey								**Updated 01/25/04**
Cross Section	Station	Feature	BF Area	Width	Max Depth	Mean Depth	W/d	Notes
1	0+57.03	riffle	61.74	29.37	2.93	2.10	14.0	

2	1+54.53	pool	91.78	37.29	4.75	2.46	15.1	Section cuts across cross vane
3	2+72.45	glide	92.72	44.44	3.15	2.09	21.3	
4	3+67.37	pool	72.42	29.59	3.72	2.45	12.1	
5	4+57.28	riffle	107.91	45.10	3.75	2.39	18.8	
6	5+34.21	riffle	92.47	41.37	3.24	2.24	18.5	Section not perpindicular to channel
7	5+92.90	pool - tail	70.33	31.48	4.36	2.23	14.1	
8	6+24.25	riffle	80.50	34.11	3.55	2.36	14.5	
9	7+65.36	pool - tail	75.89	37.33	3.78	2.03	18.4	
10	8+41.18	pool	65.22	28.52	4.68	2.29	12.5	Section cuts across cross vane
Average Riffles			94.21	39.60	3.65	2.38	16.6	Using cross section #5, 8
Average Riffles			85.66	37.49	3.37	2.27	16.4	Using all riffle features
Average Pools			76.47	31.80	4.38	2.40	13.2	Using cross section #2, 4, 10
Average Pools			75.1	32.8	4.3	2.3	14.4	Using all pool features
Total Average			81.10	35.86	3.79	2.26	15.9	Using all sections

Broadstreet Hollow - Summer 2004 Survey **Updated 01/25/04**

Cross Section	Station	Feature	BF Area	Width	Max Depth	Mean Depth	W/d	Notes
1	1+00.06	riffle	60.93	26.88	3.37	2.27	11.9	
2	1+97.03	pool	75.87	37.91	3.79	2.00	18.9	Section cuts across cross vane
3	3+14.17	glide	104.15	43.64	3.71	2.39	18.3	
4	4+09.33	pool	91.27	30.21	4.35	3.02	10.0	
5	4+98.90	riffle	99.26	38.82	3.77	2.56	15.2	
6	5+81.67	riffle	103.56	37.15	4.15	2.79	13.3	Section not perpindicular to channel
7	6+40.54	pool - tail	84.57	32.92	3.66	2.57	12.8	
8	6+70.43	riffle	77.95	33.91	3.11	2.30	14.8	
9	8+11.80	pool - tail	67.52	34.86	2.68	1.94	18.0	
10	8+90.40	pool	77.13	29.42	4.72	2.62	11.2	Section cuts across cross vane
Average Riffles			88.61	36.37	3.44	2.43	15.0	Using cross section #5, 8
Average Riffles			85.43	34.19	3.60	2.48	13.8	Using all riffle features
Average Pools			81.42	32.51	4.29	2.55	13.4	Using cross section #2, 4, 10
Average Pools			79.3	33.1	3.8	2.4	14.2	Using all pool features
Total Average			84.22	34.57	3.73	2.44	14.4	Using all sections

Broadstreet Hollow - Summer 2005 Survey **Updated 03/30/06**

Cross Section	Station	Feature	BF Area	Width	Max Depth	Mean Depth	W/d	Notes
1	1+00.06	riffle	71.99	29.05	3.62	2.48	11.7	
2	1+97.03	pool	75.38	39.02	3.41	1.93	20.2	Section cuts across cross vane
3	3+14.17	glide	105.03	52.3	3.05	2.01	26.0	
4	4+09.33	pool	115.85	34.48	5.87	3.36	10.3	
5	4+98.90	riffle	127.71	44.82	3.73	2.85	15.7	
6	5+81.67	riffle	130.73	45.28	4.19	2.89	15.7	Section not perpindicular to channel
7	6+40.54	pool - tail	118.26	46.36	4.15	2.55	18.2	
8	6+70.43	riffle	119.77	40.74	5.53	2.94	13.9	
9	8+11.80	pool - tail	129.25	38.61	5.61	3.35	11.5	
10	8+90.40	pool	126.62	40.3	5.12	3.14	12.8	Section cuts across cross vane
Average Riffles			123.74	42.78	4.63	2.89	14.8	Using cross section #5, 8
Average Riffles			112.55	39.97	4.27	2.79	14.2	Using all riffle features
Average Pools			105.95	37.93	4.80	2.81	14.4	Using cross section #2, 4, 10
Average Pools			113.1	39.8	4.8	2.9	14.6	Using all pool features
Total Average			112.06	41.10	4.43	2.75	15.6	Using all sections

Broadstreet Hollow - Summary of Cross Section Data **Updated 03/30/06**

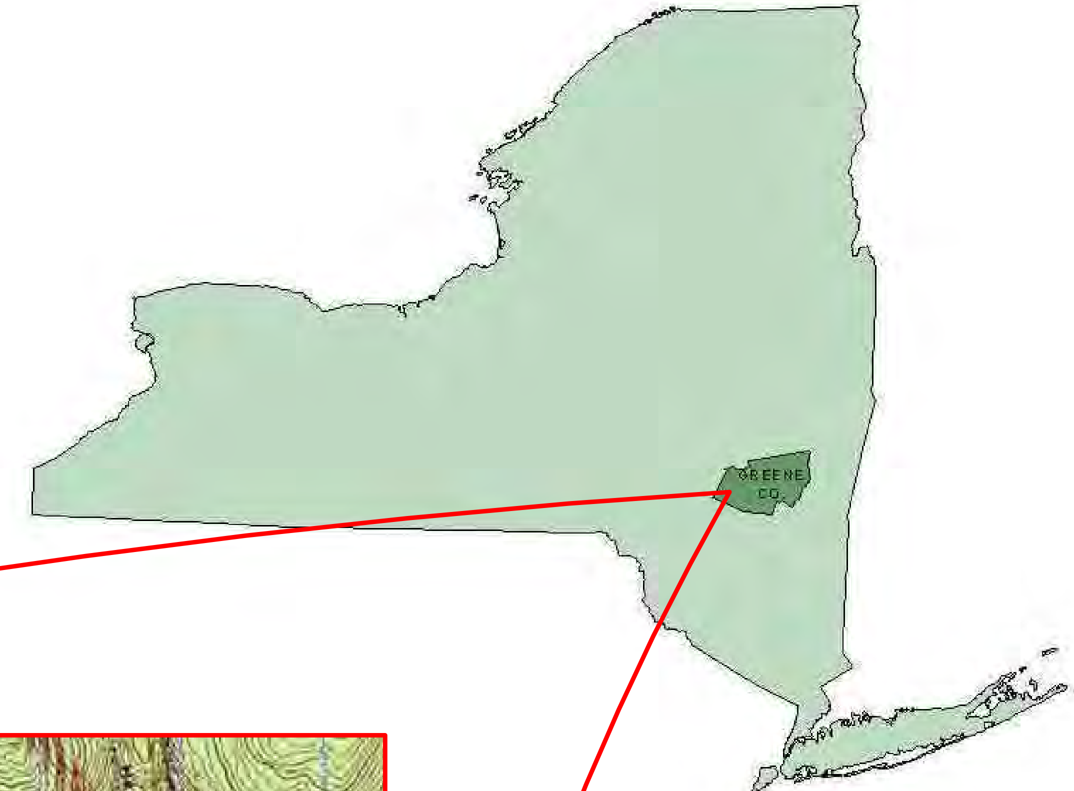
Average Bankfull Variables	Post Const	2001	2002	2003	2004	2005	Notes
Stream Type	B3	B3	B3	B3	B3	B3	
Cross Sectional Area (ft^2)	51.24	100.75	93.76	94.21	88.61	123.74	Using section 1, 5 and 8
Width (ft)	28.39	36.37	39.80	39.60	36.37	42.78	Using section 5 and 8
Mean Depth (ft)	1.80	2.75	2.34	2.38	2.43	2.89	Using section 5 and 8
Width/depth	15.77	13.32	16.93	16.65	14.97	14.79	Using section 5 and 8
Max Depth (ft)	2.71	3.80	3.58	3.65	3.44	4.63	Using section 5 and 8
Max Pool Depth (ft)	4.25	5.99	4.65	4.38	4.29	4.80	Using section 2, 4 and 10
Pool Width (ft)	30.56	34.52	32.84	31.80	32.51	37.93	Using section 2, 4 and 10

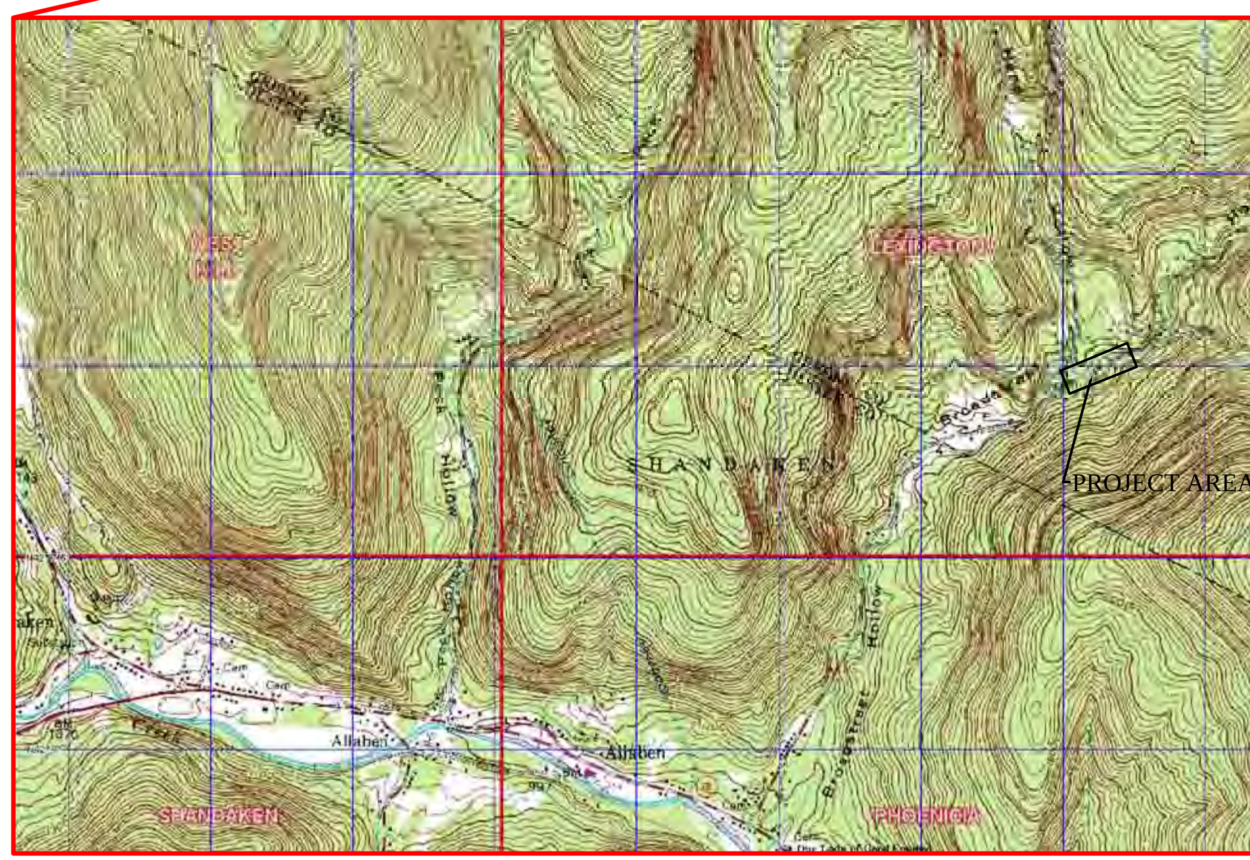
GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

STREAM MANAGEMENT PROGRAM

"BROAD STREET HOLLOW" STREAM RESTORATION PROJECT

POST CONSTRUCTION SURVEY





SITE LOCATION MAP
(NOT TO SCALE)

INDEX OF DRAWINGS

1. TITLE PAGE
2. POST CONSTRUCTION TOPOGRAPHIC SURVEY
3. POST CONSTRUCTION MONITORED CROSS SECTION LAYOUT
4. POST CONSTRUCTION MONUMENTED CROSS SECTIONS
5. POST CONSTRUCTION LONGITUDINAL PROFILE

LEGEND

REVISIONS

BROAD STREET HOLLOW STREAM RESTORATION PROJECT	
TOWN OF LEXINGTON	COUNTY OF GREENE
DECEMBER 7, 2000	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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PREPARED FOR
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

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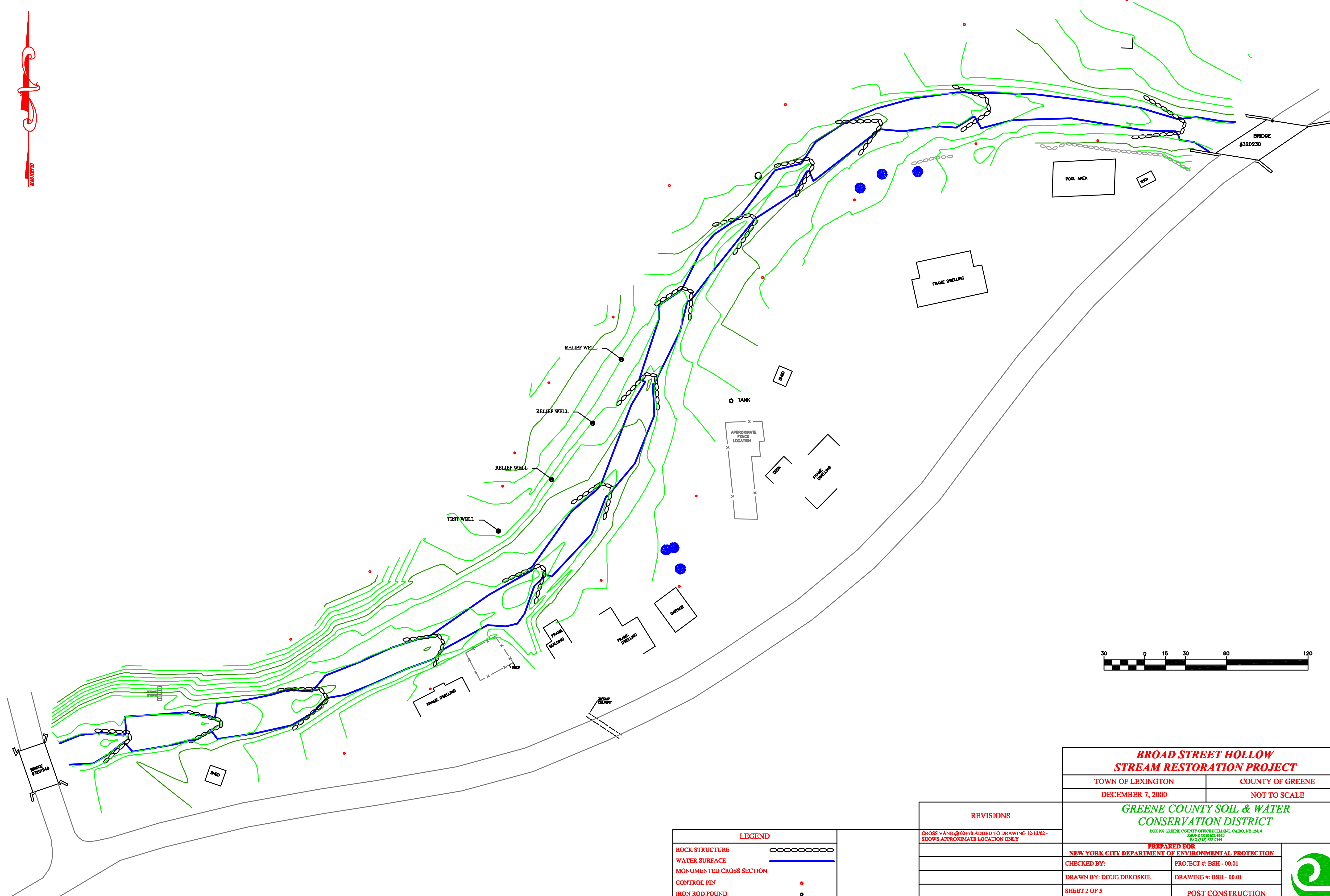
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - 00.01
SHEET 1 OF 5	TITLE PAGE



LEGEND

ROCK STRUCTURE	
WATER SURFACE	
MONUMENTED CROSS SECTION	
CONTROL PIN	
IRON ROD FOUND	
RELIEF WELL	

REVISIONS

CROSS VANE @ 02+70 ADDED TO DRAWING 12/13/02 - SHOWS APPROXIMATE LOCATION ONLY

BROAD STREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
DECEMBER 7, 2000	NOT TO SCALE

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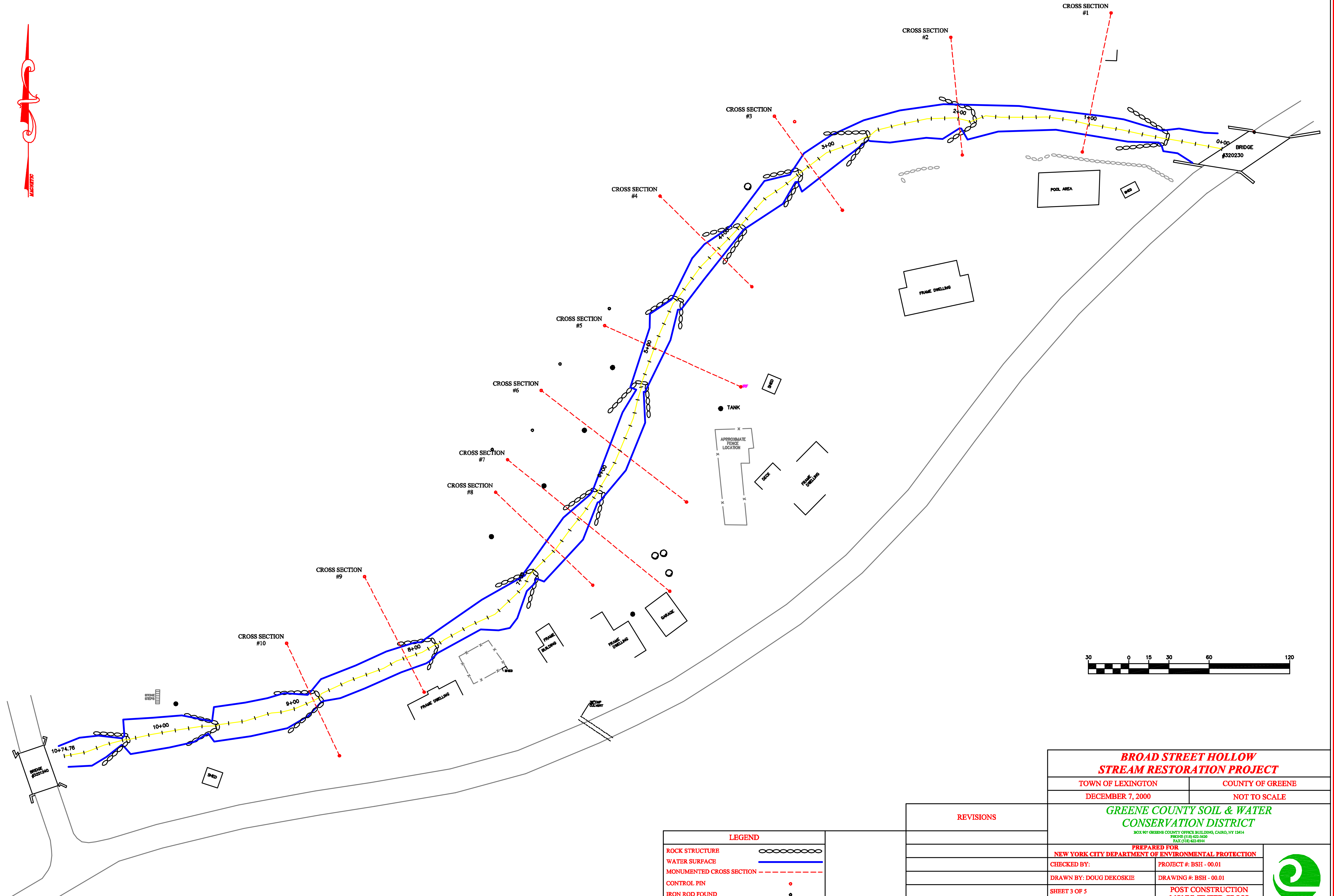
SHEET 2 OF 5	POST CONSTRUCTION TOPOGRAPHIC SURVEY



LEGEND	
ROCK STRUCTURE	
WATER SURFACE	
MONUMENTED CROSS SECTION	
CONTROL PIN	
IRON ROD FOUND	
RELIEF WELL	

REVISIONS

BROAD STREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
DECEMBER 7, 2000	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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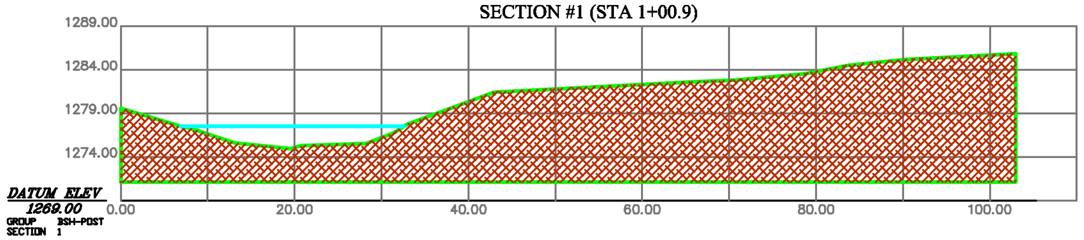
SHEET 3 OF 5	POST CONSTRUCTION MONUMENTED CROSS SECTION LAYOUT

SECTION #1 (STA 1+00.9)



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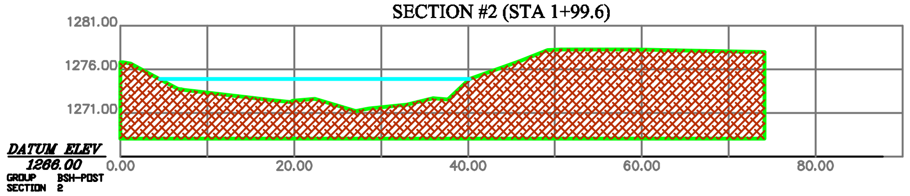

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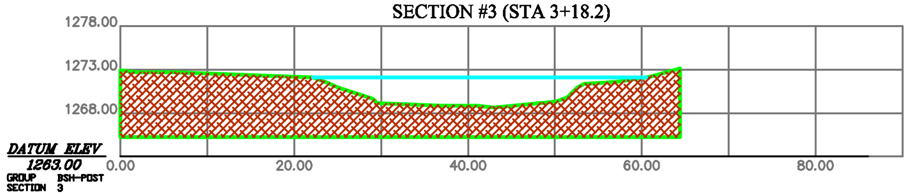

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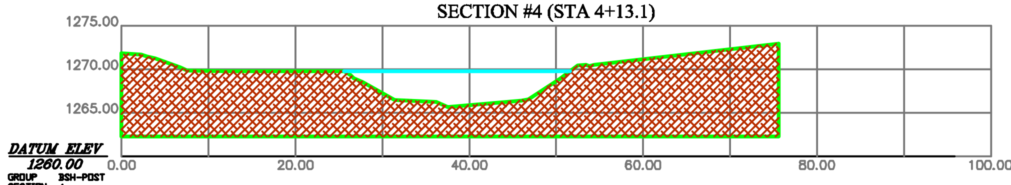

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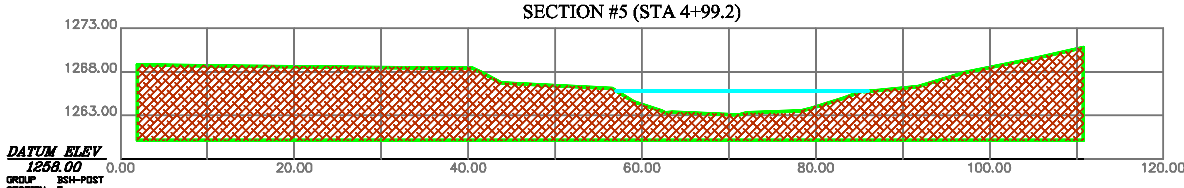

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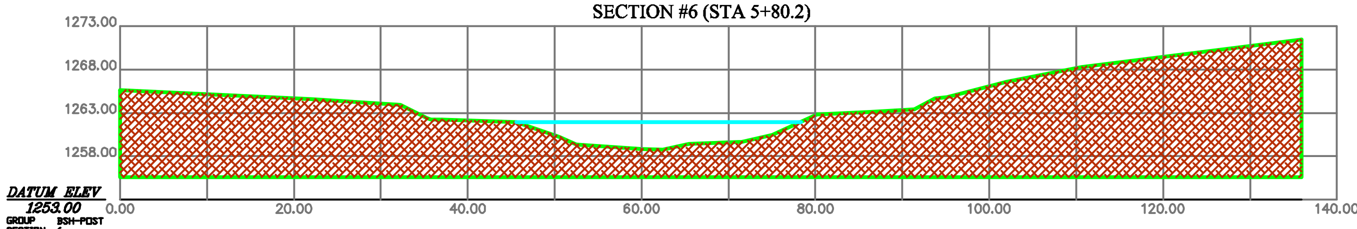

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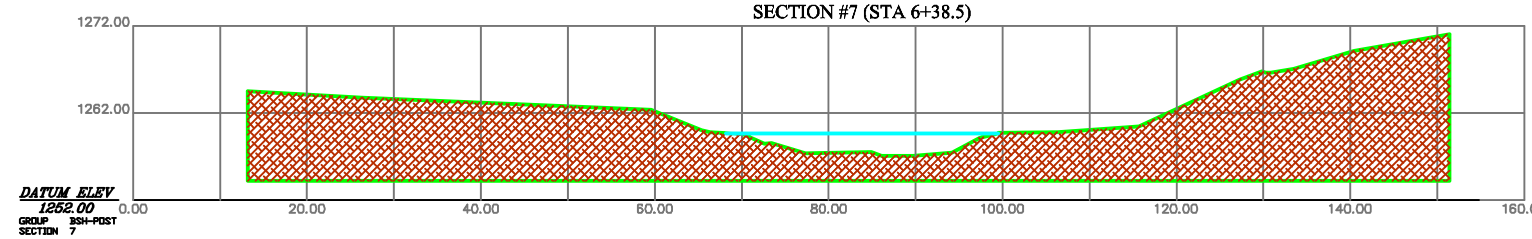

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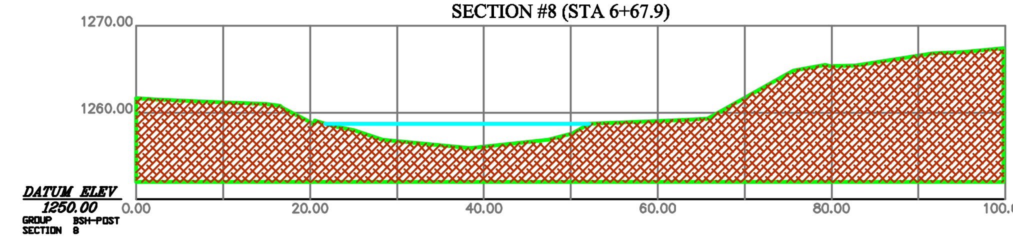
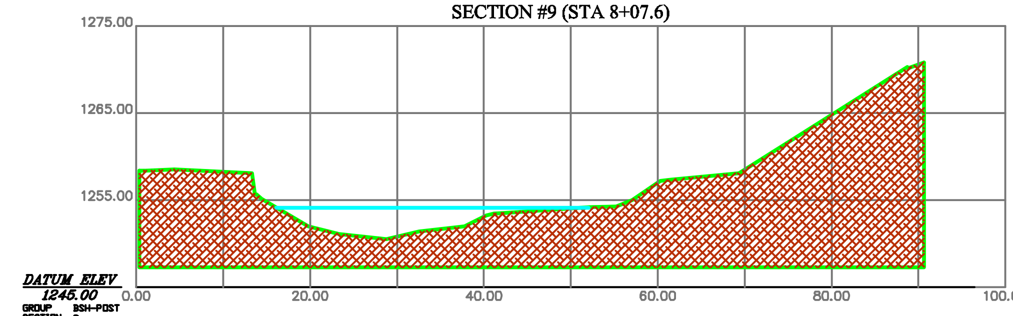
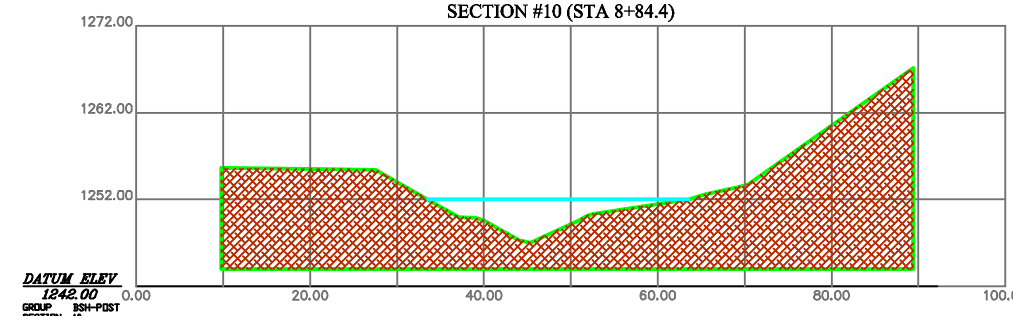


SECTION #9 (STA 8+07.6)



SECTION #10 (STA 8+84.4)



NOTE:

CROSS SECTIONS SAMPLED FROM A DECEMBER 7, 2000 POST CONSTRUCTION TOPOGRAPHIC SURVEY.

LEGEND

PROPOSED GROUND
BANKFULL SURFACE
EXISTING GROUND

REVISIONS

BROADSTREET HOLLOW
STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
DECEMBER 7, 2000	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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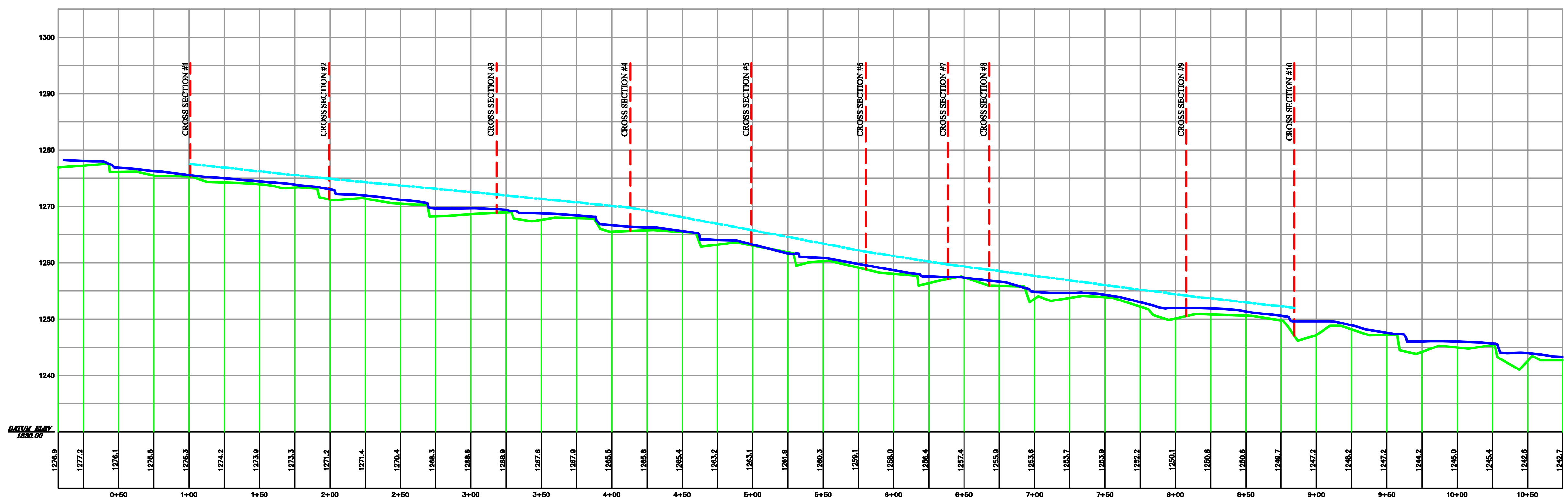
SHEET 4 OF 5	POST CONSTRUCTION MONUMENTED CROSS SECTIONS



NOTE:

POST-CONSTRUCTION PROFILE SAMPLED FROM DECEMBER 15, 2000 TOPOGRAPHIC SURVEY PERFORMED BY GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT.

LEGEND	
CONSTRUCTED THALWEG	
WATER SURFACE	
MONUMENTED CROSS SECTION	

REVISIONS

BROADSTREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
DECEMBER 15, 2000	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - 00.01
SHEET 5 OF 5	POST CONSTRUCTION LONGITUDIAL PROFILE

F.2 Project Status: Flood Event Inspection (December 17-18, 2000)

On December 17, 2000, the Broadstreet Hollow watershed experienced several inches of rain resulting in a peak flow through the stream channel equal to or exceeding the bankfull flood stage. The Broadstreet Hollow Stream Restoration Project was inspected several times during and after the flow event to document the flow conditions and project performance. Supplied in Appendix A are images of the site functioning during the flood event (Appendix A5) and following the flood event (Appendix A6). The following written description is a summary of the inspected project components.

Rock Structures:

Four of the thirteen cross vane structures experienced partial damage as a result of the flood flow. Problems associated with the structures included rotational collapse along portions of three structures and undesirable scour in areas where voids occurred between the top and footer rocks on all of the four damaged structures. The damaged structures included those located at Stations 0+50, 3+90, 4+60, and 5+25.

The primary cause of the rotational collapse is attributed to excess scour of the plunge pool immediately downstream of the structure. The scour exceeded the maximum installation depth of the footer rocks, which resulted the structure to partially collapse into the scour pool. Additionally several top rocks were moved by the flood flow presumably caused by the top rocks not being properly locked together during construction. This was noted on rock structures located at Stations 0+50, 4+60, and 5+25.

The cross vane located near station 4+60 contained the most damage of the four structures. The plunge pool scour exceeded the installation depth of the footer rocks resulting in a partial collapse of the structures top rocks and grade control sill. The rotation of the grade control sill allowed for the stream to scour upstream toward the cross vane located near station 3+90, causing a partial collapse at that structure. Further, it is felt that the scour and resulting rotational collapse was influenced by the poor clay foundation on which the structures were constructed as well as channel bottom sediment which was not sorted nor imbricated during or following the construction.

Additional problems through the four damaged structures included undesirable scour in areas where voids occurred between the top and footer rocks. Voids in the structures, larger that the available channel sediment, can lead to increased scour caused by the convergence of flow through areas of the structure. Additionally, proper deposition of sediment along the upstream face of the arms can be limited and/ or scoured by the flow concentration through the voids causing increased forces exerted on the face of the structure. This was noted at all four of the damaged structures.

Although some damage occurred to four of the thirteen rock structures, all of the cross vane structures appeared to function properly during the flood flow. The cross vanes appeared to be extremely effective at reducing the erosion and scour which potentially would have resulted prior to the installation of the project. It was felt that the four structures which experienced damage would require repair and/or maintenance, but that no immediate action needed to be taken since no threat was posed to water quality or property damage.

Sheet Pile:

The steel sheet pile wall was installed to protect the property and structure located along the lower portion of the project area. The visual inspection of the sheet pile, during and after the flood event, revealed no movement of the structure or backfill depression and settlement. The rock placed on the toe of the wall remained in place, as well as the channel alignment along the face of the wall.

Relief Wells:

The wells have been visually inspected and appear to be working effectively. A continuous small volume of clear groundwater drains from the three invert pipes and clear water is noted in the well casing to the invert elevation on all three wells. It should also be noted that during all inspections the artesian formation appears to have been mitigated and that no visible change in turbidity was noted in the project area.

Riparian Vegetation:

The installed vegetation included willow fascines and stakes which were placed along the streambanks and in the adjacent floodplain areas and conservation grass which was applied with hydro-mulch at the completion of construction. The increased shear stress produced during the event combined with the limited time for the establishment of the plants rooting system, caused some vegetative loss. Several small sections of fascine, located on the lower bank, were removed by the flood flow as well as seed and mulch located in the low bank area. It is presumed that if the vegetation had sufficient time for establishment that there would be limited vegetative damage if any.

Channel Stability:

The channel showed no evidence of large-scale deposition (aggradation) or incision (degradation) through the reach. Minor localized bank erosion was present in the area of station 3+50 and 5+00, which is attributed to structural damage of the cross vane structures described above. Further inspection of the channel revealed no clay in the active bankfull channel after the flood event. It is presumed that the bank erosion would have been partially if not entirely mitigated if the vegetation had been able to establish prior to the increased stresses caused by the flood event.

Notes:

- Extreme quantities of clay were removed from the channel prior to the cross vanes installation. The over excavation of clay material and saturated condition destabilized the subsurface foundation for the rock structures and proved to be problematic during construction. During the construction of several rock structures, it was necessary to remove all construction equipment from the work area (to prevent vibration and disturbance) and allow for the clay to solidify before continuing with rock placement. Damage to the structures and increased scour was potentially magnified as a result.

- The relatively short time span between the completion of the project construction and the flood event potentially amplified the impacts noted through the reach. Minimal to no vegetative protection (including grass), and the intensity of the event added to the destabilization of the structures.

- In consideration of these factors set forth above, it was felt that the damages exhibited were well within the limits of the project and did not require immediate repair or modification.

- The channel adjustments need to be further quantified through more detailed surveys, and the four cross vane structures sills and footers need to be repaired. Additional bioengineering and riparian planting should be completed after project repair and modifications are completed.

F.3 Project Status: Summer 2001 Inspection - Survey

Site Inspection

In July of 2001, the project site was inspected by GCSWCD, UCSWCD, and NYCDEP SMP staff in order to review the project status. The purpose of the inspection was to review the project under extreme low flow conditions in order to determine specific problems resulting from the December 17, 2000 flood event, as well as formulate recommendations for repair and/or modification. A summary of the inspection results and recommendations for repair is provided below. Photographs taken during the flood event and July inspection are included in Appendix A5 and A6 respectively.

Rock Structures:

During the storm event, four of the thirteen cross vanes structures were damaged. It is felt that the in-stream structure damage was not caused from by reach wide design issues or compounding factors but rather isolated structural problems. These deficiencies were caused by a number of factors including implementation and site considerations, time and size of the disturbance, and individual design specifications.

Specific problems, along with the recommended repair and modification, for each damaged structure is listed below:

Cross Vane - Station 0+50

Problems associated with the structure included rotational collapse along portions of structures footer rocks and undesirable scour in areas where voids occurred between the top and footer rocks. Stream flow, during periods below base flow, pass between the top rocks and the footer rocks of the structure creating a potential barrier to fish passage.

The primary cause of the rotational collapse is attributed to excess scour of the plunge pool immediately downstream of the structure. The scour exceeded the maximum installation depth of the footer rocks, which resulted the structure to partially collapse into the scour pool.

Recommendations included:

- Replacing and resetting the top rocks along the vane where deemed necessary.
- Replacing and resetting the sill rock of the vane by stepping the rocks to create more of a cascade instead of a drop.
- Backfilling the vane arms with large cobble fill to reduce voids present in the vane arms.
- Replacing the material at the bottom of the scour pool with larger cobble material.
- Placing large cobble material at the exit of the scour pool (head of the riffle)

Cross Vane - Station 3+90

Problems associated with the structure included undesirable scour in areas where voids occurred between the top and footer rocks. Voids in the structures, larger that the available channel sediment, lead to increased scour caused by the convergence of flow through areas of the structure. Proper deposition of sediment along the upstream face of the outer bank arm limited and/or scoured as a result of the flow concentration through the voids. Minor scour of the streambank vegetation was noted and attributed to the lack of proper deposition caused by the voids. Stream flow, during periods below base flow, pass between the top rocks and the footer rocks of the structures arm.

It was determined that further scour and bank erosion would only proceed to the area where the void exists and shouldn't continue further. All of the cross vane structures are installed with a bank key that extends from the vane tie in point at bankfull into the adjacent floodplain The bank key is designed to prevent sour around the structure, it is apparent at this location that the erosion has not progressed past the void and should not continue any further.

Recommendations included:

- Resetting the top rocks along the vane arm as necessary
- Backfilling the vane arms with large cobble fill to reduce voids present in the vane arms.

Cross Vane - Station 4+60

Problems associated with the structure included rotational collapse along portions of structures footer rocks and undesirable scour in areas where voids occurred between the top and footer rocks. Stream flow, during periods below base flow, pass between the top rocks and the footer rocks of the structure creating a potential barrier to fish passage.

The primary cause of the rotational collapse is attributed to excess scour of the plunge pool immediately downstream of the structure. The scour exceeded the maximum installation depth of the footer rocks, which resulted the structure to partially collapse into the scour pool.

Recommendations included:

- Replacing and resetting the top rocks along the vane where deemed necessary.
- Replacing and resetting the sill rock of the vane by stepping the rocks to create more of a cascade instead of a drop.
- Backfilling the vane arms with large cobble fill to reduce voids present in the vane arms.
- Replacing the material at the bottom of the scour pool with larger cobble material.
- Placing large cobble material at the exit of the scour pool (head of riffle)

Cross Vane - Station 5+25

Problems associated with the structure included rotational collapse along portions of structures footer rocks and undesirable scour in areas where voids occurred between the top and footer rocks. Stream flow, during periods below base flow, pass between the top rocks and the footer rocks of the structure creating a potential barrier to fish passage.

The primary cause of the rotational collapse is attributed to excess scour of the plunge pool immediately downstream of the structure. The scour exceeded the maximum installation depth of the footer rocks, which resulted the structure to partially collapse into the scour pool.

Recommendations included:

- Replacing and resetting the top rocks along the vane where deemed necessary.
- Replacing and resetting the sill rock of the vane by stepping the rocks to create more of a cascade instead of a drop.
- Backfilling the vane arms with large cobble fill to reduce voids present in the vane arms.
- Replacing the material at the bottom of the scour pool with larger cobble material.
- Placing large cobble material at the exit of the scour pool (head of riffle)

Sheet Pile:

The steel sheet pile wall was installed to protect the property and structure located along the lower portion of the project area. The visual inspection of the sheet pile, during and after the flood event, revealed no movement of the structure or backfill depression and settlement. The rock placed on the toe of the wall remained in place, as well as the channel alignment along the face of the wall.

Relief Wells:

The wells have been visually inspected and appear to be working effectively. A continuous small volume of clear groundwater drains from the three invert pipes and clear water is noted in the well casing to the invert elevation on all three wells. It should also be noted that during all inspections the artesian formation appears to have been mitigated and that no visible change in turbidity was noted in the project area.

Riparian Vegetation:

The installed vegetation included willow facines and stakes which were placed along the streambanks and in the adjacent floodplain areas and conservation grass which was applied with hydro-mulch at the completion of construction. The increased shear stress produced during the event combined with the limited time for the establishment of the plants rooting system, caused some vegetative loss. Several small sections of fascine, located on the lower bank, were removed by the flood flow as well as seed and mulch located in the low bank area.

Generally the plantings and bioengineering are doing well and are becoming established. Several isolated areas of willow fascine containing native willow species are experiencing a form of willow blight and should be monitored and inspected regularly.

Recommendations include:

- Re-seeding and mulching all disturbed areas following repair and modifications to the rock structures.
- Replacing and enhancing bioengineering and riparian plantings as needed following the repair and modification of the rock structures.

- Treating the blight infected willows as necessary to maintain proper growth.

Channel Stability:

The channel showed no evidence of large-scale deposition (aggradation) or incision (degradation) through the reach. Minor localized bank erosion was present in the area of station 3+50 and 5+00, which is attributed to structural damage of the cross vane structures described above. Further inspection of the channel revealed no clay in the active bankfull channel after the flood event. It is presumed that the bank erosion would have been partially if not entirely mitigated if the vegetation had been able to establish prior to the increased stresses caused by the flood event. Visual inspection of the reaches located upstream and downstream of the project area indicates no evidence of erosion, deposition, or lateral migration. The inspections have not shown any visual indication of turbidity in the adjacent reaches.

Project Reach Notes and Recommendations:

- To prevent the problem of increased scour below the structures it is proposed that the top sill rocks along each of the damaged cross vanes be shifted to sit upstream, instead of being placed directly on top of the footer rock. Also the placement will reduce the rotational moment of the top sill rock and provide for a more “cascade-like“ entrance over the lip into the pool behind the structures. This modification will deviate from the sharp plunge pool that was originally built. Further this modification will assist in limiting the scour depth near the footer rocks by dissipating energy away from the foundation of the rock structures.

- The bed substrate for the completed project consisted of a homogeneous mixture of cobble and gravel material. Consideration should be given to adding larger cobble material to coarsen several riffle areas near the damage structures. This would provide better resistance to bed scour and assist in the natural stratification of bed materials between riffle and pool features throughout the reach.

- During construction, each rock structure is inspected before complete backfill to identify any large voids in the vane arms or sill. If a void is larger than the available stream sediment is detected, measures are taken to reset the rock within the structure to minimize the voids. An alternative commonly used to prevent re-constructing the structure is to place large cobble (small boulder) material along the upstream face of the structure to prevent excess water and sediment from passing through the structure as opposed to over the structure. In some instances all voids can not be detected or are left to remain within the structure. It is recommended that greater care in the inspection and specification of the vane backfill material be given for the structures.

- Although vegetation expectations were met in 2000, it is recommended that the floodplain and access areas be supplemented with additional plantings and seed to ensure maximum growth and stability.

Project Reach Survey:

A monitoring survey was initiated in July of 2001 to document the project status and physical condition of the stream channel resulting from the December 17, 2000 flood and subsequent events. The monitoring included surveying the 10 monumented cross sections and complete longitudinal profile, performing composite pebble counts, and a summary of conditions. The dimensions represent changes occurring from the flood event including sections of channel where damage of the rock structures resulted as stated above. Caution must be made in performing direct comparisons between the surveys.

Cross Section Survey

At the time of the as-built survey, ten monumented cross sections were installed for use in future detailed monitoring efforts. Cross sections were monumented using capped rebar pins which are located in the topographic survey as well as recorded using GPS. Cross sections were stationed at various locations along the channel profile in order to provide monitoring for stream process and stability. The cross sections were installed through various stream features (pools, riffles, etc.) and structures in order to document stream classification, potential erosion and scour, and to document the overall channel stability.

The as-built cross section plots were sampled from a (TIN) surface, created from the post-construction topographic survey of the site. The 2001 survey included detailed sections beginning at the left control pin and continuing to the right control pin at each section. The cross sections created from the TIN surface do not provide the detail necessary to perform a direct comparison between the constructed channel and the 2001 survey. The values presented below for the 2001 survey are averages taken through multiple, feature specific cross sections. Values for riffle comparisons were obtained from cross sections 5 and 8 while values for pool comparisons were obtained from cross sections 2, 4, and 10. A more detailed data set is attached at the end of this report.

Variables	Post Construction	2001 Survey
Stream Type	B3	B3
Bankfull Width (ft.)	28.4	36.4
Bankfull Mean Depth (ft.)	1.8	2.75
Bankfull Max. Depth (ft.)	2.7	3.8
Bankfull Cross Sectional Area (ft^2)	51.2	100.7
Maximum Pool Depth (ft.)	4.25	5.99
Pool Width (ft.)	30.6	34.5

Longitudinal Profile

The longitudinal profile survey included the sampling of ground and water surface elevations along the slope breaks of the thalweg. The post-construction profile was sampled from a (TIN) surface, created from the post-construction topographic survey of the site. The 2001 survey included a detailed profile beginning and ending at the top and bottom of the project reach.

Bankfull elevations were added by reviewing cross sectional data and transposing the bankfulll elevation and station to the longitudinal profile. The sampling was tied to the original pre-restoration datum and topographic survey.

The stationing along the thalweg of each channel varies between the two years resulting from the selection of features by the field staff and minor changes in thalweg plan form. The overlay of the surveyed profiles must be used with caution since stationing is not a direct match. A comparison of general features can be made as well as the overlay of segments of the profile when matched with the permanent location of the cross sections.

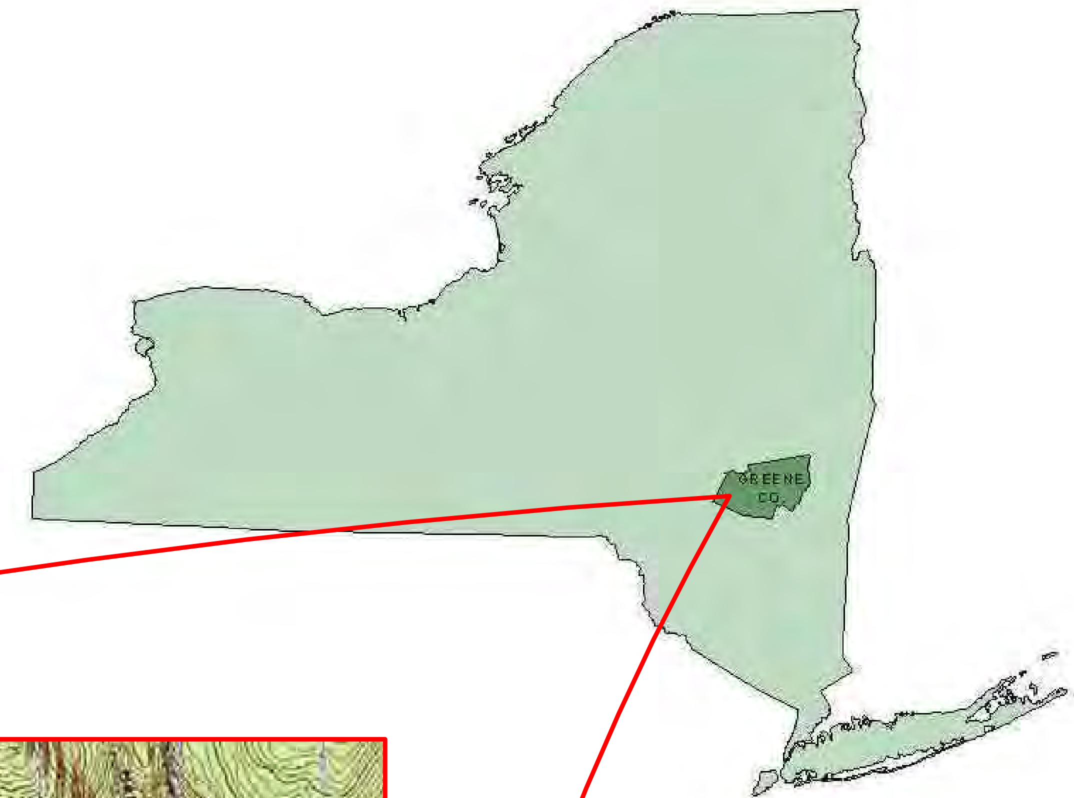
Channel alignment changes were analyzed by reviewing the cross sections and lateral alignment of the thalweg of the stream profile. Although minor erosion and deposition were noted through isolated areas of the project reach there appears to be no evidence of lateral migration or plan form change of meander radius, meander length, or sinuosity.

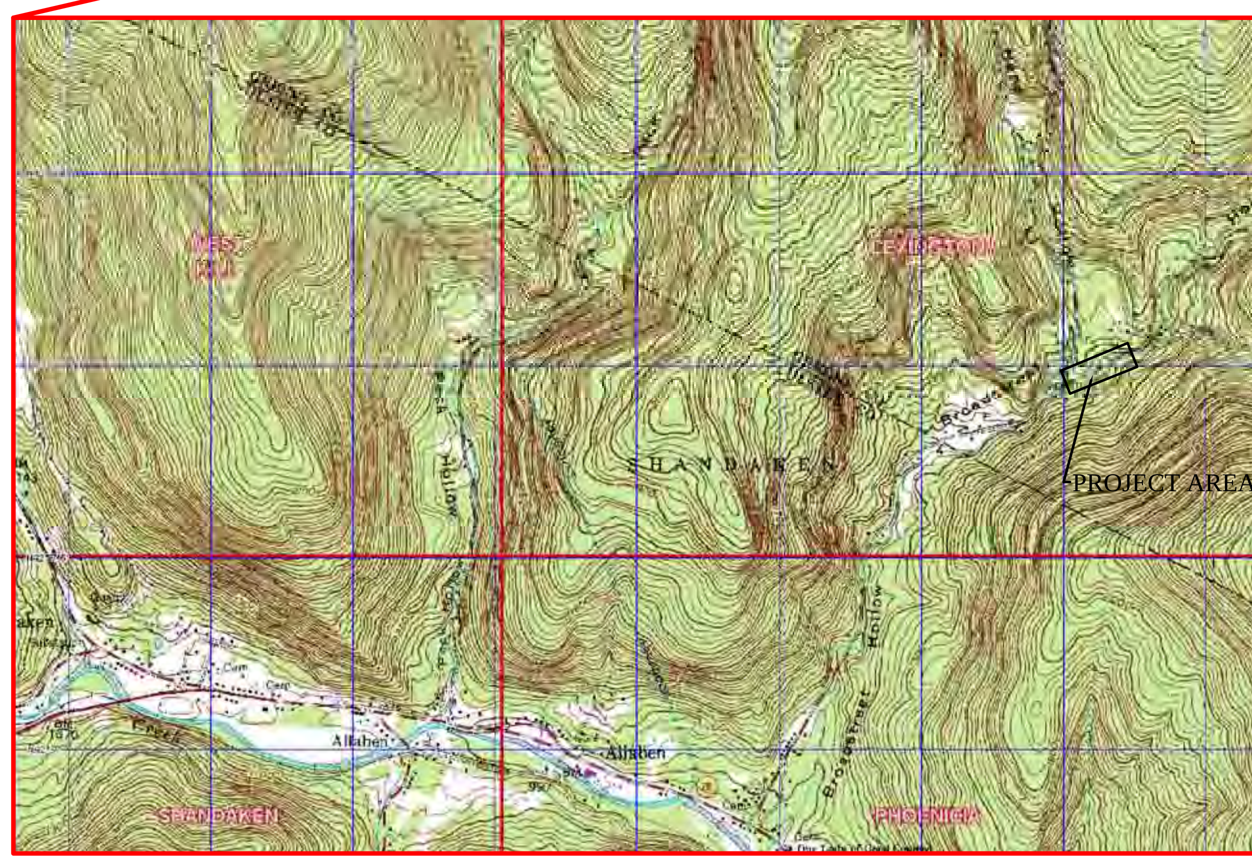
GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

STREAM MANAGEMENT PROGRAM

"BROAD STREET HOLLOW" STREAM RESTORATION PROJECT

2001 MONITORING SURVEY





SITE LOCATION MAP
(NOT TO SCALE)

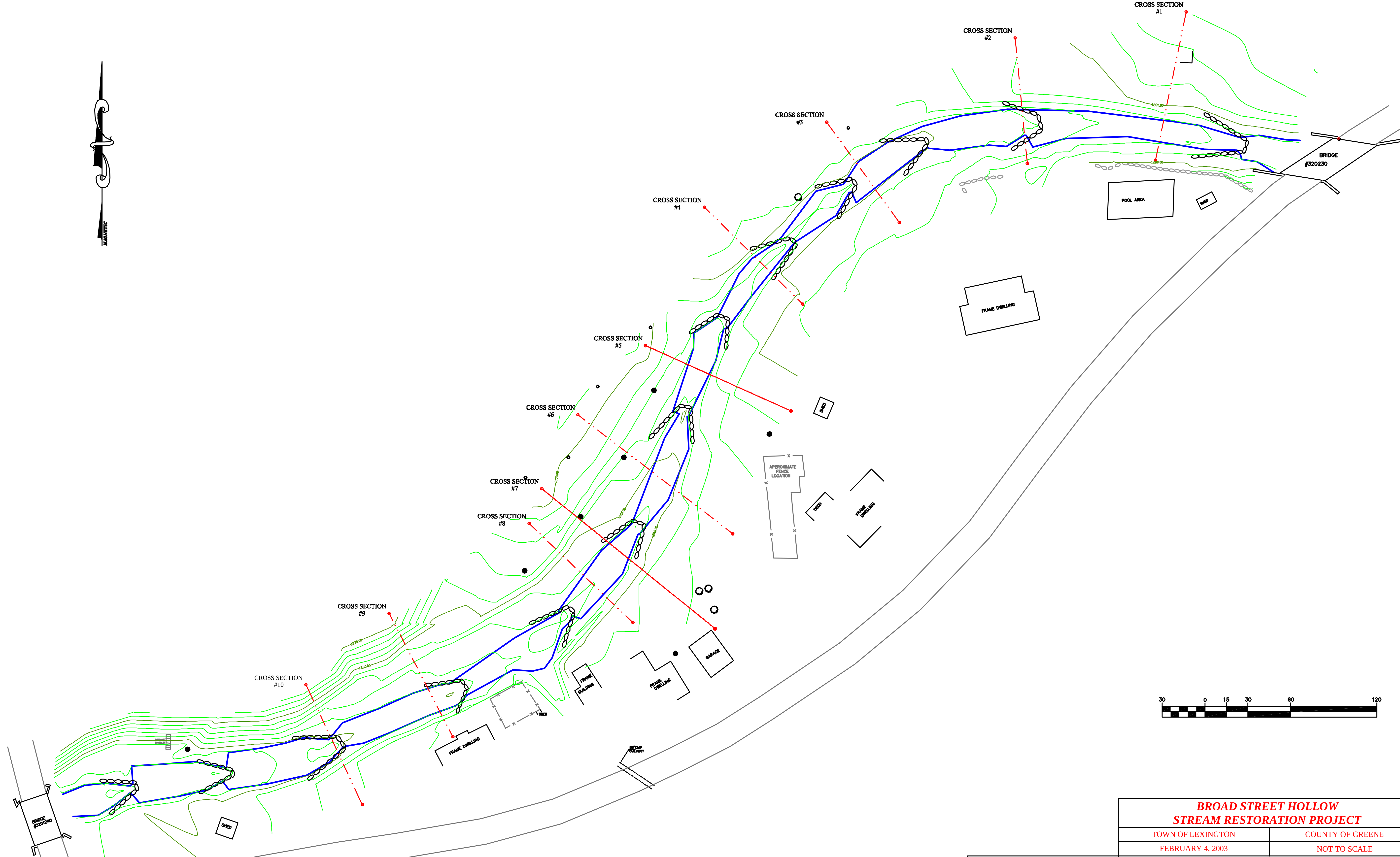
INDEX OF DRAWINGS

1. TITLE PAGE
2. POST CONSTRUCTION TOPOGRAPHIC SURVEY
3. 2001 MONITORED CROSS SECTIONS
4. 2001 MONITORED CROSS SECTIONS
5. 2001 MONITORED LONGITUDINAL PROFILE

LEGEND

REVISIONS

BROAD STREET HOLLOW STREAM RESTORATION PROJECT	
TOWN OF LEXINGTON	COUNTY OF GREENE
FEBRUARY 4, 2003	NOT TO SCALE
GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12414 PHONE (518) 622-3620 FAX (518) 622-0344	
PREPARED FOR NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION	
CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M01
SHEET 1 OF 5	TITLE PAGE



NOTE:

POST CONSTRUCTION TOPOGRAPHIC SURVEY COMPLETED ON DECEMBER 7, 2000 BY GCSWCD.

LEGEND
ROCK STRUCTURE
WATER SURFACE
MONUMENTED CROSS SECTION
CONTROL PIN
IRON ROD FOUND
RELIEF WELL

REVISIONS

BROAD STREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
FEBRUARY 4, 2003	NOT TO SCALE

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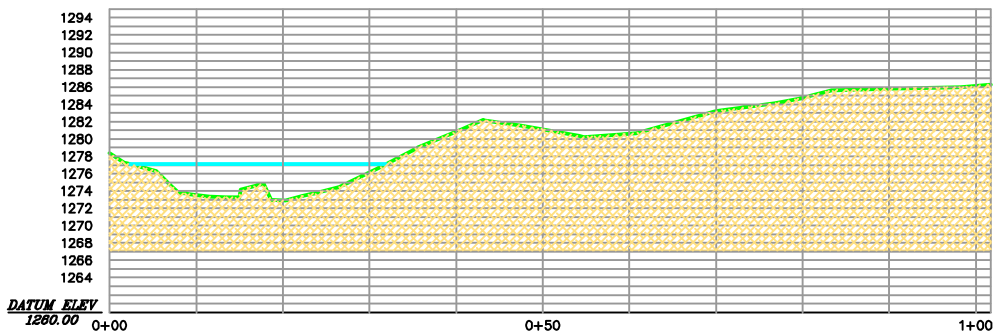
SHEET 2 OF 5	POST CONSTRUCTION TOPOGRAPHIC SURVEY
CONTOUR INTERVAL: 2'	

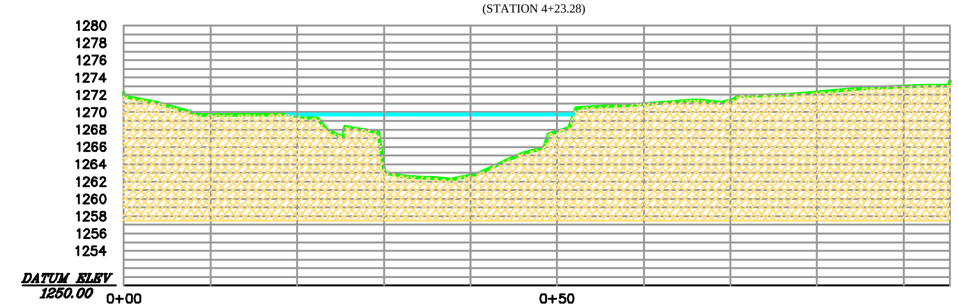
CROSS SECTION #1

(STATION 0+99.87)



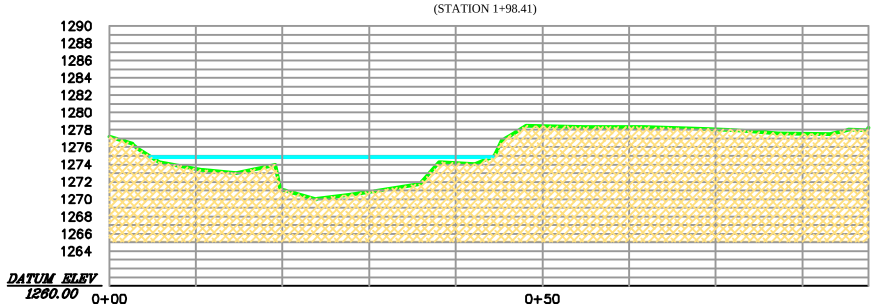
CROSS SECTION #4

(STATION 4+23.28)



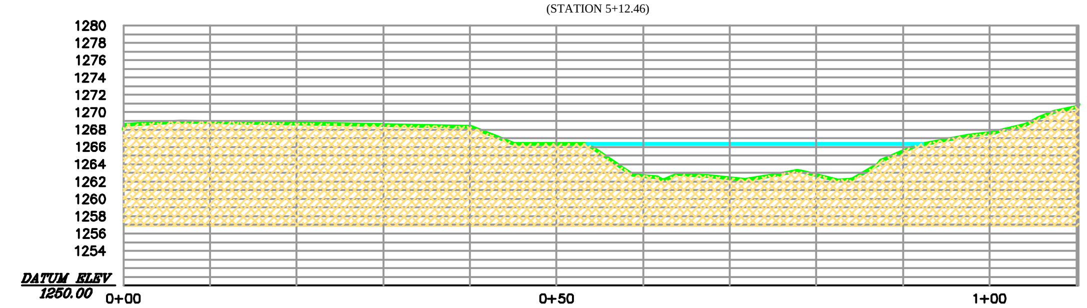
CROSS SECTION #2

(STATION 1+98.41)



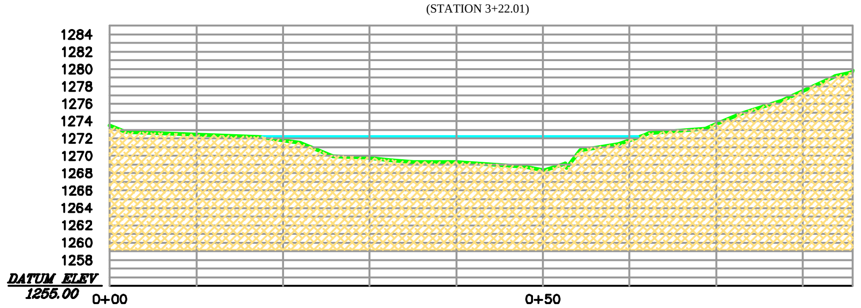
CROSS SECTION #5

(STATION 5+12.46)



CROSS SECTION #3

(STATION 3+22.01)



NOTE:

CROSS SECTIONS WERE CREATED FROM A JULY 2001 MONITORING SURVEY. POINTS WERE COLLECTED ALONG MONUMENTED CROSS SECTION USING A TOTAL STATION.

LEGEND	
2001 GROUND	green line
BANKFULL SURFACE	cyan line

REVISIONS

BROADSTREET HOLLOW STREAM RESTORATION PROJECT

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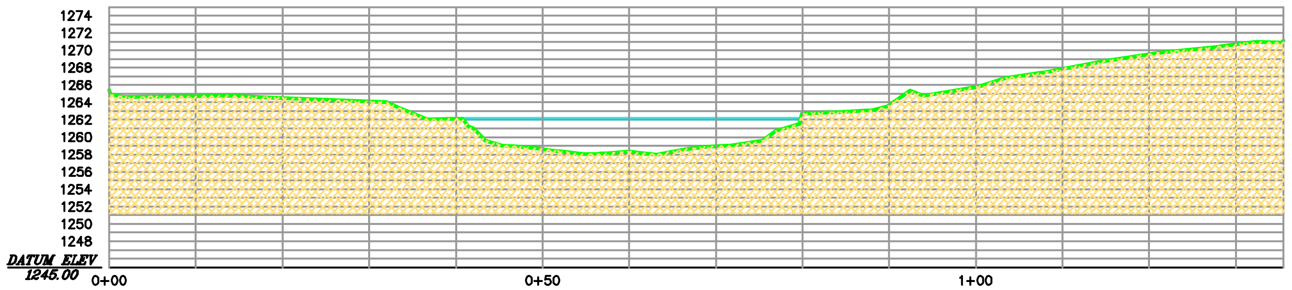
SHEET 3 OF 5	MONITORING SURVEY CROSS SECTIONS

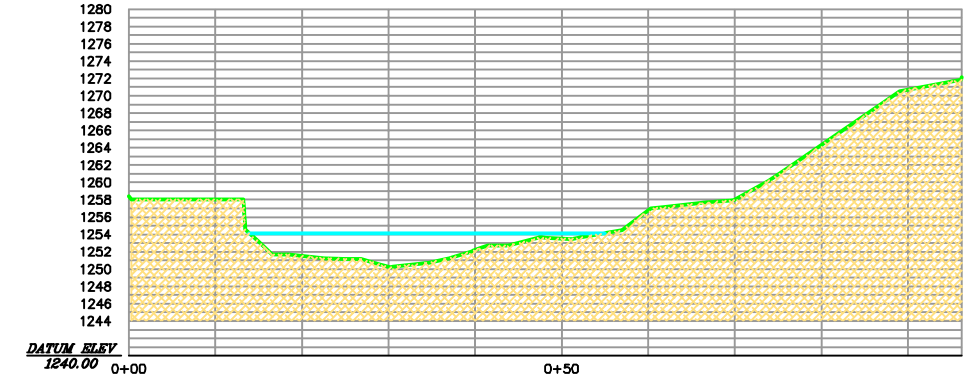
CROSS SECTION #6

(STATION 5+95.50)



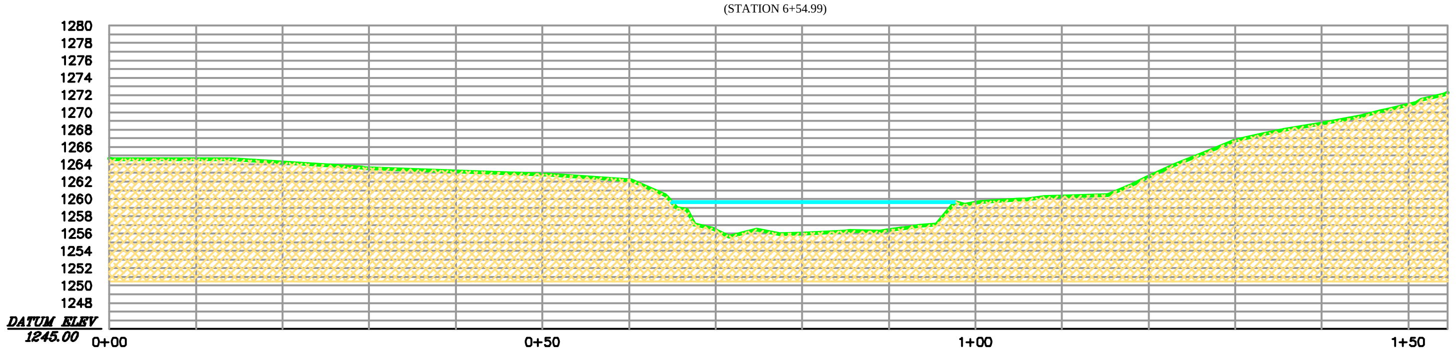
CROSS SECTION #9

(STATION 8+31.60)



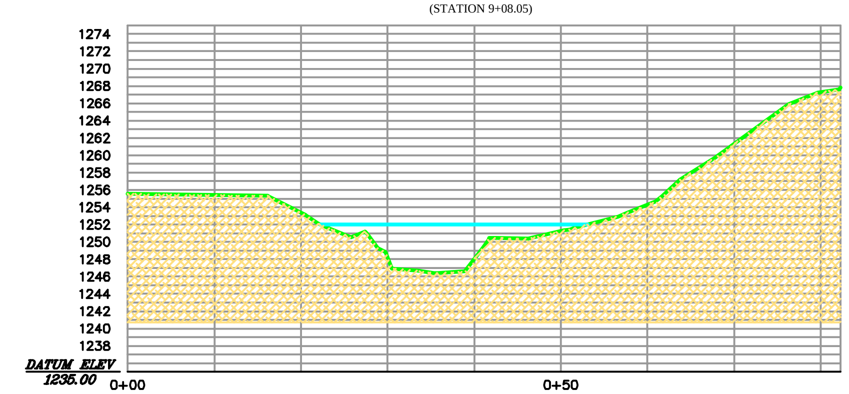
CROSS SECTION #7

(STATION 6+54.99)



CROSS SECTION #10

(STATION 9+08.05)



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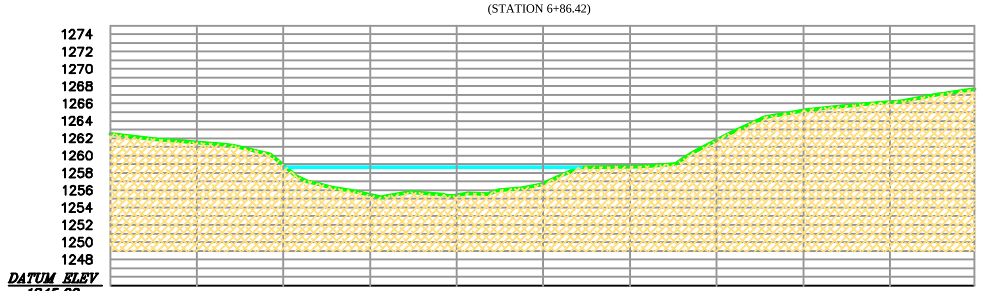
(STATION 6+86.42)



NOTE:

CROSS SECTIONS WERE CREATED FROM A JULY 2001 MONITORING SURVEY. POINTS WERE COLLECTED ALONG MONUMENTED CROSS SECTION USING A TOTAL STATION.

LEGEND

2001 GROUND

BANKFULL SURFACE

REVISIONS

BROADSTREET HOLLOW
STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
FEBRUARY 4, 2003	NOT TO SCALE

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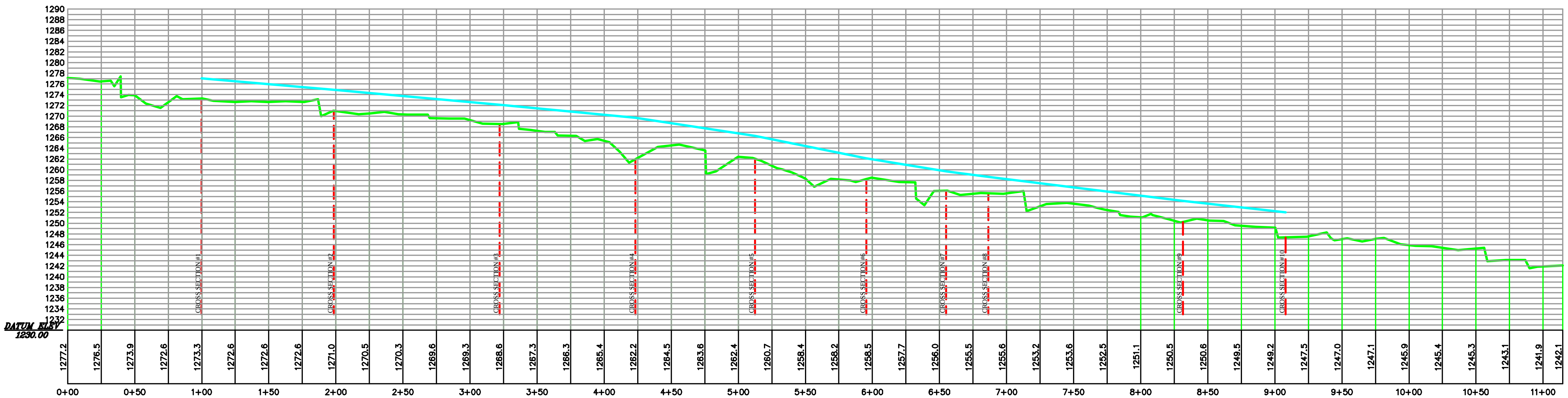
CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M01
SHEET 4 OF 5	MONITORING SURVEY CROSS SECTIONS



NOTE:

LONGITUDINAL PROFILE WAS CREATED FROM A JULY 2001 MONITORING SURVEY. POINTS WERE COLLECTED ALONG THE EXISTING CHANNEL THALWEG USING A TOTAL STATION.

LEGEND

BANKFULL SURFACE

THALWEG

CROSS SECTION

REVISIONS

BROADSTREET HOLLOW
STREAM RESTORATION PROJECT

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SHEET 5 OF 5	MONITORING SURVEY LONGITUDIAL PROFILE

F.4 Project Status: Project Modification/Repair (Summer 2001)

In October of 2001, following recommendations made during the 2001 project inspection, structure modifications and repair work was initiated throughout the Broadstreet Hollow project area. Modifications were made by GCSWCD staff and Fastracs Inc. during the first week of October with supplemental vegetative plantings installed by district staff and volunteers continuing into early winter. Photographs of the project repair are included within Appendix A.7.

The initial repair work was focused on the four damaged cross vane structures. Equipment mobilization and project site access allowed for the modification of several isolated reaches including the coarsening of the channel substrate among the four structures as well as vegetative enhancement through the entire project. Described below are the specific project modifications, implementation details, and costs associated with the repair and enhancement of the Broadstreet Hollow Project.

Repair Details

The repair and modifications to the project were implemented under permit extensions of the original project permits from the NYSDEC, ACOE, and NYCDEP. Reviewing agencies were notified of the expected work and required the work be completed in accordance with the original project permits.

A submersible pump and pipeline was used to de-water isolated sections of the channel in order that repair work was performed in dry conditions. A large excavator with a hydraulic thumb attachment, supplied by the contractor, was used to perform repair and modification to the four damaged cross vane structures. A smaller excavator and farm tractor was supplied by the District, and used to reduce the extent of disturbance during the channel modification as well as perform final grading.

Additional rock material was imported to the project site as needed for the project repairs. Material included large rock for use in re-setting portions of the damaged structures, large cobble/boulder material to provide for a coarsened stream channel in riffle features, and fill material to backfill structures.

Rock Structures:

Four rock cross vane structures were modified through the project reach. Specific tasks performed followed recommendations made during the 2001 project inspection, see Appendix F.3. Details of the project repair and modifications are listed below.

Cross Vane - Station 0+50

- Replaced and reset the top rocks along the vane where deemed necessary.
- Replaced and reset the sill rock of the vane by stepping the rocks to create more of a cascade instead of a drop.
- Backfilled the vane arms with large cobble fill to reduce voids present in the vane arms.
- Replaced the material at the bottom of the scour pool with larger cobble material.
- Placed large cobble material at the exit of the scour pool (head of the riffle)

Cross Vane - Station 3+90

- Reset the top rocks along the vane arm as needed
- Backfilled the vane arms with large cobble fill to reduce voids present in the vane arms.

Cross Vane - Station 4+60

- Replaced and reset the top rocks along the vane where necessary.
- Replaced and reset the sill rock of the vane by stepping the rocks to create more of a cascade instead of a drop.
- Backfilled the vane arms with large cobble fill to reduce voids present in the vane arms.
- Replaced the material at the bottom of the scour pool with larger cobble material.
- Placed large cobble material at the exit of the scour pool (head of riffle)

Cross Vane - Station 5+25

- Replaced and reset the top rocks along the vane where necessary.
- Replaced and reset the sill rock of the vane by stepping the rocks to create more of a cascade instead of a drop.
- Backfilled the vane arms with large cobble fill to reduce voids present in the vane arms.
- Replaced the material at the bottom of the scour pool with larger cobble material.
- Placed large cobble material at the exit of the scour pool (head of riffle)

Channel Modification

Channel Bed Substrate

Large cobble fill material was added to several riffle areas between station 0+75 and station 5+75. The cobble material was added to provide better resistance to bed scour and assist in the natural stratification of bed materials between riffle and pool features. The bed substrate for the completed project consisted of a homogenous mixture of cobble and gravel material which did not adequately reflect the natural channel armorment. The modification included the addition of approximately 300 tons of cobble to the riffle areas.

Channel Bankfull Bench

The bankfull benches from station 4+60 - 5+50 were enhanced with bank run gravel as needed and re-graded following the project repair. Floodplain areas which were disturbed were re-graded with bank run gravel. Areas accessed through portions of the project maintained as lawn were re-graded with topsoil and raked to remove all gravel and prepare for seeding.

Riparian Vegetation Enhancement

The damage caused by heavy equipment to the existing vegetation within the work area was minimized by effective staging. The disturbed areas were replanted with a conservation seed mix in floodplain areas, and a lawn mix in the access areas near bordering homes. Enhancements to the existing vegetation were accomplished by GCSWCD staff and laborers from Fastracs Inc. The planting included the addition of native willow stakes.

Project Repair/Modification Cost:

The final project repair cost was $28,1888.90. The repair work was performed under a time and material contract with Fastracs, Inc. and did not include the construction management by District staff. The table below displays the specific material types used, purpose and placement within the project area, and the specific quantities hauled to the site. Additionally the cost of each has been included as well as the time required for the repair work.

Materials	Purpose/ Placement	Quantity	Cost
Large Rip-Rap	In-Structure Repair	214 tons	$3,791.93
Cobble	Channel Bed	303 tons	$5,566.47
Bank Run Gravel	Floodplain Benches/ and Structure Backfill	105 yards	$1,102.50
Top Soil	Floodplain/ Vegetation	40 yards	$714.00
		Total Cost Materials	$11,174.90
		Labor and Equipment (7 Days)	$17,014.00
		Total Cost Materials and Labor and Equipment	$28,188.90

Recommendations

It has been typical, using natural or geomorphic restoration techniques for the project to require minor modification and maintenance within the first two years after construction. The four damaged cross vane structures were repaired successfully and appear to be functioning properly. It is recommended that the project continue to be monitored and inspected regularly in order document and changes present within the project area.

F.5 Project Status: Summer 2002 Inspection - Survey

Site Inspection and Monitoring Survey

In July of 2002 the project site was inspected and surveyed by GCSWCD staff in order to review the project status and to document the physical condition and stability of the stream channel. The inspection included a review of the overall stability, rock structures, sheet pile, relief wells, and riparian vegetation. The monitoring survey included surveying the 10 monumented cross sections and complete longitudinal profile, performing composite pebble counts, and a summary of conditions. A summary of the inspection results and recommendations is provided below. Photographs taken during various site visits in 2002 are included in Appendix A8.

Rock Structures:

Four of the thirteen cross vanes structures experienced partial damage as a result of the flood flow in December of 2000. The structures were further modified and repaired in October 2001 as outlined in Appendix F.4.

Inspection of the cross vanes revealed no visual damage, erosion, or problems associated with the structures. Minor voids in the vane arms and sills were noted, allowing small volumes of water to penetrate the structures during low flow periods but do not seem to pose any significant problems with the structural integrity or vane function. Regular deposition along the upstream portion of the vane arms appears normal and the vanes all appear to be functioning properly during various flow stages. The cross vanes appear to be effective at reducing the erosion and scour which potentially would have resulted prior to the installation of the project.

Sheet Pile:

The steel sheet pile wall was installed to protect the property and structure located along the lower portion of the project area. The visual inspection of the sheet pile, during and after the flood event, revealed no movement of the structure or backfill depression and settlement. The rock placed on the toe of the wall remained in place, as well as the channel alignment along the face of the wall.

Relief Wells:

The wells have been visually inspected and appear to be working effectively. A continuous small volume of clear groundwater drains from the three invert pipes and clear water is noted in the well casing to the invert elevation on all three wells. It should also be noted that during all inspections the artesian formation appears to have been mitigated and that no visible change in turbidity was noted in the project area.

Riparian Vegetation:

The installed vegetation included willow fascines and stakes which were placed along the streambanks and in the adjacent floodplain areas and conservation grass which was applied with hydro-mulch. Additional bioengineering was installed during the 2001 project repair as outlined in Appendix F.4 as well as riparian planting installed by volunteers in the Spring of 2002 to include streamco willow, silky dogwood and hybrid poplar.

The conservation seed mix is becoming established primarily with birdsfoot trefoil having rigorous growth and only minor take of fescue and rye grass. The bionegineering and planting appear to be establishing appropriately despite heavy browsing by deer. It is expected that mild browsing will result in increased generation of plant rooting and subsequent plant top growth once the plants become established. The extent of the browsing should be monitored and mitigated if necessary until the planting become established.

Recommendations include:

- Enhancing bioengineering and riparian plantings as needed.
- Continued monitoring and inspection for signs of willow blight and over browsing.

Channel Stability:

The channel showed no evidence of large-scale deposition (aggradation) or incision (degradation) through the reach. There was no visual stream bank erosion noted during the project inspection and there was no glacial clays visibly present in the channel bottom or stream.

Visual inspection of the reaches located upstream and downstream of the project area indicates no evidence of erosion, deposition, or lateral migration. The inspections have not shown any visual indication of turbidity in the adjacent reaches.

Project Reach Survey:

A monitoring survey was initiated in July of 2002 to document the annual project status and physical condition of the stream channel. The monitoring included surveying the 10 monumented cross sections and complete longitudinal profile, performing composite pebble counts, and a summary of conditions. The dimensions presented represent changes occurring during the monitoring period as well as modifications made during the project modifications and repair in 2001.

Cross Section Survey

At the time of the as-built survey, ten monumented cross sections were installed for use in future detailed monitoring efforts. Cross sections were monumented using capped rebar pins which are located in the topographic survey as well as recorded using GPS. Cross sections were stationed at various locations along the channel profile in order to provide monitoring for stream process and stability. The cross sections were installed through various stream features (pools, riffles, etc.) and structures in order to document stream classification, potential erosion and scour, and to document the overall channel stability.

Caution must be made in performing direct comparisons between the 2001 and 2002 surveys since there was no surveyed performed directly after the project modifications were made. The values presented below for the 2002 survey are averages taken through multiple, feature specific cross sections. Values for riffle comparisons were obtained from cross sections 5 and 8 while values for pool comparisons were obtained from cross sections 2, 4, and 10. A more detailed data set is attached at the end of this report.

Variables	2001 Survey	2002 Survey
Stream Type	B3	B3
Bankfull Width (ft.)	36.4	39.8
Bankfull Mean Depth (ft.)	2.75	2.34
Bankfull Max. Depth (ft.)	3.8	3.6
Bankfull Cross Sectional Area (ft^2)	100.7	93.8
Maximum Pool Depth (ft.)	5.99	4.66
Pool Width (ft.)	34.5	32.8

Longitudinal Profile

The longitudinal profile survey included the sampling of ground and water surface elevations along the slope breaks of the thalweg. The 2001 and 2002 survey included a detailed profile beginning and ending at the top and bottom of the project reach. Bankfull elevations were added by reviewing cross sectional data and transposing the bankfull elevation and station to the longitudinal profile.

The stationing along the thalweg of each channel varies between the two years resulting from the selection of features by the field staff and minor changes in thalweg plan form. The overlay of the surveyed profiles must be used with caution since stationing is not a direct match. A comparison of general features can be made as well as the overlay of segments of the profile when matched with the permanent location of the cross sections.

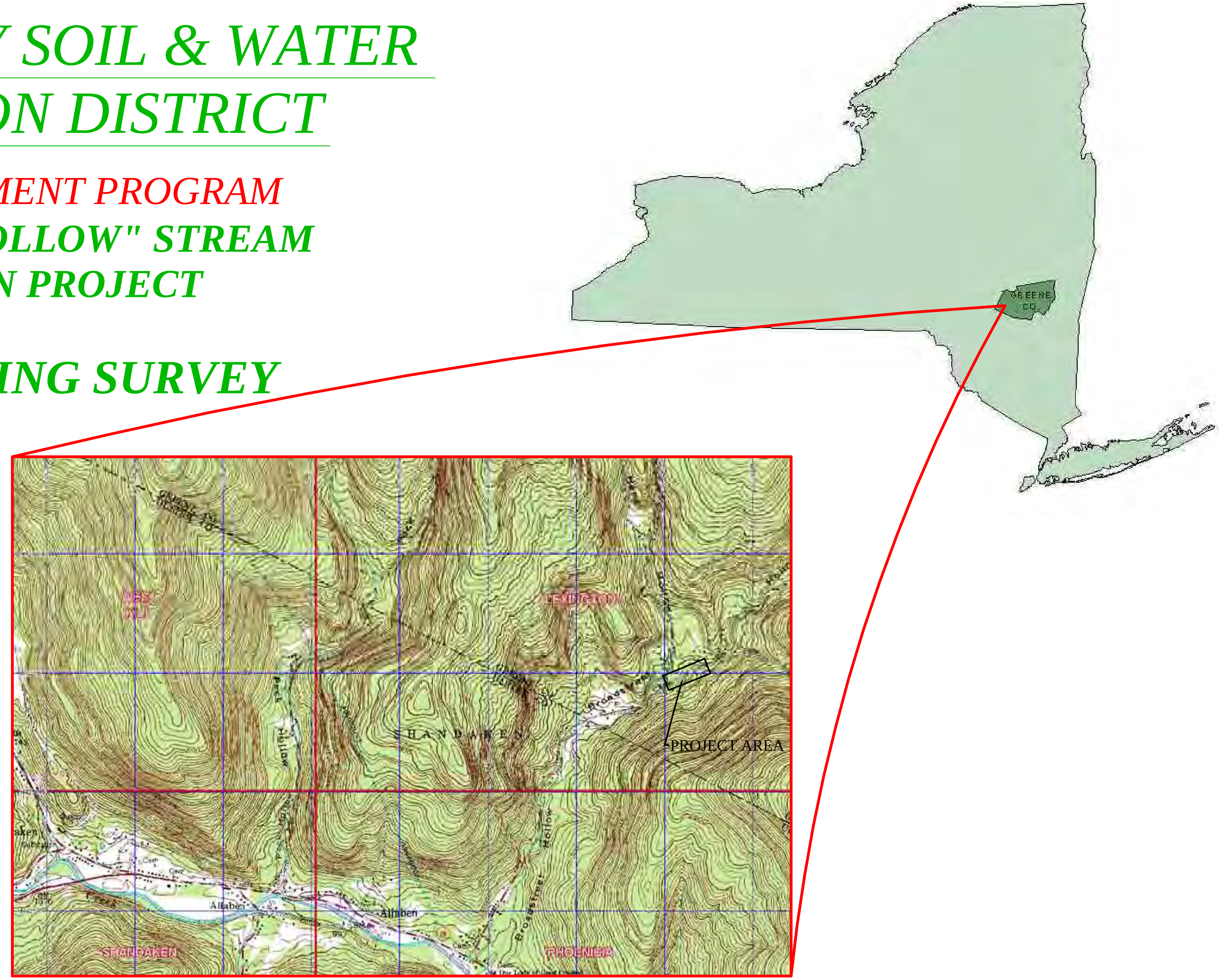
Channel alignment changes were analyzed by reviewing the cross sections and lateral alignment of the thalweg of the stream profile. Although minor erosion and deposition were noted through isolated areas of the project reach there appears to be no evidence of lateral migration or plan form change of meander radius, meander length, or sinuosity.

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

STREAM MANAGEMENT PROGRAM

"BROAD STREET HOLLOW" STREAM RESTORATION PROJECT

2002 MONITORING SURVEY



SITE LOCATION MAP
(NOT TO SCALE)

INDEX OF DRAWINGS

LEGEND

REVISIONS

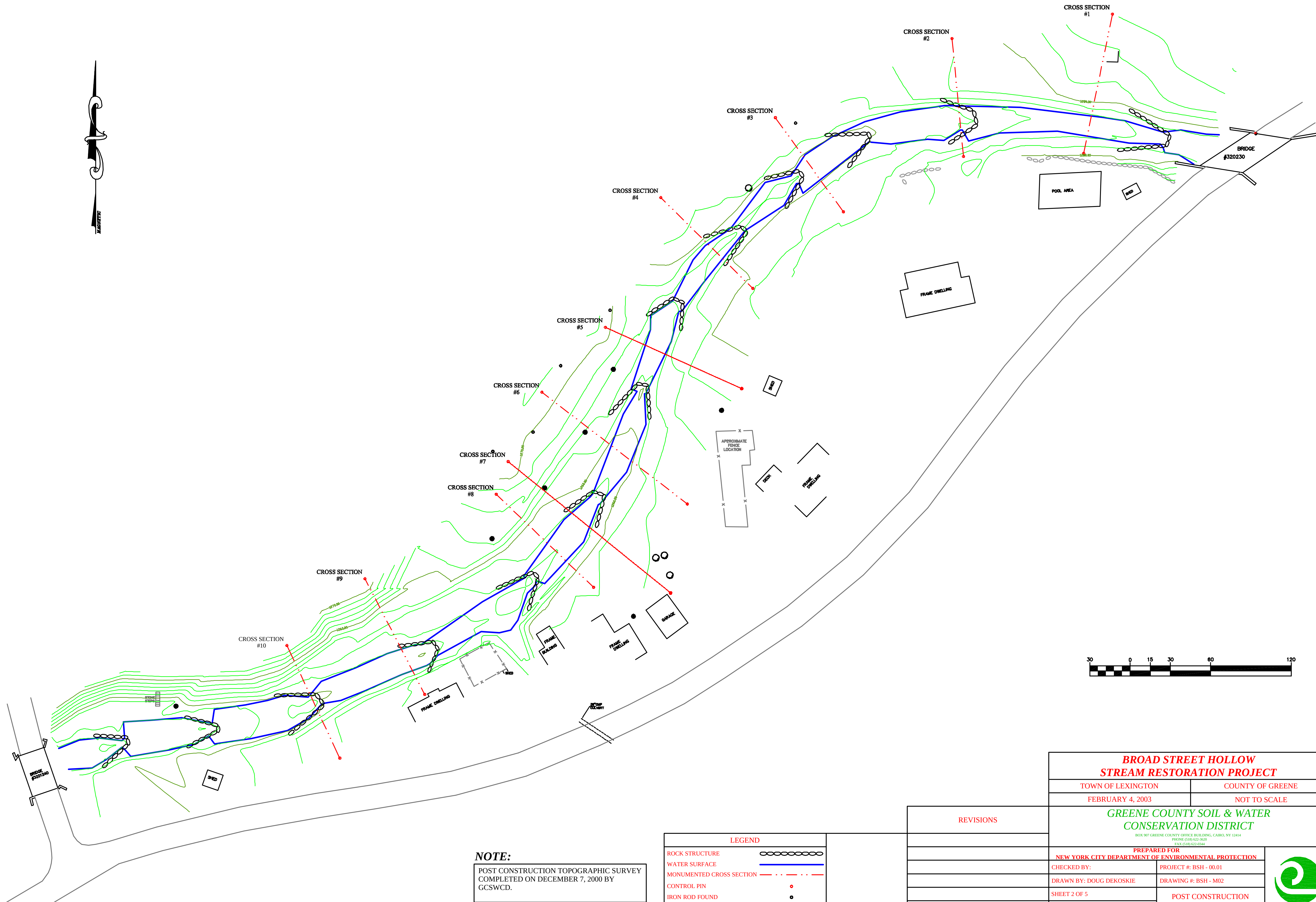
BROAD STREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
FEBRUARY 4, 2003	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT
BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12414
PHONE (518) 622-3620
FAX (518) 622-0344

PREPARED FOR NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M02
SHEET 1 OF 5	TITLE PAGE



NOTE:

POST CONSTRUCTION TOPOGRAPHIC SURVEY COMPLETED ON DECEMBER 7, 2000 BY GCSWCD.

LEGEND	
ROCK STRUCTURE	
WATER SURFACE	
MONUMENTED CROSS SECTION	
CONTROL PIN	
IRON ROD FOUND	
RELIEF WELL	

REVISIONS

BROAD STREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
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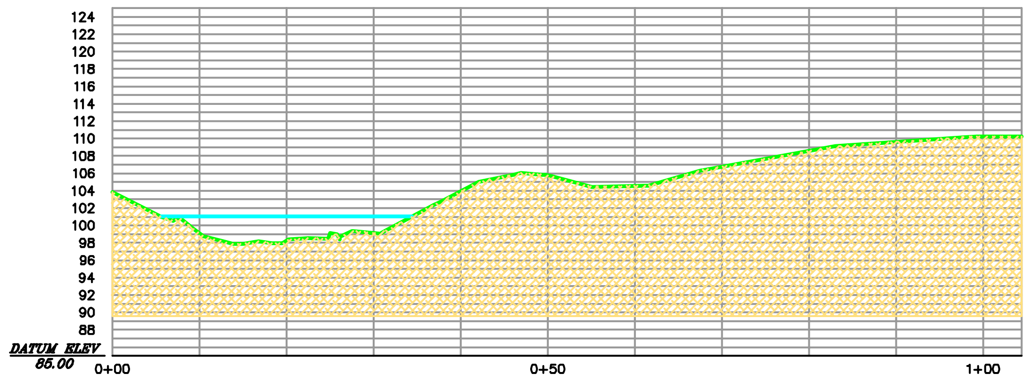
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M02
SHEET 2 OF 5	POST CONSTRUCTION TOPOGRAPHIC SURVEY
CONTOUR INTERVAL: 2'	

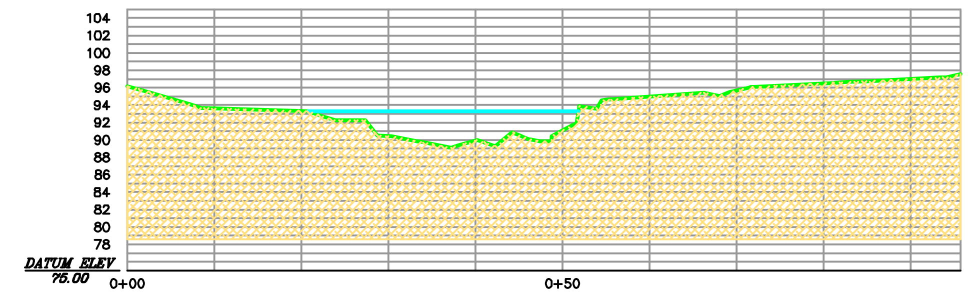
CROSS SECTION #1

(STATION 0+94.32)



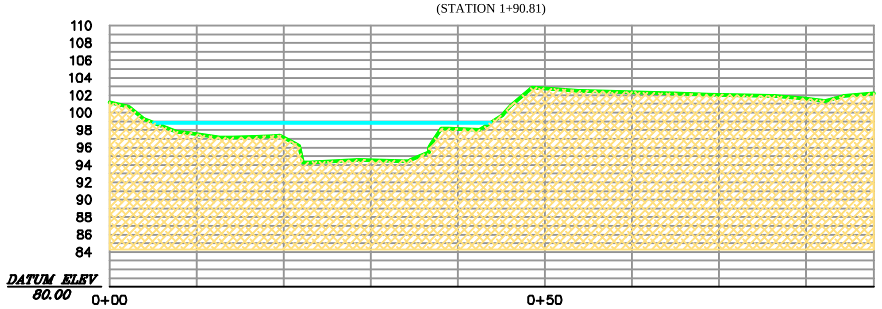
CROSS SECTION #4

(STATION 4+03.11)



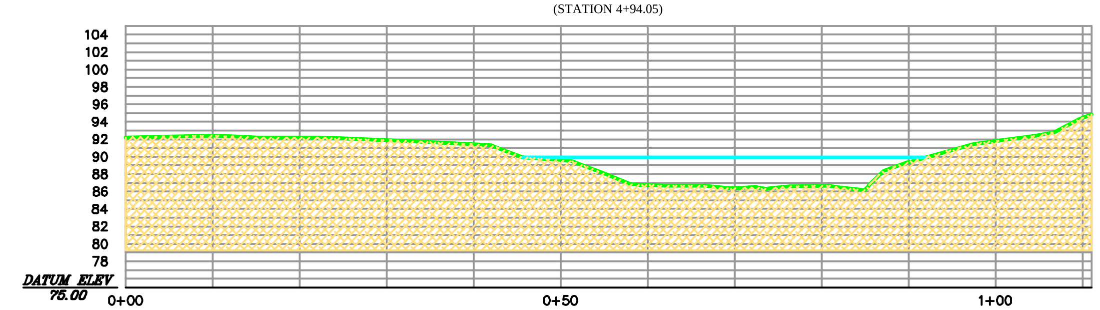
CROSS SECTION #2

(STATION 1+90.81)



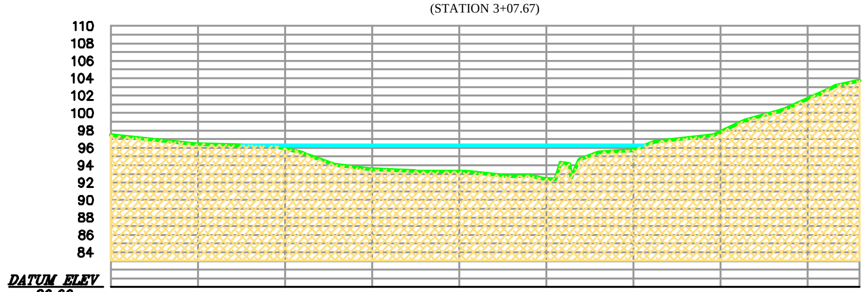
CROSS SECTION #5

(STATION 4+94.05)



CROSS SECTION #3

(STATION 3+07.67)



NOTE:

CROSS SECTIONS WERE CREATED FROM A JULY 2002 MONITORING SURVEY. POINTS WERE COLLECTED ALONG MONUMENTED CROSS SECTION USING A TOTAL STATION.

LEGEND	
2001 GROUND	(green line)
BANKFULL SURFACE	(cyan line)

REVISIONS

BROADSTREET HOLLOW
STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
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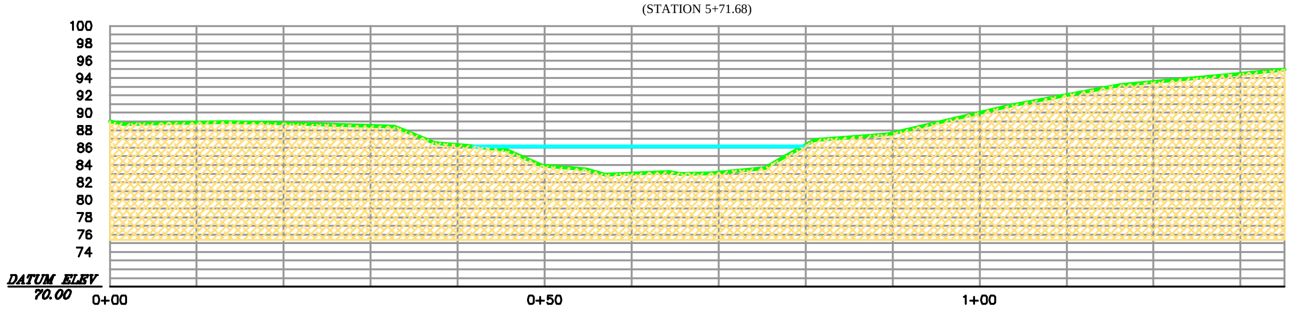
SHEET 3 OF 5	MONITORING SURVEY CROSS SECTIONS

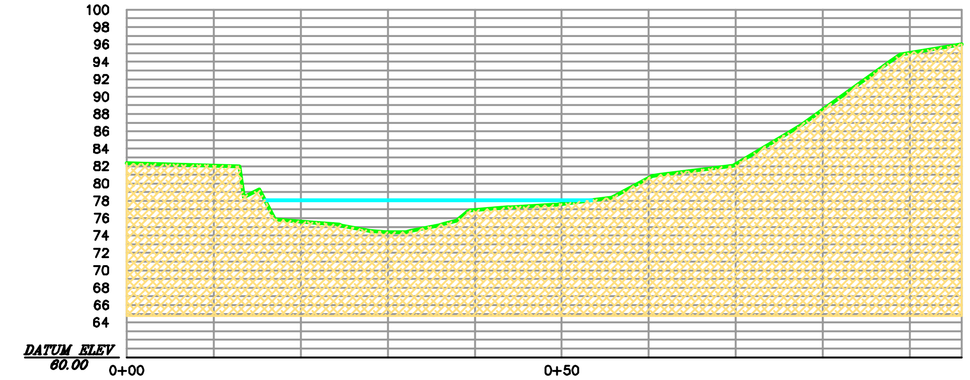
CROSS SECTION #6

(STATION 5+71.68)



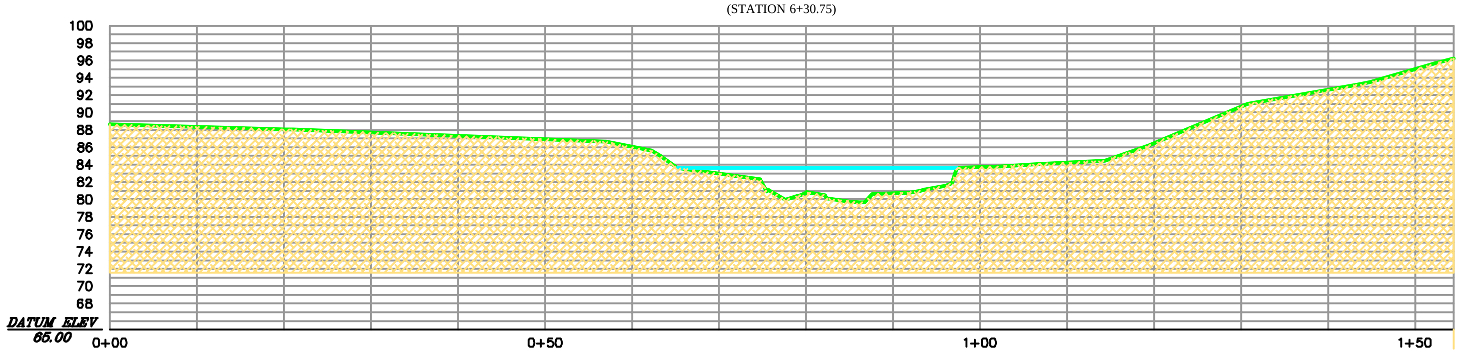
CROSS SECTION #9

(STATION 8+03.06)



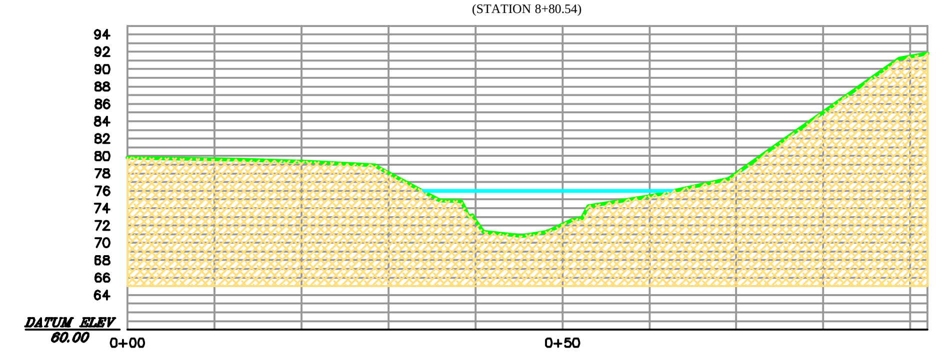
CROSS SECTION #7

(STATION 6+30.75)



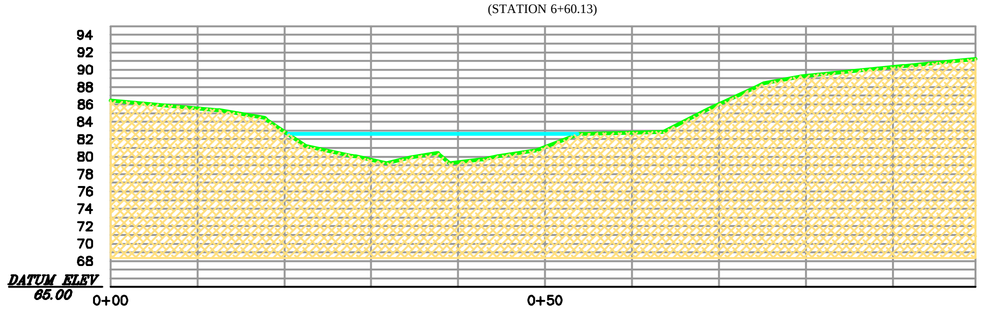
CROSS SECTION #10

(STATION 8+80.54)



CROSS SECTION #8

(STATION 6+60.13)



NOTE:

CROSS SECTIONS WERE CREATED FROM A JULY 2002 MONITORING SURVEY. POINTS WERE COLLECTED ALONG MONUMENTED CROSS SECTION USING A TOTAL STATION.

LEGEND	
2001 GROUND	
BANKFULL SURFACE	

REVISIONS

BROADSTREET HOLLOW
STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
FEBRUARY 4, 2003	NOT TO SCALE

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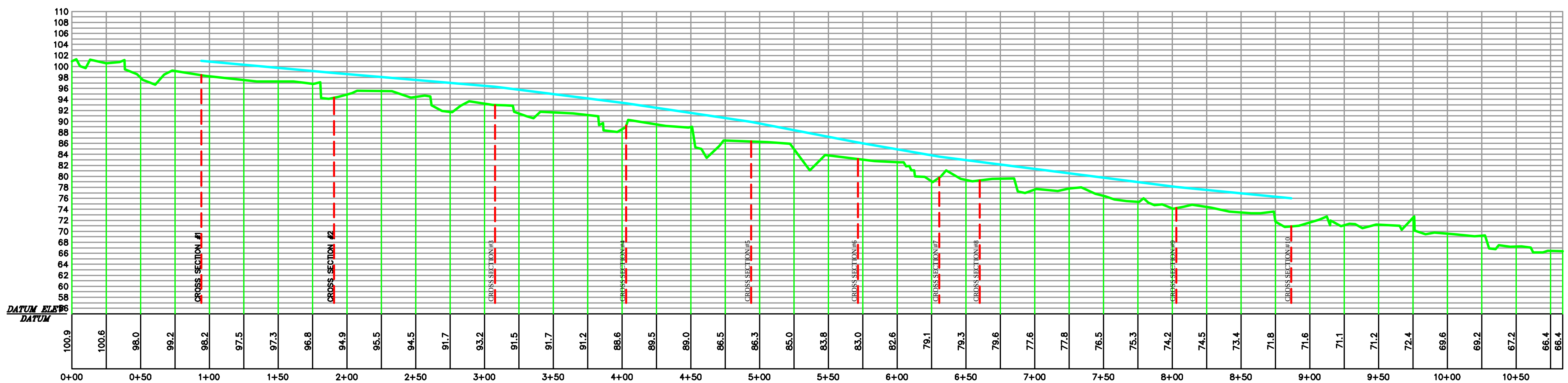
CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M02
SHEET 4 OF 5	MONITORING SURVEY CROSS SECTIONS



NOTE:

LONGITUDINAL PROFILE WAS CREATED FROM A JULY 2002 MONITORING SURVEY. POINTS WERE COLLECTED ALONG THE EXISTING CHANNEL THALWEG USING A TOTAL STATION.

LEGEND	
BANKFULL SURFACE	
THALWEG	
CROSS SECTION	

REVISIONS

BROADSTREET HOLLOW
STREAM RESTORATION PROJECT

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CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M02
SHEET 5 OF 5	MONITORING SURVEY LONGITUDIAL PROFILE

F.6 Project Status: Fisheries and Habitat 2002

The following summary of results was extracted from the draft report “Preliminary results of fishery surveys of Broad Street Hollow study reaches, 1999-2002", provided by B.P. Baldigo from the U.S. Geological Survey. The assessment is an ongoing effort to monitor fish populations and communities in the project area in comparison with control and reference habitat reaches.

Results:

Community data from the 1999, 2000, and 2002 surveys (Table 1) show that the stable Broad Street Hollow reference site generally had a similar number of species and diversity as the unstable project reach. Biomass was also higher at the reference reach than at the unstable project and control reaches before restoration, but higher at the project reach after restoration. The number of species, diversity, and density was higher at the unstable control reach than at both the treatment and reference reach in 2000, before restoration. The fish community at the control reach is strongly affected by it’s proximity to the Esopus River, thus, it is not directly comparable to that observed at the project reach. After restoration, brook trout were more common and the biomass of all species, especially rainbow trout, increased considerably at the restored reach. Though annual variations in all indices occur naturally, some changes may be related to the effects of restoration and increases in channel stability and quality of fish habitat. Findings generally support the hypotheses that (1) fish communities in unstable reaches differ from communities from stable reaches and (2) stream habitat and fisheries at unstable reaches may be improved by channel restoration.

Table 1. Fish-community indices from Broad St. Hollow study reaches, 1999-2002.

Community Index	Project/Treatment	Control	Reference
	1999 (pretreated)		
Community richness	5	na	4
Community density	1.21	na	1.25
Community biomass	9.03	na	15.40
Species diversity		na	1.60
	2000 (pretreated)		
Community richness	3	9	4
Community density	0.52	0.71	0.53
Community biomass	5.49	6.71	8.46
Species diversity	1.25	3.51	1.73
	2002 (restored)		
Community richness	4	8	4
Community density	1.53	3.18	0.89
Community biomass	16.45	15.91	7.32

Density of fish populations observed at the three reaches (Fig. 2) during 2000 suggest underlying causes for observed differences in community indices. Fish communities at the treatment and reference reaches during 2000 consisted entirely of slimy sculpin, brown, and rainbow trout. Trout made up a larger percentage of fish at the reference site, where a small number brook trout were also observed. The community at the control reach contained many fish species in relatively high numbers. Trout made up 12% of the community at the control reach, and they constituted 34% of the total number of fish at the reference reach.

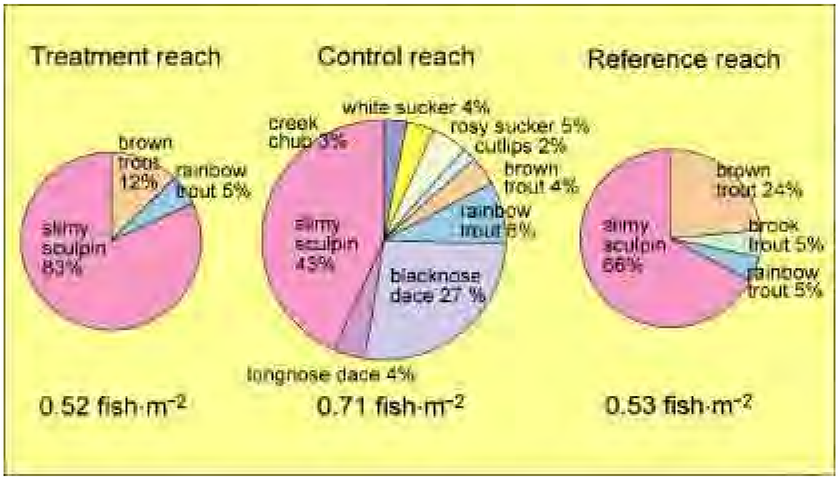


Figure 2. Density of fish communities from treatment, control, and reference reaches in Broad Street Hollow, 2000.

Estimates of species biomass at the three reaches in 2000 (Fig. 3) tell a different story. Trout dominated community biomass at the two upstream reaches. Trout biomass decreased from about 3.7 g/m^2 at the downstream control reach, to 2.1 g/m^2 at the treatment reach, and increased to about 7 g/m^2 at the furthest upstream reference reach. Biomass of slimy sculpin and blacknose dace did not dominate the community as their densities (Fig. 2) might suggest. During 2000, biomass at the control reach was evenly balanced among trout, sculpin, dace, and several other species (suckers and the creek cub).

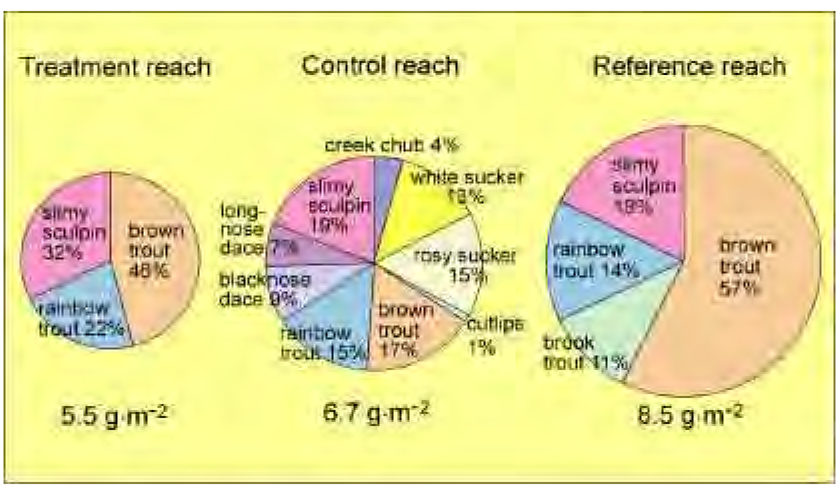


Figure 3. Biomass of fish populations from treatment, control, and reference reaches in Broad Street Hollow, 2000.

Variations in species densities before and after stream restoration at the project/treatment reach are shown in figure 4. Densities of each species population decreased from 1999 to 2000, however, relative proportions of each species changed little. Community density and population densities increased at this reach following restoration. The density of each population increased, but all three trout species increased more relative to sculpin densities. No brook trout were collected in 2000 and only one was observed in 1999. The large increase in rainbow and brown trout was related mainly to the large number of young-of-the-year of both species that were collected in 2002. Year-to-year differences in community density were likely related to normal variations in precipitation, temperature, runoff, reproductive success and other factors that generally affect all resident species similarly. Changes in species richness and the proportion of each species present may be related to the effects of channel restoration.

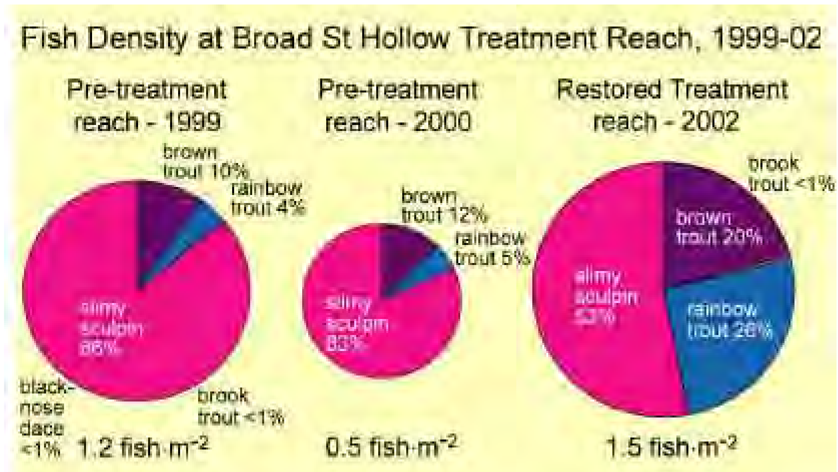


Figure 4. Estimates of fish-species densities at the project/treatment reach before (1999 and 2000) and after restoration (2002).

Variations in species biomass before and after stream restoration at the project/treatment reach (Fig. 5) follow similar trends as species densities (Fig. 4). Biomass of each population decreased from 1999 to 2000, however, relative proportions changed only slightly. Biomass of each population and the overall community increased following restoration, however, biomass of rainbow (and brook) trout species increased more relative to sculpin and brown trout populations. Year-to-year differences in community biomass were likely related to normal variations in precipitation, temperature, runoff, reproductive success and other factors that generally affect all resident species in a similar fashion. The presence of more brook trout and the relatively large increase in rainbow trout biomass (and density) may be related to the effects of stream restoration.

Figure 5. Estimates of fish-species biomass at the project/treatment reach before (199 and 2000) and after restoration (2002).

In general, the fish community at the stable reference reach was typical of productive headwater systems of the Catskill Region; juvenile and mature brook trout and slimy sculpin were common. Brown and rainbow trout were present in large numbers and their biomass was higher than expected for such a small headwater system. This may be related to the stream's short length and the reach's proximity to the Esopus River. The fish community at the unstable treatment reach was unusual in that brook trout were rare or absent during two surveys. Fish communities at Broad Street Hollow, before restoration differed between reference and unstable reaches, between control and treatment reaches, and were generally of higher quality (for a trout fishery) at the stable reference reach. Changes in species richness and the proportions of sculpin and trout in the project/treatment reach after restoration suggest that increased channel stability and habitat changes may have affected resident fish populations and the overall fish community.

Additional fishery and habitat surveys and more complete data analyses are needed to verify these interpretations and results. All findings are subject to change, thus they need to be treated as preliminary and cited as unpublished data or personal communication. For example, community biomass and density estimates were based on unit-area samples and vary greatly with habitat volume and area; final interpretation of annual trends and changes in each index, therefore, will need to be standardized against annual variations in flow and other factors.

F.7 Project Status: Summer 2003 Inspection - Survey

Site Inspection and Monitoring Survey

In July of 2003 the project site was inspected and surveyed by GCSWCD staff in order to review the project status and to document the physical condition and stability of the stream channel. The inspection included a review of the overall stability, rock structures, sheet pile, relief wells, and riparian vegetation. The monitoring survey included surveying the 10 monumented cross sections and complete longitudinal profile, performing composite pebble counts, and a summary of conditions. A summary of the inspection results and recommendations is provided below. Photographs taken during various site visits in 2003 are included in Appendix A9 and A10.

Rock Structures:

Inspection of the cross vanes revealed no visual damage, erosion, or problems associated with the structures. Minor voids in the vane arms and sills were noted, allowing small volumes of water to penetrate the structures during low flow periods but do not seem to pose any significant problems with the structural integrity or vane function. Regular deposition along the upstream portion of the vane arms appears normal and the vanes all appear to be functioning properly during various flow stages. The cross vanes appear to be effective at reducing the erosion and scour which potentially would have resulted prior to the installation of the project.

Sheet Pile:

The steel sheet pile wall was installed to protect the property and structure located along the lower portion of the project area. The visual inspection of the sheet pile, during and after the flood event, revealed no movement of the structure or backfill depression and settlement. The rock placed on the toe of the wall remained in place, as well as the channel alignment along the face of the wall.

Relief Wells:

The wells have been visually inspected and appear to be working effectively. A continuous small volume of clear groundwater drains from the three invert pipes. Clear water is noted in the well casing to the invert elevation on all three wells. One of the well caps has a broken seal and should be replaced. All three well caps are not locked It should also be noted that during the inspection the artesian formation appears to have been mitigated and that no visible change in turbidity was noted in the project area.

Riparian Vegetation:

The overall bioengineering treatments that have been made to date seem to be increasing in growth and density. It is believed the plants have benefitted from the wet Spring and Summer of 2003. Substantial growth was noticed on both the native and hybrid varieties of willows and dogwoods within the bankfull channel. Variable success was noticed on tree planting on the large bank. Varieties of low growing clover seem to be dominating growth of species on the bank, although a number of white pine transplants seem to be thriving in this area.

Channel Stability:

The channel showed no evidence of large-scale deposition (aggradation) or incision (degradation) through the reach. There was no visual stream bank erosion noted during the project inspection and there was no glacial clays visibly present in the channel bottom or stream.

Visual inspection of the reaches located upstream and downstream of the project area indicates no evidence of erosion, deposition, or lateral migration. The inspections have not shown any visual indication of turbidity in the adjacent reaches.

Project Reach Survey:

A monitoring survey was initiated in July of 2003 to document the annual project status and physical condition of the stream channel. The monitoring included surveying the 10 monumented cross sections and complete longitudinal profile, performing composite pebble counts, and a summary of conditions. The dimensions below represent changes occurring during the monitoring period in 2001, 2002 and 2003.

Cross Section Survey

At the time of the as-built survey, ten monumented cross sections were installed for use in future detailed monitoring efforts. Cross sections were monumented using capped rebar pins which are located in the topographic survey as well as recorded using GPS. Cross sections were stationed at various locations along the channel profile in order to provide monitoring for stream process and stability. The cross sections were installed through various stream features (pools, riffles, etc.) and structures in order to document stream classification, potential erosion and scour, and to document the overall channel stability.

Caution must be made in performing direct comparisons between the 2001 and 2002 surveys since there was no surveyed performed directly after the project modifications were made. The values presented below survey are averages taken through multiple, feature specific cross sections. Values for riffle comparisons were obtained from cross sections 5 and 8 while values for pool comparisons were obtained from cross sections 2, 4, and 10. A more detailed data set is attached at the end of this report.

Variables	2001 Survey	2002 Survey	2003 Survey
Stream Type	B3	B3	B3
Bankfull Width (ft.)	36.4	39.8	39.6
Bankfull Mean Depth (ft.)	2.75	2.34	2.38
Bankfull Max. Depth (ft.)	3.8	3.6	3.6
Bankfull Cross Sectional Area (ft^2)	100.7	93.8	94.2
Maximum Pool Depth (ft.)	5.99	4.66	4.38
Pool Width (ft.)	34.5	32.8	31.8

Longitudinal Profile

The longitudinal profile survey included the sampling of ground and water surface elevations along the slope breaks of the thalweg. The survey included a detailed profile beginning and ending at the top and bottom of the project reach. Bankfull elevations were added by reviewing cross sectional data and transposing the bankfull elevation and station to the longitudinal profile.

The stationing along the thalweg of each channel varies between the years resulting from the selection of features by the field staff and minor changes in thalweg plan form. The overlay of the surveyed profiles must be used with caution since stationing is not a direct match. A comparison of general features can be made as well as the overlay of segments of the profile when matched with the permanent location of the cross sections.

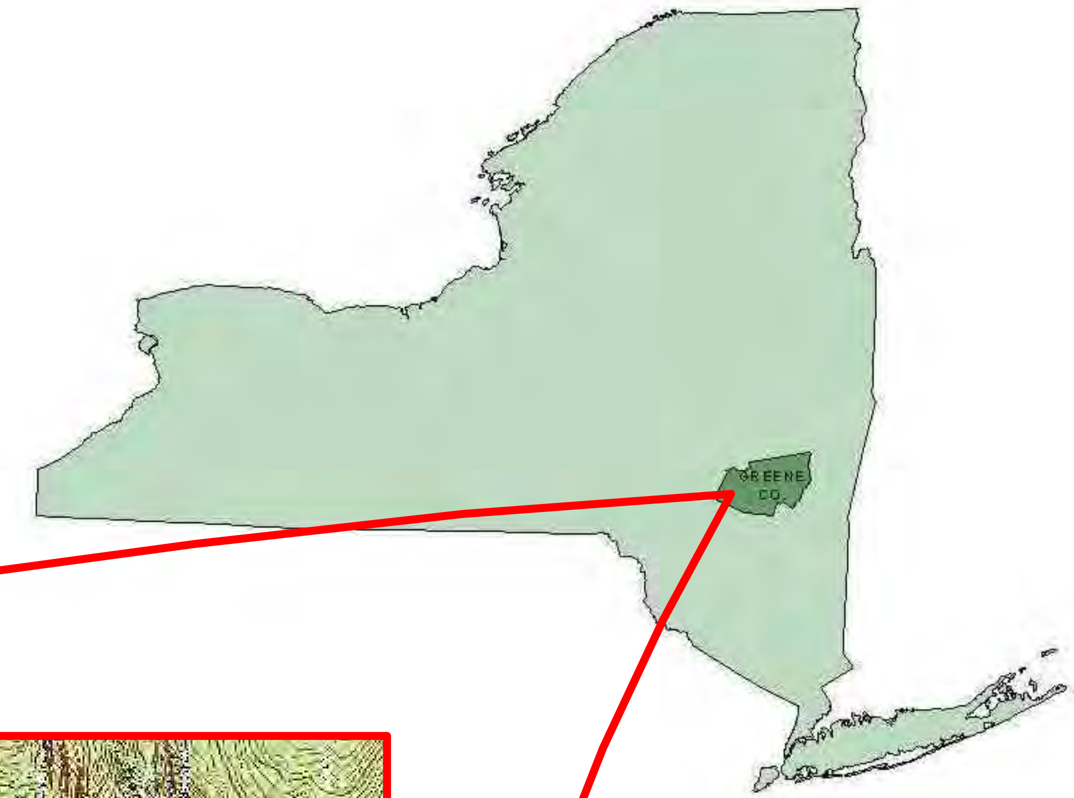
Channel alignment changes were analyzed by reviewing the cross sections and lateral alignment of the thalweg of the stream profile. Although minor erosion and deposition were noted through isolated areas of the project reach there appears to be no evidence of lateral migration or plan form change of meander radius, meander length, or sinuosity.

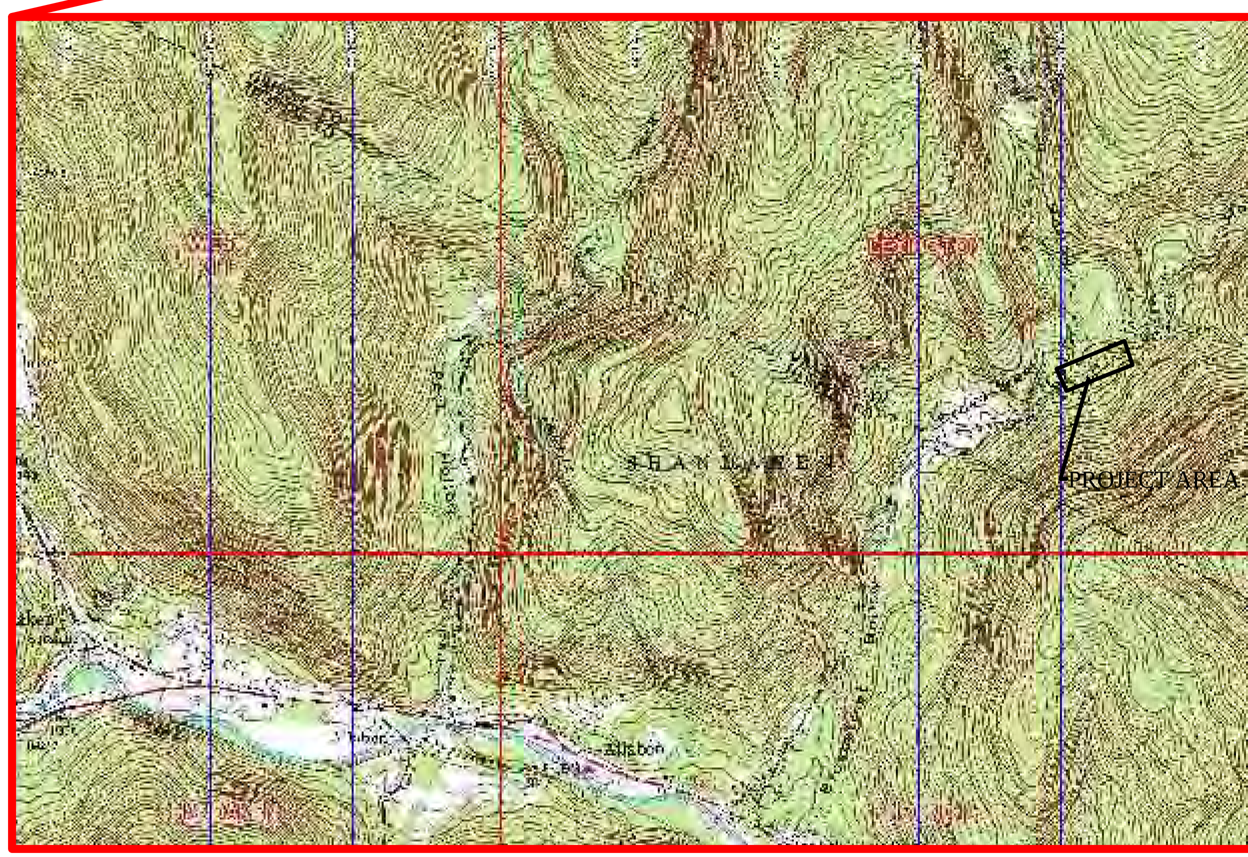
GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

STREAM MANAGEMENT PROGRAM

"BROAD STREET HOLLOW" STREAM RESTORATION PROJECT

2003 MONITORING SURVEY





SITE LOCATION MAP
(NOT TO SCALE)

INDEX OF DRAWINGS

LEGEND	
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BROAD STREET HOLLOW STREAM RESTORATION PROJECT	
TOWN OF LEXINGTON	COUNTY OF GREENE
OCTOBER 16, 2003	NOT TO SCALE
GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT	
PREPARED FOR NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION	
CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M02
SHEET 1 OF 5	TITLE PAGE

NOTE:

PLAN VIEW AND CROSS SECTION LOCATIONS WERE SAMPLED FROM THE PROJECT AS-BUILT SURVEY, DECEMBER 2000.

A 2001 DIGITAL ORTHO-IMAGE IS USED AS BACKGROUND FOR APPROXIMATE LOCATION ONLY.

LEGEND
ROCK STRUCTURE
WATER SURFACE
MONUMENTED CROSS SECTION
CONTROL PIN
IRON ROD FOUND
RELIEF WELL

REVISIONS

BROAD STREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
OCTOBER 16, 2003	NOT TO SCALE

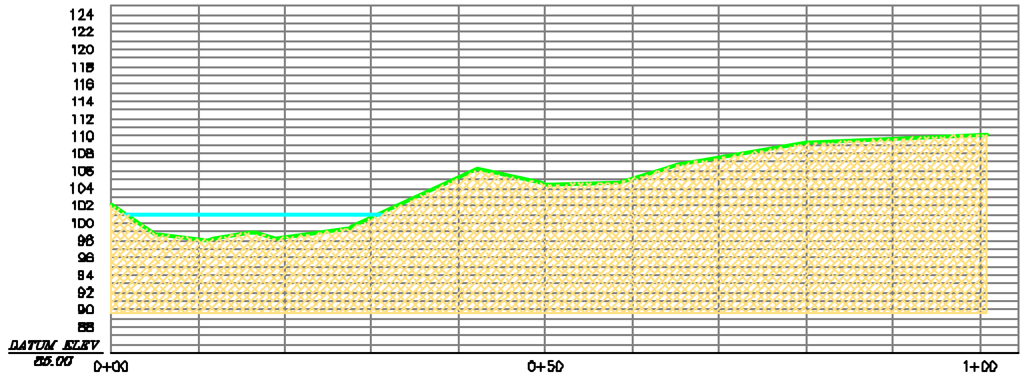
GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

PREPARED FOR
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - 00.01
SHEET 2 OF 5	MONUMENTED CROSS SECTION LAYOUT

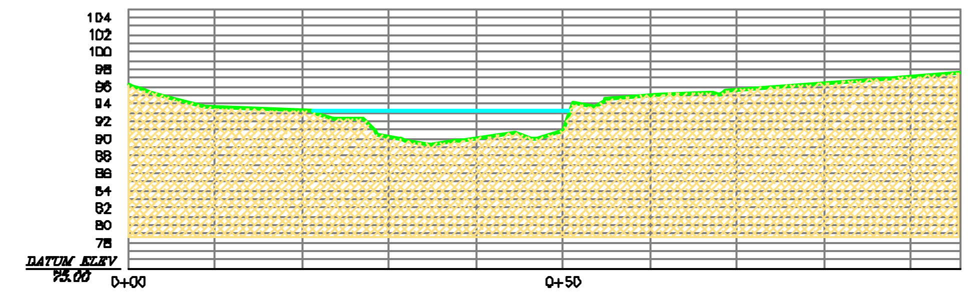
CROSS SECTION #1

(STATION 0+67.05)



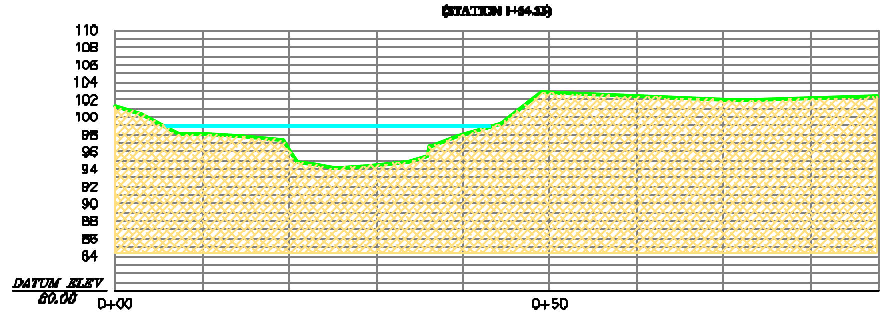
CROSS SECTION #4

(STATION 3+67.37)



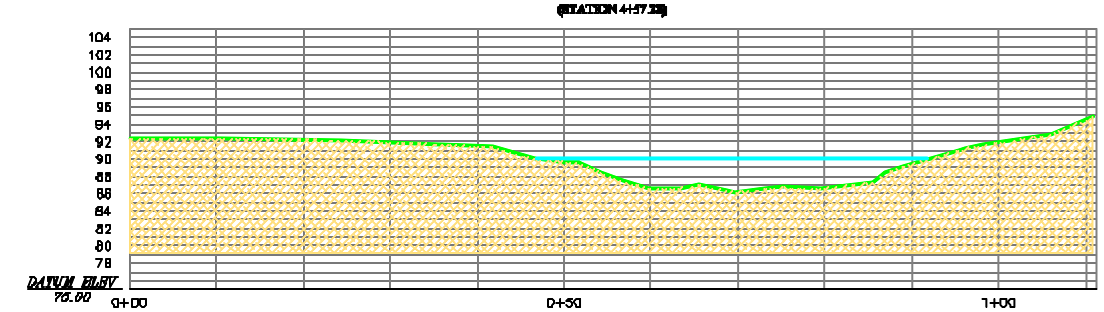
CROSS SECTION #2

(STATION 1+64.53)



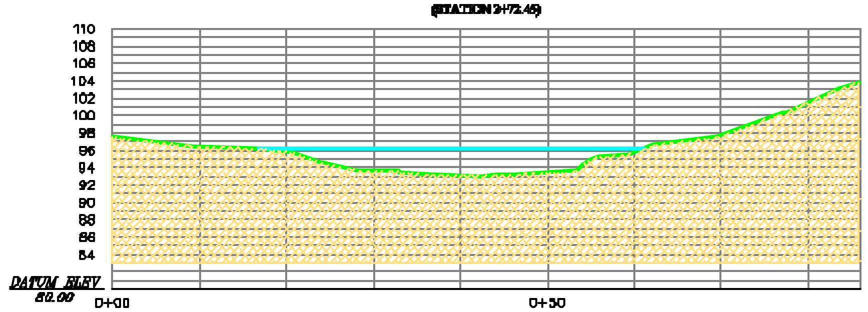
CROSS SECTION #5

(STATION 4+57.25)



CROSS SECTION #3

(STATION 2+72.45)



NOTE:

CROSS SECTIONS WERE CREATED FROM A JULY 2003 MONITORING SURVEY. POINTS WERE COLLECTED ALONG MONUMENTED CROSS SECTION USING A TOTAL STATION.

LEGEND	
2003 GROUND	
BANKFULL SURFACE	

REVISIONS

BROADSTREET HOLLOW
STREAM RESTORATION PROJECT

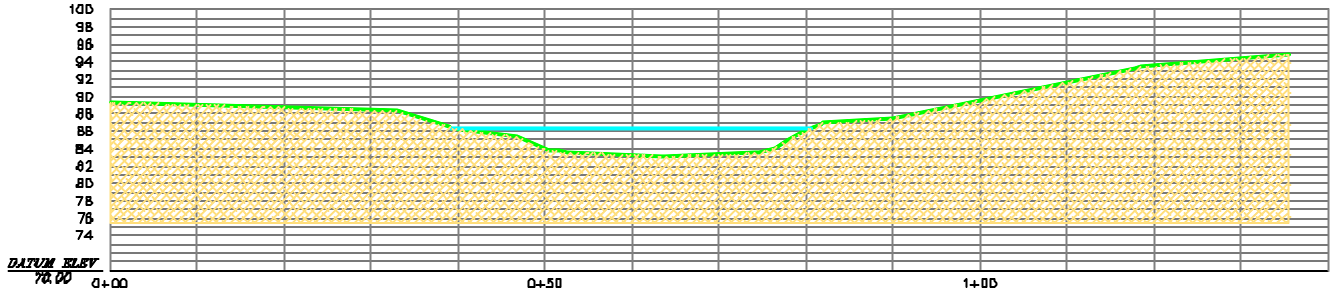
TOWN OF LEXINGTON	COUNTY OF GREENE
OCTOBER 16, 2003	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

PREPARED FOR:
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHECKED BY:	PROJECT #: BSH - [illegible]
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - [illegible]
SHEET [illegible] OF [illegible]	MONITORING SURVEY CROSS SECTIONS

CROSS SECTION #6
(STATION 5+34.21)



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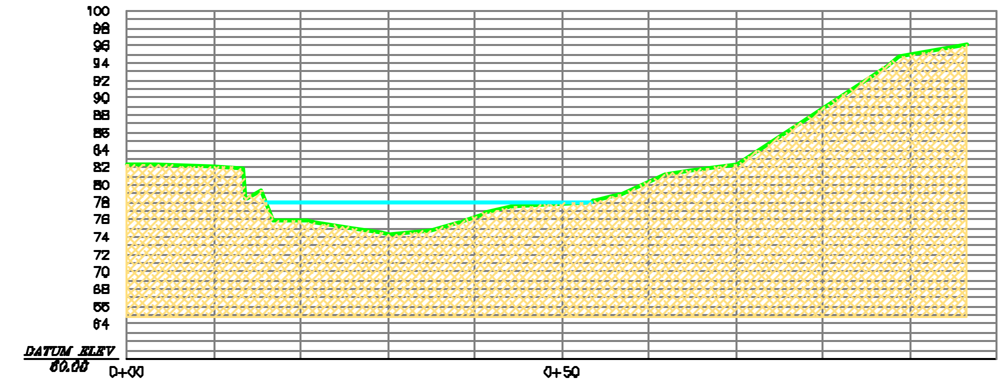
(STATION 7+65.36)



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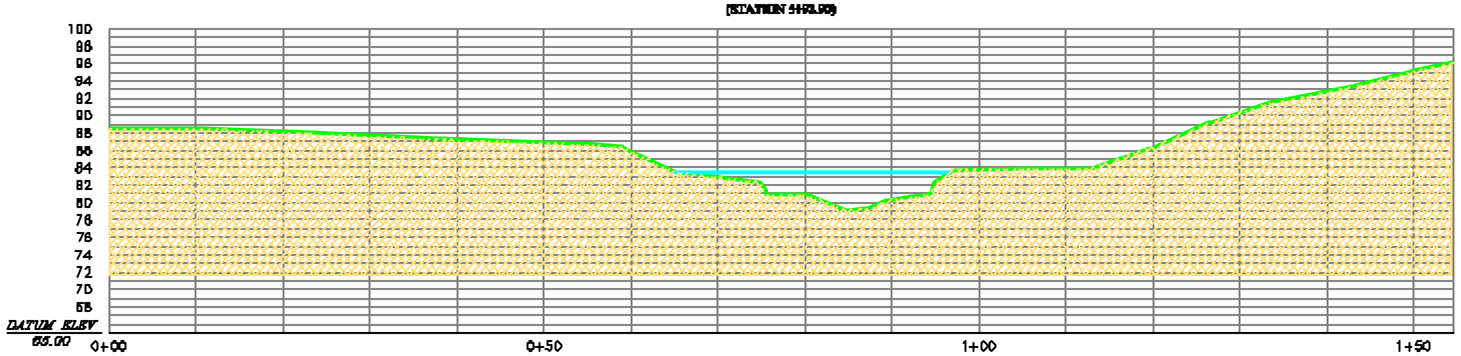
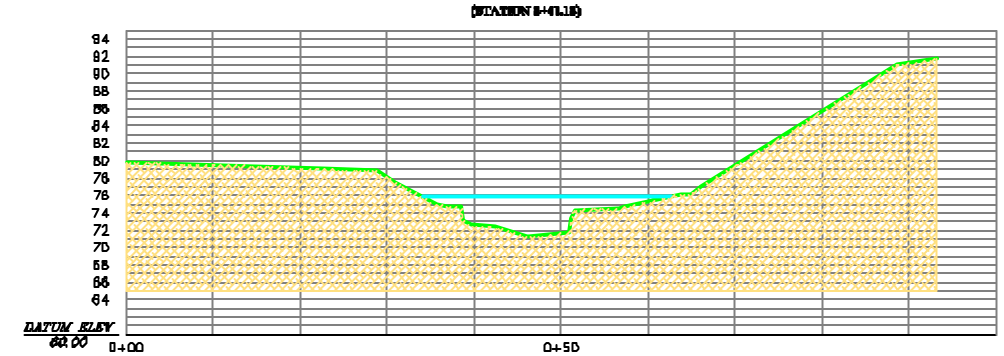
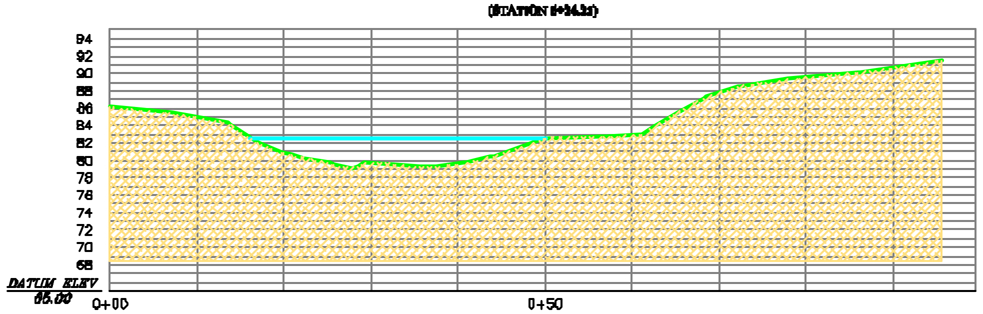


CROSS SECTION #10
(STATION 8+41.18)



CROSS SECTION #8
(STATION 6+34.32)



NOTE:

CROSS SECTIONS WERE CREATED FROM A JULY 2003 MONITORING SURVEY. POINTS WERE COLLECTED ALONG MONUMENTED CROSS SECTION USING A TOTAL STATION.

LEGEND	
2003 GROUND	
BANKFULL SURFACE	

REVISIONS

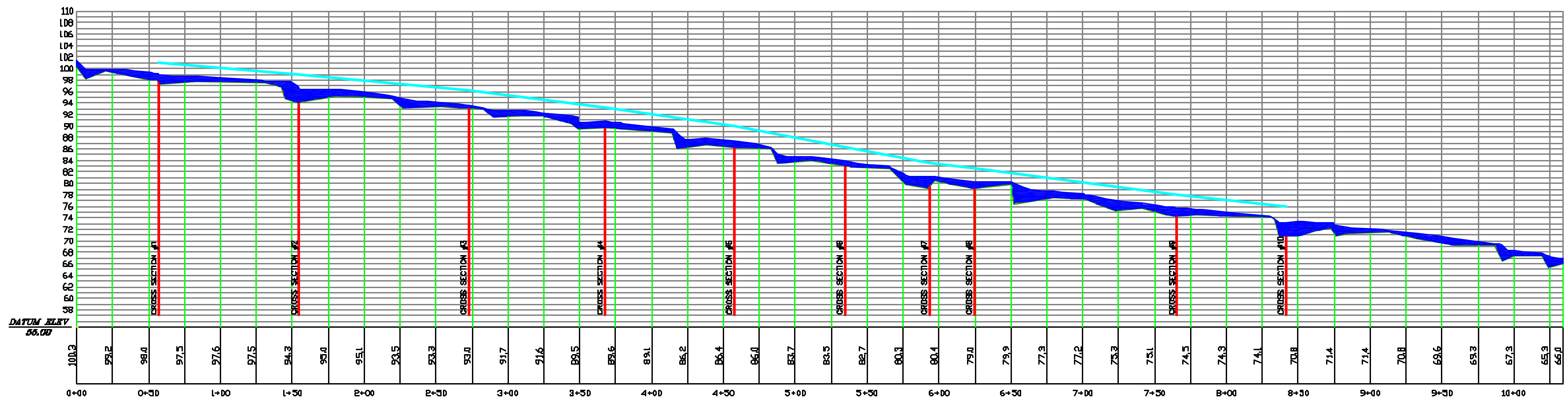
BROADSTREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
OCTOBER 16, 2003	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

PREPARED FOR
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHECKED BY:	PROJECT #: BSH - 06.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M02
SHEET 4 OF 5	MONITORING SURVEY CROSS SECTIONS



NOTE:

LONGITUDINAL PROFILE WAS CREATED FROM A JULY 2003 MONITORING SURVEY. POINTS WERE COLLECTED ALONG THE EXISTING CHANNEL THALWEG USING A TOTAL STATION.

LEGEND	
BANKFULL SURFACE	
THALWEG	
CROSS SECTION	
WATER SURFACE	

REVISIONS

BROADSTREET HOLLOW STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
October 16, 2003	NOT TO SCALE

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

PREPARED FOR
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHECKED BY:	PROJECT #: BSH - 02.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - M02
SHEET 5 OF 5	MONITORING SURVEY LONGITUDINAL PROFILE

F.8 Project Status: Summer 2004 Inspection - Survey

Site Inspection and Monitoring Survey

In May of 2004 the project site was inspected and surveyed by GCSWCD staff in order to review the project status and to document the physical condition and stability of the stream channel. The inspection included a review of the overall stability, rock structures, sheet pile, relief wells, and riparian vegetation. The monitoring survey included: surveying the 10 monumented cross sections and the complete longitudinal profile, performing pebble counts at each cross section, and a summary of conditions. A summary of the inspection results and recommendations is provided below. Photographs taken during various site visits in 2004 are included in Appendix A11.

Rock Structures:

Inspection of the cross vanes revealed no visual damage, erosion, or problems associated with the structures. Minor voids in the vane arms and sills were noted, allowing small volumes of water to penetrate the structures during low flow periods but do not seem to pose any significant problems with the structural integrity or vane function. Regular deposition along the upstream portion of the vane arms appears normal and the vanes all appear to be functioning properly during various flow stages. The cross vanes appear to be effective at reducing the erosion and scour which potentially would have resulted prior to the installation of the project.

Sheet Pile:

The steel sheet pile wall was installed to protect the property and structure located along the lower portion of the project area. The visual inspection of the sheet pile, during and after the flood event, revealed no movement of the structure or backfill depression and settlement. The rock placed at the toe of the wall remained in place, as did the channel alignment along the face of the wall.

Relief Wells:

The wells have been visually inspected and appear to be working effectively. A continuous small volume of clear groundwater drains from the three invert pipes. Clear water is noted in the well casing to the invert elevation on all three wells. One of the well caps has a broken seal and should be replaced. All three well caps are not locked It should also be noted that during the inspection the artesian formation appears to have been mitigated and that no visible change in turbidity was noted in the project area.

Riparian Vegetation:

The overall bioengineering treatments that have been made to date seem to be increasing in growth and density. It is believed the plants have benefited from the wet Spring and Summer of 2003. Substantial growth was noticed on both the native and hybrid varieties of willows and dogwoods within the bankfull channel. Variable success was noticed on tree planting on the large bank. Varieties of low growing clover seem to be dominating growth on the bank near cross section seven, however, the white pine transplants also appear to be growing well.

Channel Stability:

The channel showed no evidence of large-scale deposition (aggradation) or incision (degradation) through the reach. There was no visual stream bank erosion noted during the project inspection and there was no glacial clays visibly present in the channel bottom or stream.

Visual inspection of the reaches located upstream and downstream of the project area indicates no evidence of erosion, deposition, or lateral migration. The inspections have not shown any visual indication of turbidity in the adjacent reaches.

Project Reach Survey:

A monitoring survey was initiated in May of 2004 to document the annual project status and physical condition of the stream channel. The monitoring included surveying the 10 monumented cross sections and the complete longitudinal profile, performing pebble counts at each cross section, and a summary of conditions. The dimensions below represent changes occurring during the monitoring period in 2001, 2002, 2003, 2004.

Cross Section Survey

At the time of the as-built survey, ten monumented cross sections were installed for use in future detailed monitoring efforts. Cross sections were monumented using capped rebar pins and were located with the topographic survey as well as a global positioning system receiver. Cross sections were stationed at various locations along the channel profile in order to provide monitoring for stream process and stability. The cross sections were installed through various stream features (pools, riffles, etc.) and structures in order to document stream classification, potential erosion and scour, and to document the overall channel stability.

Caution must be made in performing direct comparisons between the 2001 and 2002 surveys since there was no surveys performed directly after the project modifications were made. The table below outlines various parameters as observed between the years 2001-2004. Values for riffle comparisons (Bankfull: width, mean depth, max depth, and cross-sectional area) were obtained from cross sections 5 and 8 while values for pool comparisons (maximum pool depth, pool width) were obtained from cross sections 2, 4, and 10. A more detailed data set is attached at the end of this report.

Variables	2001 Survey	2002 Survey	2003 Survey	2004 Survey
Stream Type	B3	B3	B3	B3
Bankfull Width (ft.)	36.4	39.8	39.6	36.4
Bankfull Mean Depth (ft.)	2.75	2.34	2.38	2.43
Bankfull Max. Depth (ft.)	3.8	3.6	3.6	3.4
Bankfull Cross Sectional Area (ft^2)	100.7	93.8	94.2	88.6
Maximum Pool Depth (ft.)	5.99	4.66	4.38	4.29
Pool Width (ft.)	34.5	32.8	31.8	32.5

Longitudinal Profile

The longitudinal profile survey included the sampling of ground and water surface elevations along the slope breaks of the thalweg. The survey included a detailed profile beginning and ending at the top and bottom of the project reach. Bankfull elevations were added by reviewing cross sectional data and transposing the bankfull elevation and station to the longitudinal profile.

The stationing along the thalweg of each channel varies between the years resulting from the selection of features by the field staff and minor changes in thalweg plan form. The overlay of the surveyed profiles must be used with caution since stationing is not a direct match. A comparison of general features can be made as well as the overlay of segments of the profile when matched with the permanent location of the cross sections.

Channel alignment changes were analyzed by reviewing the cross sections and lateral alignment of the thalweg of the stream profile. Although minor erosion and deposition were noted through isolated areas of the project reach there appears to be no evidence of lateral migration or plan form change of meander radius, meander length, or sinuosity.

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

NYCDEP STREAM MANAGEMENT PROGRAM

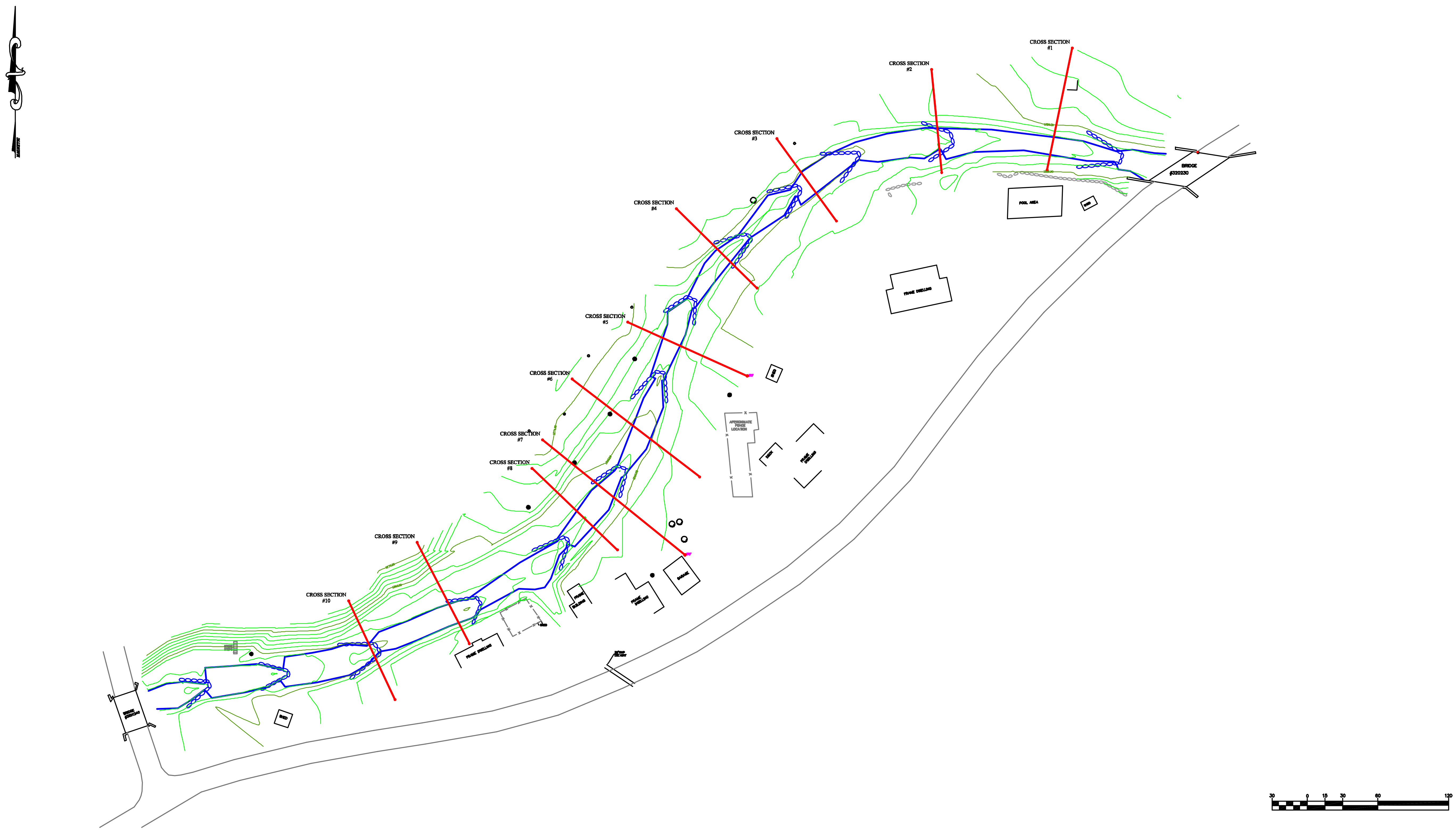
"BROAD STREET HOLLOW" STREAM RESTORATION PROJECT

2004 MONITORING SURVEY

INDEX OF DRAWINGS

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT
BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12413
PHONE (518) 622-3620
FAX (518) 622-0344

BROADSTREET HOLLOW BROADSTREET HOLLOW RD. LEXINGTON GREENE COUNTY, NY	PROJECT:		DRAWING:
	DATE:	3/28/06	BSH-1
	SCALE:	NTS	
	DRAWN BY:	MM/JB	
TITLE PAGE	DESIGN BY:		SHEET 1 OF 5



NOTE:

PLAN VIEW AND CROSS SECTION LOCATIONS WERE SAMPLED FROM THE PROJECT AS-BUILT SURVEY, DECEMBER 2000.

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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

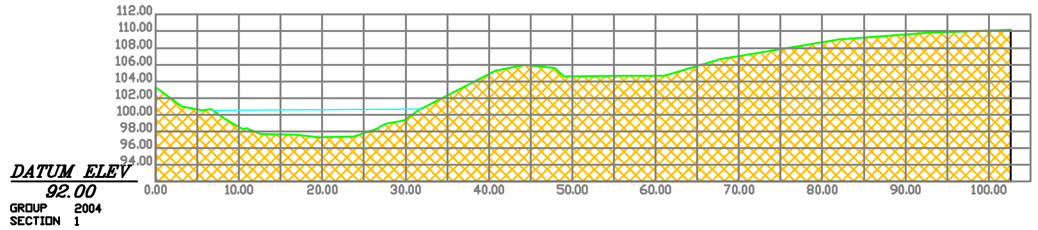
LEXINGTON GREENE COUNTY, NY

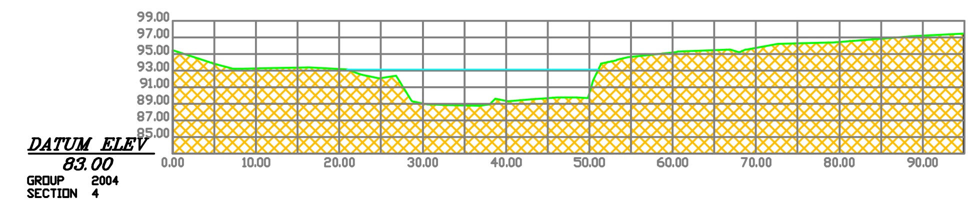
MONUMENTED CROSS SECTION LAYOUT

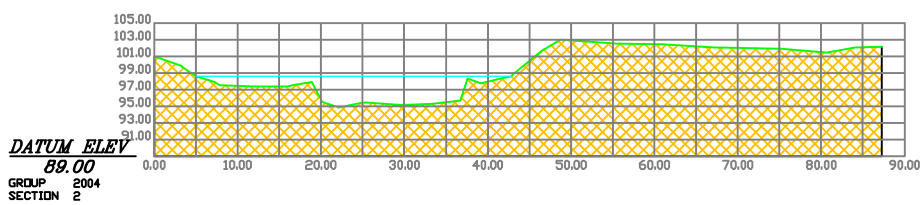
PROJECT:	
DATE:	3/28/06
SCALE:	NTS
DRAWN BY:	MM/JB
DESIGN BY:	

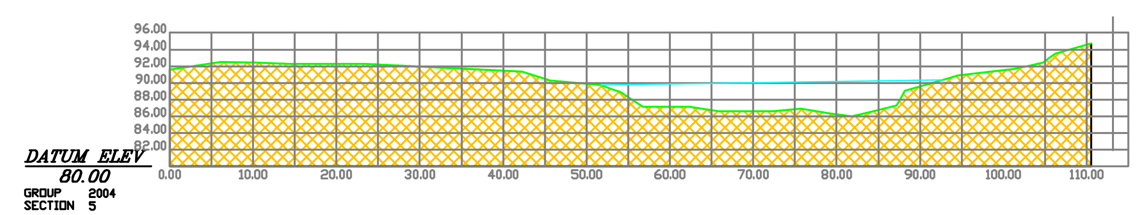
DRAWING:

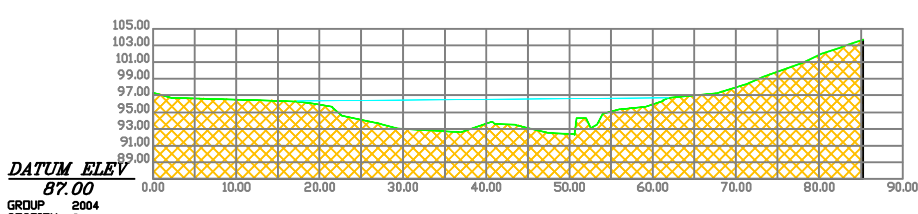
BSH-2











Legend

Bankfull

Existing Surface

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

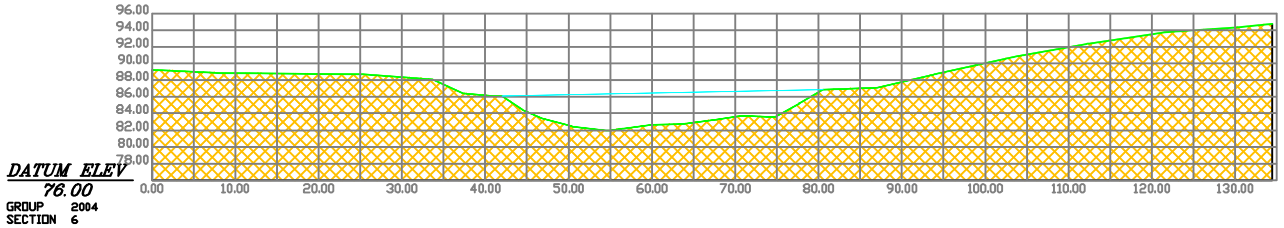
LEXINGTON GREENE COUNTY, NY

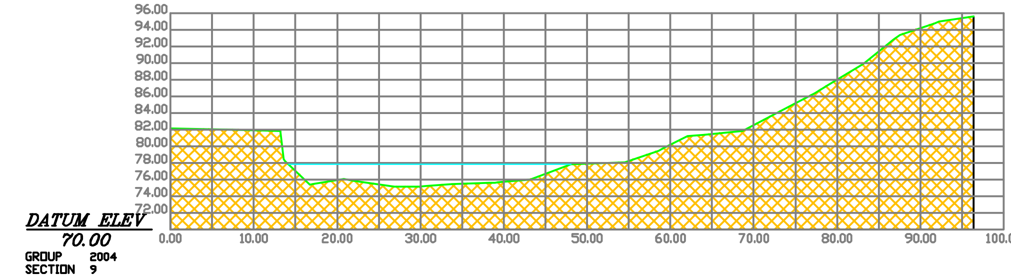
CROSS SECTION 1-5

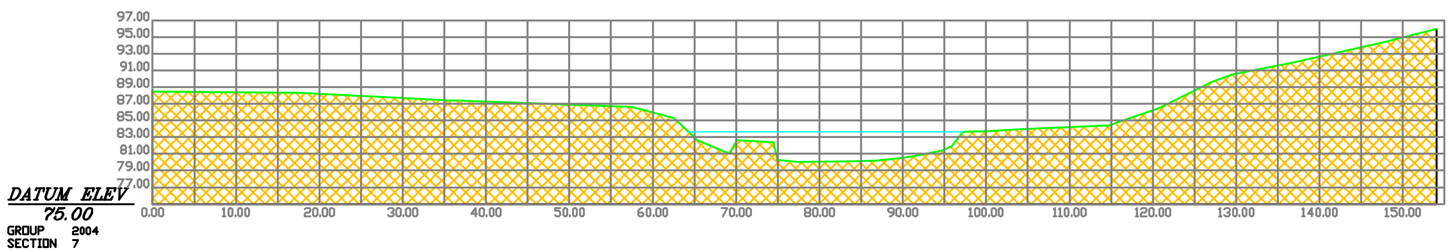
PROJECT:
DATE: 3/28/06
SCALE: NTS
DRAWN BY: MM/JB
DESIGN BY:

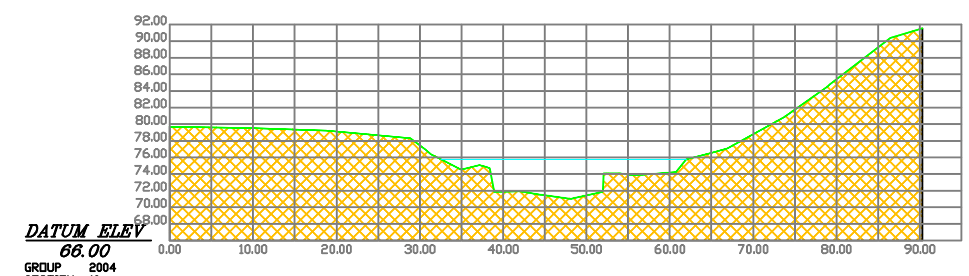
DRAWING:
BSH-3

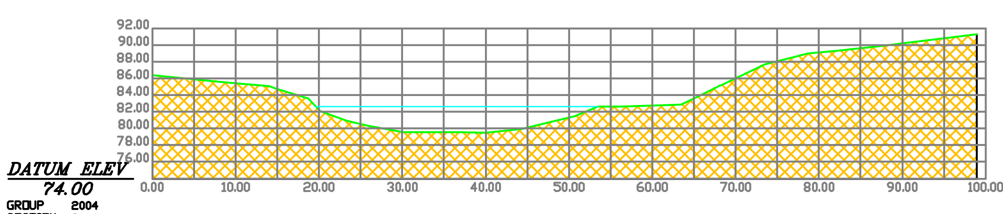
SHEET 3 OF 5











Legend

Bankfull

Existing Surface

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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

LEXINGTON GREENE COUNTY, NY

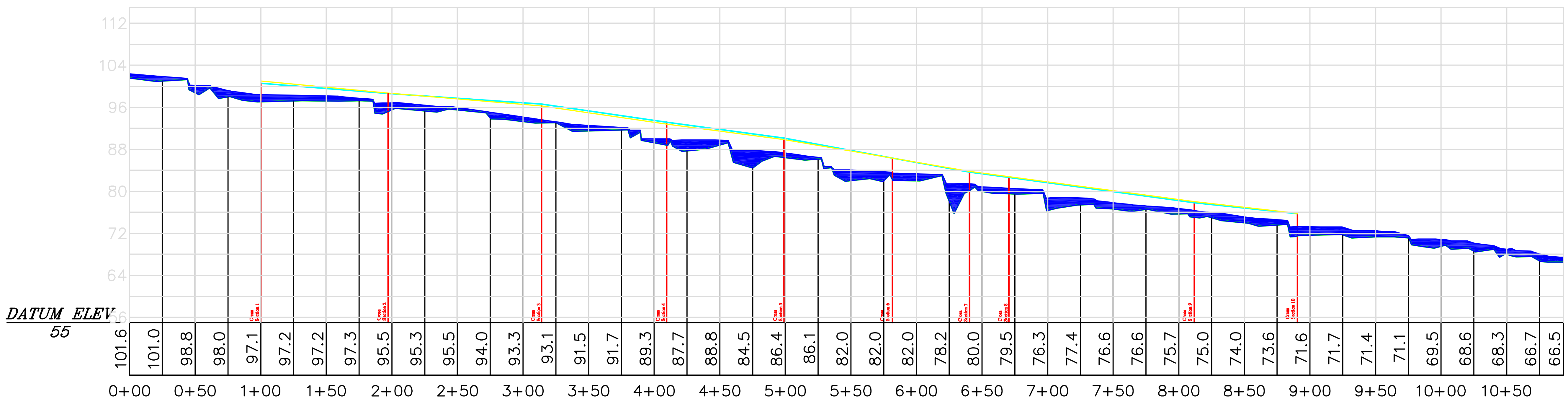
CROSS SECRIONS 5-10

PROJECT:
DATE: 3/28/06
SCALE: NTS
DRAWN BY: MM/JB
DESIGN BY:

DRAWING:

BSH-4

SHEET 4 OF 5



Legend

Bankfull	
Cross Section	
Thalweg	
Water Surface	

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

LEXINGTON GREENE COUNTY, NY

PROFILE

PROJECT:
DATE: 3/28/06
SCALE: NTS
DRAWN BY: MM/JB
DESIGN BY:

DRAWING: **BSH-5**

SHEET 5 OF 5

F.9 Project Status: Flood Event Inspection (April 19, 2005)

Site Inspection

On April 3, 2005, the Broadstreet Hollow watershed experienced several inches of rain on snow resulting in a peak flow through the stream channel exceeding the bankfull flood stage. A peak flow of 2,420cfs was recorded by USGS at a crest stage gage located upstream of the project reach. The Broadstreet Hollow Stream Restoration Project was inspected several times during and after the flow event to document the flow conditions and project performance. Appendix A.12 contains images of damages and. The following written description is a summary of the inspected project components, and a project plan view drawing noting areas requiring repair.

Rock Structures:

Seven of the thirteen cross vane structures experienced partial damage as a result of the flood flow. Problems associated with the structures were limited to flanking of the rock key (where the bankfull end of the structure is tied in to the floodplain) and/or shifting of the top rocks off their footer rocks. The damaged structures included those located at Stations 00+40, 03+90, 04+60, 05+25, 06+15, 06+70, 07+85.

The primary cause of the flanking is attributed to the inconsistent installation and length of the rock keys and floodplain vegetation. In all areas where flanking occurred the rock keys were notably short, and in some instances only consisted of one or two rocks, which generally remained intact. It is felt that if the rock keys had been extended further into the floodplain, to the extent possible, and were constructed more similar to the rock cross vane structures (to rock vane specifications, with footer rocks, rocks abutting each other, with minimal void space, etc.), flanking would have been minimized or eliminated.

Several top rocks were moved by the flood flow presumably caused by the top rocks not being properly locked together during construction. This was noted on rock structures located at Stations 03+90, 06+90, 07+85. The cross vane located near Station 06+90 experienced the most damage with a partial collapse of the right arm and sill. This particular structure was not included in the previous repair/modification of the project.

Although problems occurred at seven of the thirteen rock structures, all of the cross vane structures appeared to function properly during the flood flow. The cross vanes appeared to be effective at reducing the erosion and scour which potentially would have resulted prior to the installation of the project. A similar sized flow event in January of 1996 caused a complete channel migration, widespread erosion and channel incision which resulted in the significant loss of property.

Sheet Pile:

The steel sheet pile wall was installed to protect the property and structure located along the lower portion of the project area to accommodate modifications in meander geometry required by the tight spacing of structures and infrastructure within the valley walls. The visual inspection of the sheet pile, during and after the flood event, revealed no movement of the structure or backfill depression and settlement. The rock placed on the toe of the wall remained in place, as well as the channel alignment along the face of the wall.

Relief Wells:

The wells have been visually inspected and appear to be working effectively. A continuous small volume of clear groundwater drains from the three invert pipes and clear water is noted in the well casing to the invert elevation on all three wells. It should also be noted that during all inspections the artesian formation appears to have been mitigated.

Flanking through the right bench of cross vane near Station 05+25 exposed the invert pipe of relief well #1, and removed the flexible plastic pipe from the solid PVC connector pipe. A defined visible change in water clarity was noted in the project area and appeared to result from exposed clay and silt along the right bank in the area of the relief wells.

Riparian Vegetation:

The installed vegetation included willow fascines and stakes, which were placed along the streambanks and in the adjacent floodplain areas, as well as conservation grass which was applied with hydro-mulch. Additional bioengineering was installed during the 2001 project repair, and again by volunteers in the Spring of 2002 to include streamco willow, silky dogwood and hybrid poplar.

Establishment of vegetation appears poor considering the amount and density of the installed material. It is felt that the lack of established vegetation exacerbated the damage through the project site. It is presumed that if the vegetation had become established the damages would have been limited and in some areas avoided.

Channel Stability:

The channel showed no evidence of large-scale deposition (aggradation) or incision (degradation) through the reach. Localized bank erosion was present in areas surrounding rock key damage of the cross vane structures described above. Further inspection of the channel revealed only small isolated areas of clay in the active bankfull channel after the flood event. It is presumed that the bank erosion would have been partially if not entirely mitigated if the vegetation had been able to establish prior to the increased stresses caused by the flood event.

Recommendations and proposed repair/modification:

- Modification and repair to the project site should be initiated as soon as possible to avoid further erosion of the damaged areas.

- Monitoring of the entire site should be completed prior to the initiation of any modification or repair. Additionally, the monitoring should be completed again immediately after the modification/repair is completed.

- Monitoring of the site should include surveying all ten monumented cross sections, flood stage profile through the entire site, as well as a composite pebble count.

Thought should be given to surveying a longitudinal profile along the channel invert to document pool depth and possible local scour and deposition.

- Repair and modification to the project site should include the rebuild and extension (where applicable) of the flanked rock keys. Rocks must abut one another and should contain minimal void space between the rocks. Cobble fill should be used along the upstream side of the vane arm and bank key. The rock key should be built to the bankfull elevation, even at cross vanes which were constructed to an elevation less than bankfull.

- Possible modifications to the existing bank keys include extending a second key arm from the structure at approximately ½ the acute angle between the vane arm and the existing key and adding cobble fill between the arms before backfilling.

- Re-install the flexible plastic pipe to the solid PVC connector pipe at the first relief well. The flexible plastic pipe should be re-installed through the cross vane structure at Station 05+25 during the repair to the bank key.

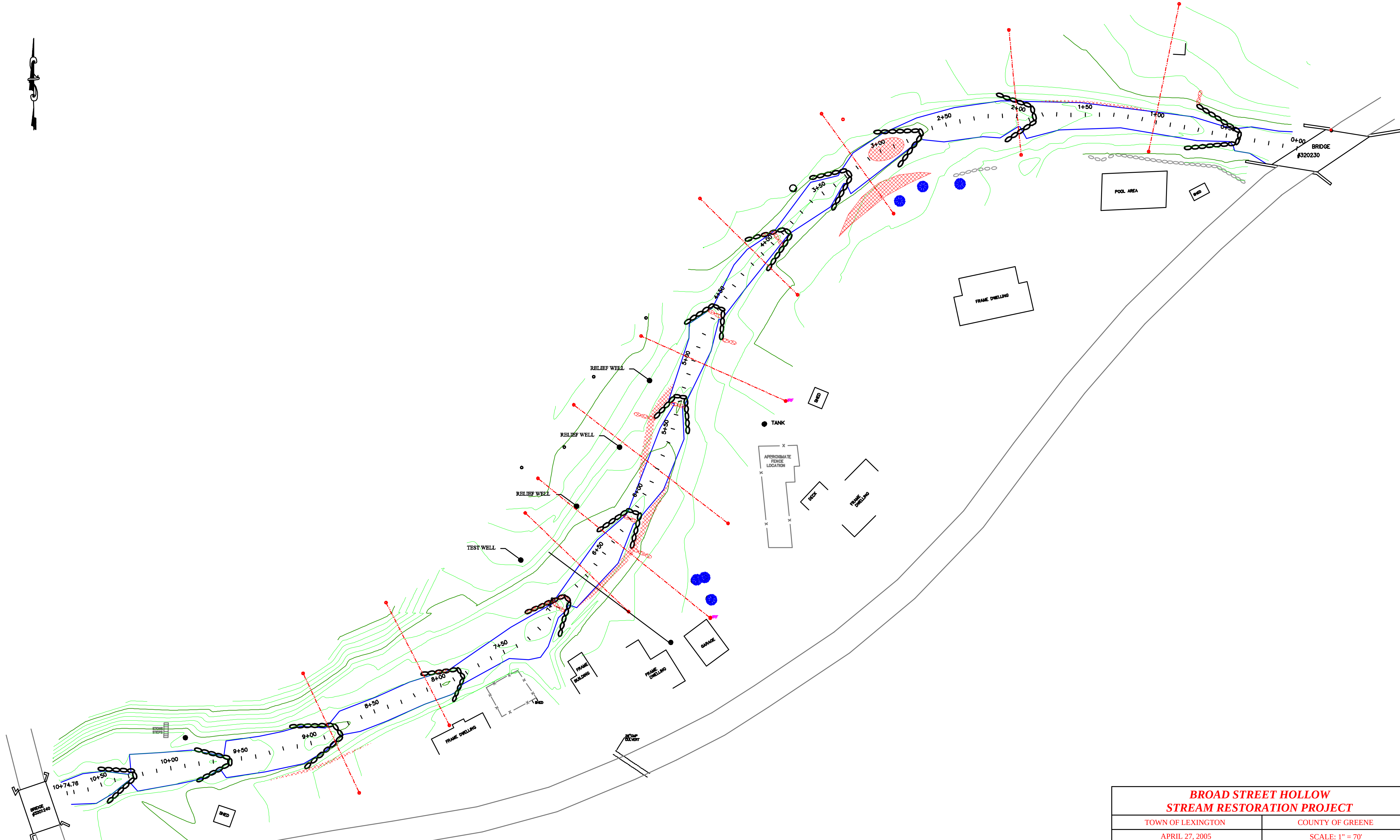
- Re-grade banks, seed, and vegetate exposed areas after completion of project repair/modifications. Provisions should be made to water and maintain the vegetation.

- The eroded left bank behind the former Torregrossa Residence (located between Station 05+60 and 06+75) should be repaired using large rock placed at the designed toe of the bank, backfilled and vegetated. Large stone will provide added protection in the event of another large flow event, prior to vegetative establishment. Medium sized natural boulders (>24") will be individually placed along the bank toe. Installation will not be in the form of a riprap blanket. Additionally, the repair/modification to the bank keys should prevent future erosion in this area.

- The cross vane located at Station 06+90 should be reconstructed following modifications previously applied to the project in 2001.

- Consideration should be given to adding a second cross vane sill to all of the structures located between Stations 03+90 and 06+90. The secondary sill would be constructed at a lower elevation and set back further into the throat of the cross vane. The secondary sill should assist fish passage during low flow, as well as provide increased energy dissipation during high flow.

- Upon completing the outlined structure modifications, the top of each riffle should be set at the location and elevation delineated in the original project design. Coarse cobble/boulder material should be used which is "natural" in appearance with a minimal particle size that represents the dominant channel material.



LEGEND	
ROCK STRUCTURE	
WATER SURFACE	
RELIEF WELL	
CONTROL PIN	
ERODED AREA	

REVISIONS

BROAD STREET HOLLOW
STREAM RESTORATION PROJECT

TOWN OF LEXINGTON	COUNTY OF GREENE
APRIL 27, 2005	SCALE: 1" = 70'

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12414
PHONE (518) 622-3620
FAX (518) 622-0344

PREPARED FOR
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION

CHECKED BY:	PROJECT #: BSH - 00.01
DRAWN BY: DOUG DEKOSKIE	DRAWING #: BSH - 00.01
	PROJECT MAINTENANCE & REPAIR - APRIL 2005

F.10 Project Status: Summer 2005 Inspection - Survey

Site Inspection and Monitoring Survey

In May of 2005 the project site was inspected and surveyed by GCSWCD staff in order to review the project status and to document the physical condition and stability of the stream channel. The inspection included a review of the overall stability, rock structures, sheet pile, relief wells, and riparian vegetation. The monitoring survey included surveying the 10 monumented cross sections and complete longitudinal profile, performing composite pebble counts, and a summary of conditions. A summary of the inspection results and recommendations is provided below. Photographs taken during site visit in 2005 are included in Appendix A 13.

Rock Structures:

Please refer to Appendix F.9 for a description of the rock structures for the 2005 season.

Sheet Pile:

The steel sheet pile wall was installed to protect the property and structure located along the lower portion of the project area. The visual inspection of the sheet pile, during and after the flood event, revealed no movement of the structure or backfill depression and settlement. The rock placed on the toe of the wall remained in place, as well as the channel alignment along the face of the wall.

Relief Wells:

Please refer to Appendix F.9 for a description of the relief wells for the 2005 season.

Riparian Vegetation:

The overall bioengineering treatments that have been made to date seem to be increasing in growth and density. It is believed the plants have benefitted from the wet Spring and Summer of 2003. Substantial growth was noticed on both the native and hybrid varieties of willows and dogwoods within the bankfull channel. Variable success was noticed on tree planting on the large bank. Varieties of low growing clover seem to be dominating growth of species on the bank, although a number of white pine transplants seem to be thriving in this area.

Channel Stability:

Please refer to Appendix F.9 for a description of the channel stability for the 2005 season.

Project Reach Survey:

A monitoring survey was initiated in May of 2005 to document the annual project status and physical condition of the stream channel. The monitoring included surveying the 10 monumented cross sections and complete longitudinal profile, performing composite pebble counts, and a summary of conditions. The dimensions below represent changes occurring during the monitoring period in 2001, 2002, 2003, 2004 and 2005.

Cross Section Survey

At the time of the as-built survey, ten monumented cross sections were installed for use in future detailed monitoring efforts. Cross sections were monumented using capped rebar pins which are located in the topographic survey as well as recorded using GPS. Cross sections were stationed at various locations along the channel profile in order to provide monitoring for stream process and stability. The cross sections were installed through various stream features (pools, riffles, etc.) and structures in order to document stream classification, potential erosion and scour, and to document the overall channel stability.

Caution must be made in performing direct comparisons between the 2001 and 2002 surveys since there was no surveyed performed directly after the project modifications were made. The values presented below survey are averages taken through multiple, feature specific cross sections. Values for riffle comparisons were obtained from cross sections 5 and 8 while values for pool comparisons were obtained from cross sections 2, 4, and 10. A more detailed data set is attached at the end of this report.

Variables	2001 Survey	2002 Survey	2003 Survey	2004 Survey	2005 Survey
Stream Type	B3	B3	B3	B3	B3
Bankfull Width (ft.)	36.4	39.8	39.6	36.4	42.8
Bankfull Mean Depth (ft.)	2.75	2.34	2.38	2.43	2.89
Bankfull Max. Depth (ft.)	3.8	3.6	3.6	3.4	4.6
Bankfull Cross Sectional Area (ft^2)	100.7	93.8	94.2	88.6	123.7
Maximum Pool Depth (ft.)	5.99	4.66	4.38	4.29	4.80
Pool Width (ft.)	34.5	32.8	31.8	32.5	37.9

Longitudinal Profile

The longitudinal profile survey included the sampling of ground and water surface elevations along the slope breaks of the thalweg. The survey included a detailed profile beginning and ending at the top and bottom of the project reach. Bankfull elevations were added by reviewing cross sectional data and transposing the bankfull elevation and station to the longitudinal profile.

The stationing along the thalweg of each channel varies between the years resulting from the selection of features by the field staff and minor changes in thalweg plan form. The overlay of the surveyed profiles must be used with caution since stationing is not a direct match. A comparison of general features can be made as well as the overlay of segments of the profile when matched with the permanent location of the cross sections.

Channel alignment changes were analyzed by reviewing the cross sections and lateral alignment of the thalweg of the stream profile. Although minor erosion and deposition were noted through isolated areas of the project reach there appears to be no evidence of lateral migration or plan form change of meander radius, meander length, or sinuosity.

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

NYCDEP STREAM MANAGEMENT PROGRAM

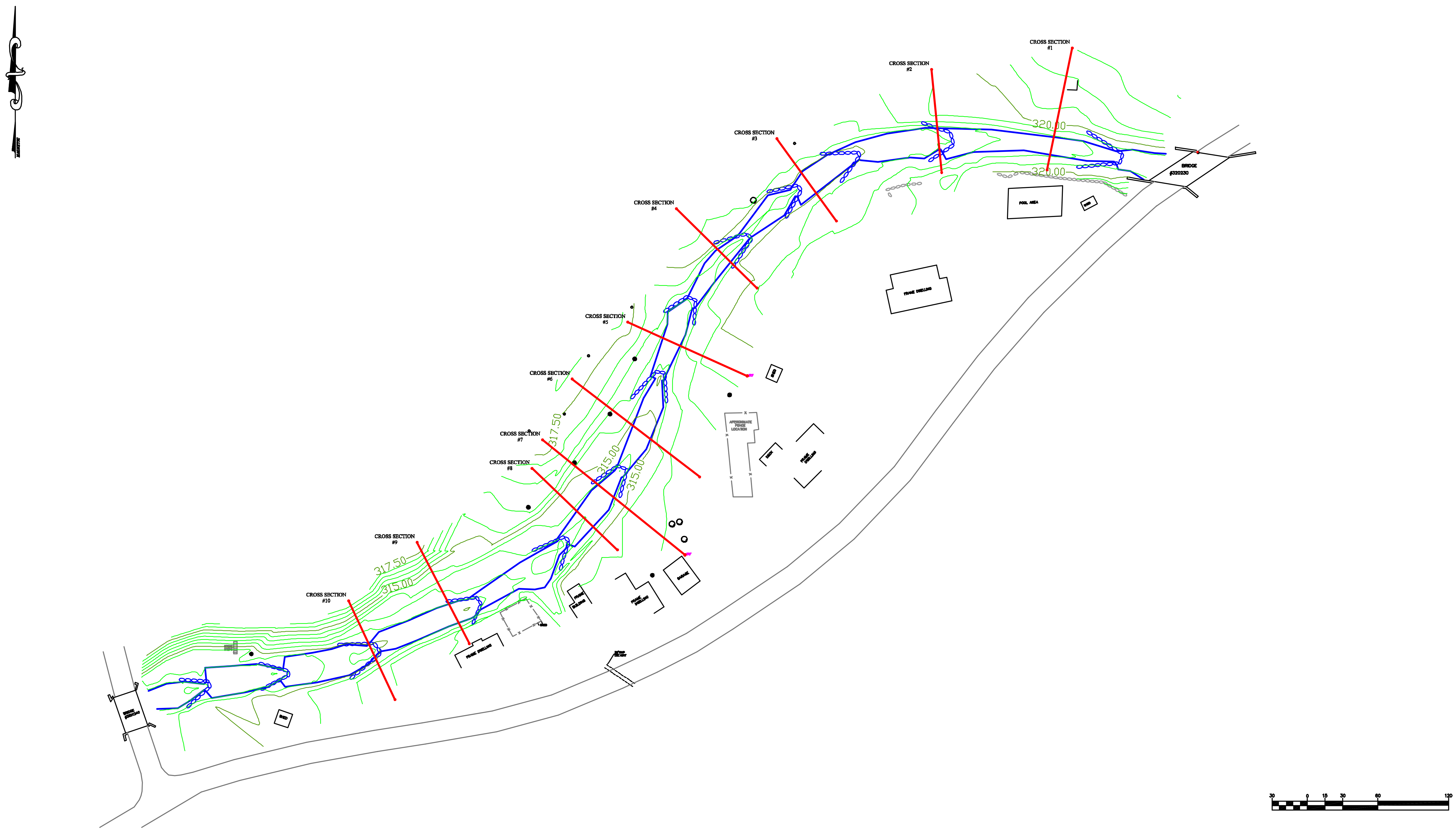
"BROAD STREET HOLLOW" STREAM RESTORATION PROJECT

2005 MONITORING SURVEY

INDEX OF DRAWINGS

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT
BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12413
PHONE (518) 622-3620
FAX (518) 622-0344

BROADSTREET HOLLOW	PROJECT:		DRAWING:
BROADSTREET HOLLOW RD.	DATE:	3/28/06	BSH-1
LEXINGTON	SCALE:	NTS	
GREENE COUNTY, NY	DRAWN BY:	MM/JB	
TITLE PAGE	DESIGN BY:		SHEET 1 OF 5



NOTE:

PLAN VIEW AND CROSS SECTION LOCATIONS WERE SAMPLED FROM THE PROJECT AS-BUILT SURVEY, DECEMBER 2000.

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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

LEXINGTON

GREENE COUNTY, NY

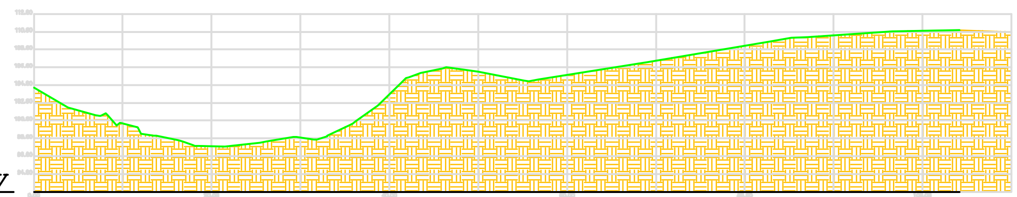
MONUMENTED CROSS SECTION LAYOUT

PROJECT:
DATE: 3/28/06
SCALE: NTS
DRAWN BY: MM/JB
DESIGN BY:

DRAWING:

BSH-2

SHEET 2 OF 5



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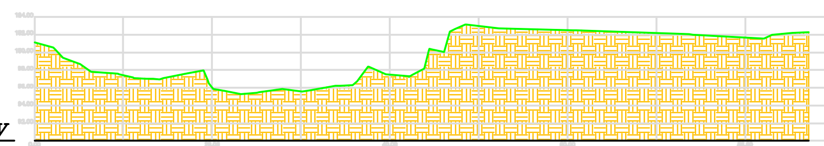

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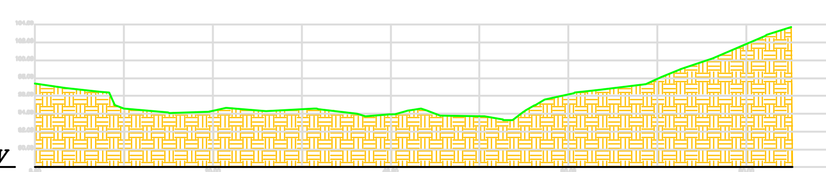

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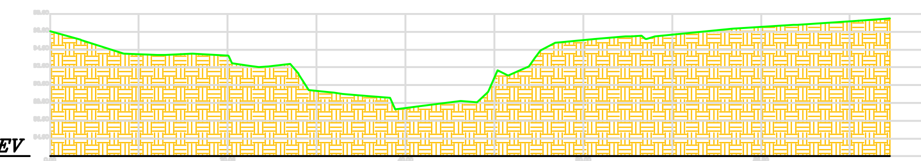

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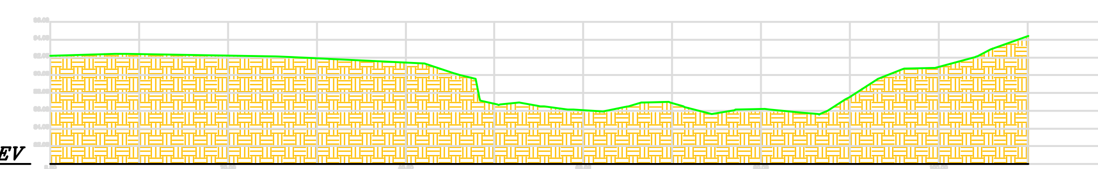

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Legend

Bankfull

Existing Surface

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

LEXINGTON — GREENE COUNTY, NY

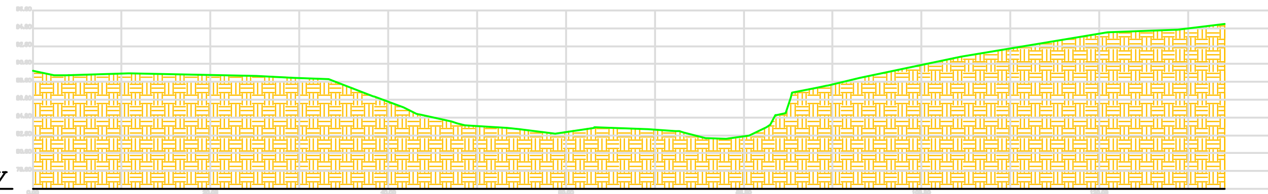
CROSS SECTION 1-5

PROJECT:	
DATE:	3/28/06
SCALE:	NTS
DRAWN BY:	MM/JB
DESIGN BY:	

DRAWING:

BSH-3

SHEET 3 OF 5



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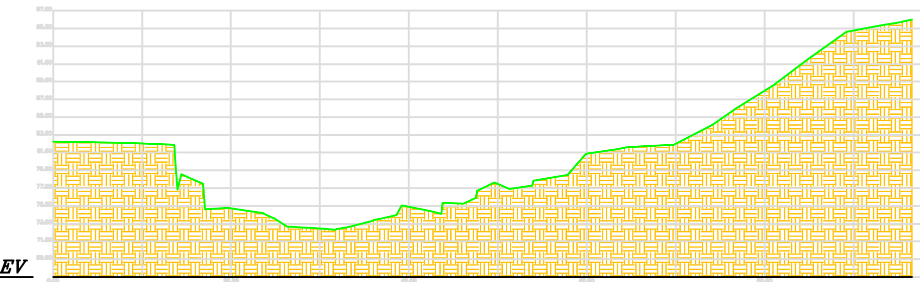

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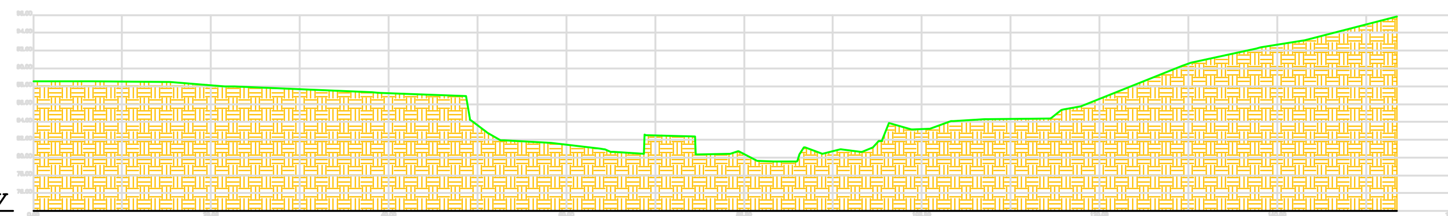

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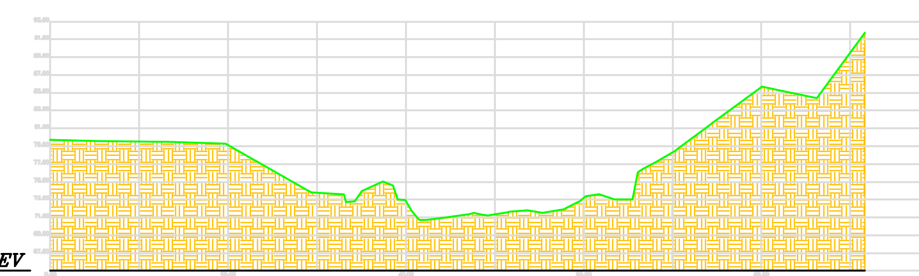

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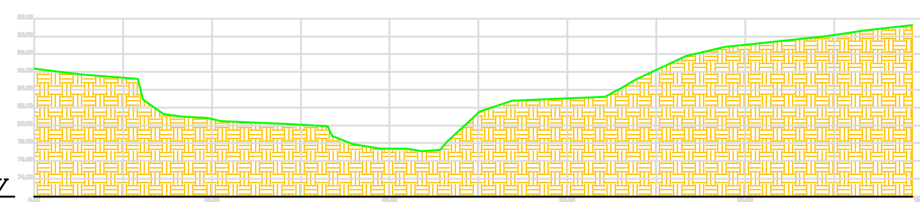

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GROUP XS05
SECTION 8

Legend

Bankfull

Existing Surface

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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

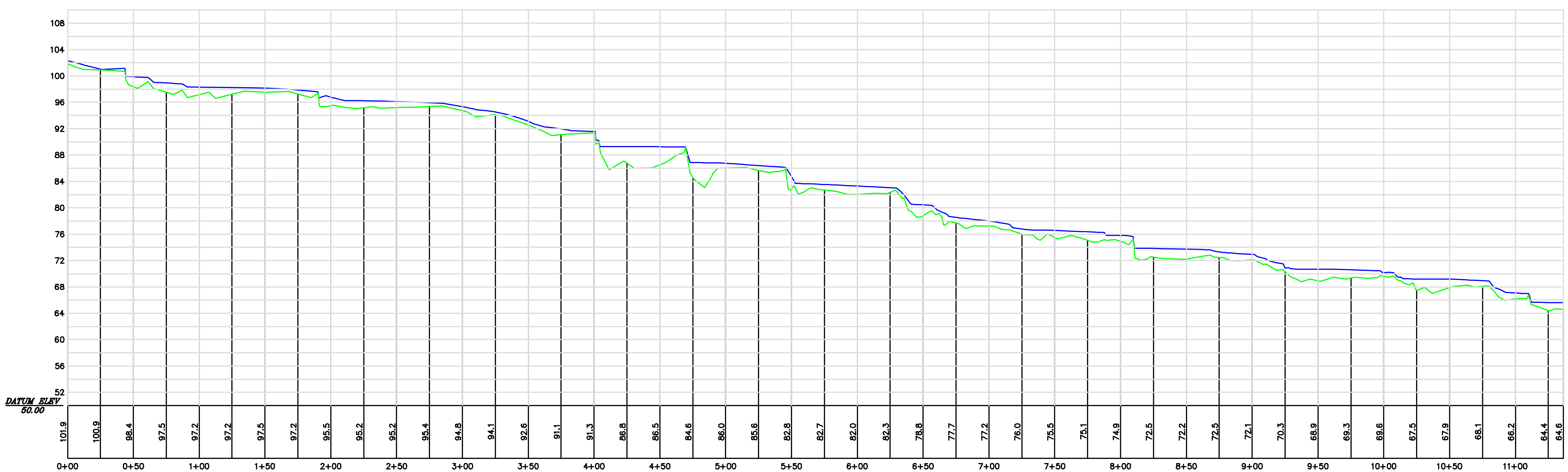
LEXINGTON | GREENE COUNTY, NY

CROSS SECTION 5-10

PROJECT:
DATE: 3/28/06
SCALE: NTS
DRAWN BY: MM/JB
DESIGN BY:

DRAWING:
BSH-4

SHEET 4 OF 5



Legend

Water Surface

Existing Surface

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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PHONE (518) 622-3620
FAX (518) 622-0344

BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

LEXINGTON

GREENE COUNTY, NY

PROFILE

PROJECT:
DATE: 3/28/06
SCALE: NTS
DRAWN BY: MM/JB
DESIGN BY:

DRAWING:

BSH-5

SHEET 5 OF 5

F.11 Project Status: 2007 Inspection - Survey

Site Inspection and Monitoring Survey

In October of 2007 the project site was inspected and surveyed by GCSWCD staff in order to review the project status and to document the physical condition and stability of the stream channel. The inspection included a review of the overall stability, rock structures, and riparian vegetation. The monitoring survey included surveying the ten monumented cross sections and the complete longitudinal profile, performing pebble counts and a bar sample. A summary of the inspection results and recommendations is provided below. Photographs taken during the survey work in October 2007 are also included in this appendix.

Rock Structures:

Seven of the thirteen cross vanes remain partially damaged as a result of flood flow from 2005. This damage seems limited to flanking of the rock keys (where the bankfull end of structure is tied into the flood plain) and shifting of some of the top rocks off their lower footer rocks. Despite damages, the cross vanes appear to still be effective at reducing erosion and scour, although repairs would certainly improve their capacity to reduce these processes.

Recommendations include:

- Continued monitoring of flanking occurring at cross vanes
- Repair of damaged vanes by replacing top rocks and repairing flanked structures

Sheet Pile:

The steel sheet pile wall which was installed to protect property and the structure located at the lower portion of the project reach appears to be in good condition. There is no noticeable movement of the sheet pile, and no evidence of backfill depression or settlement. The rock placed along the toe of the wall remains in place providing some further protection to the structure.

Relief Wells:

In summer 2007 local land owners noticed that a mud boil had returned to the bottom of the stream. Visual inspection by GCSWCD staff confirmed the reoccurrence of a mud boil. Testing was done on the relief wells installed in project reach and it was determined that the wells had become clogged and were no longer functioning properly. Maintenance on the wells is currently being scheduled for 2008 in order return them to proper working condition.

Recommendations include:

- Continued monitoring of wells to ensure their functionality
- Flushing all wells to restore them to their original functionality

Riparian Vegetation:

The overall bioengineering treatments that have been made to date seem to be increasing in growth and density. Substantial growth was noted on all trees planted as part of the restoration effort. The hybrid willows planted in the flood plain are thriving and have grown substantially. The white pine which were planted on the large bank on the right side of the stream are growing well. The ground cover in disturbed areas has changed from clover dominated to grass dominated with substantial amounts of red raspberry noted in some areas.

Recommendations include:

- Enhancing biodiversity of native plant species through follow up shrub and tree plantings
- Continued monitoring for invasive plant species

Channel Stability:

The channel showed no evidence of large-scale deposition (aggradation) or incision (degradation) through the reach. Localized bank erosion was present in areas where the cross vane structures tied into the channel banks and flood plain. A couple of areas show signs of erosion which is exposing soil to the bankfull channel. At present these areas do not appear to be contributing sediment year-round. Inspection of the channel revealed isolated areas of clay in the active bankfull channel, these areas were concentrated towards the lower reach of the project site.

Recommendations include:

- Continued monitoring of the site for accelerated channel migration and changes to the sediment regime
- Evaluate potential for regarding areas where banks have become cut and are eroding

Downstream Bridge:

There was no evidence of channel instability around the bridge structure located near the bottom of the project reach. The bridge opening appears to be properly transporting stream flow and sediment. There was no accumulation of large woody debris or other objects near the bridge opening that may impede stream flow.

Project Reach Survey:

A monitoring survey was initiated in October of 2007 to document the annual project status and physical condition of the stream channel. The monitoring included surveying the ten monumented cross sections and the complete longitudinal profile, performing composite pebble counts, bar sample, and a summary of conditions.

Cross Section Survey

At the time of the as-built survey, ten monumented cross sections were installed for use in future detailed monitoring efforts. Cross sections were monumented using capped rebar pins which are located in the topographic survey as well as recorded using GPS. Cross sections were stationed at various locations along the channel profile in order to provide monitoring for stream process and stability. The cross sections were installed through various stream features (pools, riffles, etc.) and structures in order to document stream classification, potential erosion and scour, and to document the overall channel stability. A summary of cross sectional data is presented in Table 1.

Table 1: Summary of bankfull cross section dimensions, October 2007.

Cross Section	Feature	Area (ft.)	Width (ft.)	Max. Depth (ft.)	Mean Depth (ft.)
1	Riffle	79.6	34.9	3.62	2.28
2	Pool	151.8	45.5	5.58	3.34
3	Riffle	128.6	53.1	3.84	2.42
4	Pool	76.7	31.2	4.66	2.46
5	Pool	71.4	41.1	2.32	1.74
6	Riffle	80.5	45.1	2.29	1.78
7	Riffle	60.3	28.2	3.73	2.14
8	Pool	112.0	34.8	4.25	3.22
9	Pool	134.1	43.1	5.80	3.11
10	Pool	140.1	38.2	4.92	3.67
Average Riffles		87.2	40.3	3.37	2.16
Average Pools		114.3	39.0	4.59	2.92
Reach Average		103.5	39.5	4.10	2.62

The values presented in Table 2 are averages taken from multiple cross sections. Values for riffle comparisons were obtained from cross sections 1, 3, 6 and 7 while values for pool comparisons were obtained from cross sections 2, 4, 5, 8, 9 and 10.

Table 2: Summary of bankfull cross sectional measurements.

Variable	Survey 2001	Survey 2002	Survey 2003	Survey 2004	Survey 2005	Survey 2007
Stream Type	B3	B3	B3	B3	B3	B3
Bankfull Width (ft.)	36.4	39.8	39.6	36.4	42.8	40.3
Bankfull Mean Depth (ft).	2.75	2.34	2.38	2.43	2.89	2.16
Bankfull Max. Depth (ft.)	3.8	3.6	3.6	3.4	4.6	3.4
Bankfull Cross Sectional Area (ft^2)	100.7	93.8	94.2	88.6	123.7	87.2
Maximum Pool Depth (ft.)	5.99	466	4.38	4.29	4.80	4.59
Pool Width (ft.)	34.5	32.8	31.8	32.5	37.9	39.0

Longitudinal Profile

The longitudinal profile survey included the sampling of bankfull, ground, and water surface elevations along the slope breaks of the thalweg. The 2007 survey included a detailed profile beginning and ending at the top and bottom of the project reach. The stationing along the thalweg of the channel varies between years as a result of the selection of features by field staff and minor changes in thalweg plan form.

Channel Pattern

Channel alignment changes were analyzed by reviewing the cross sections and lateral alignment of the thalweg of the stream profile. Although minor erosion and deposition were noted through isolated areas of the project reach there appears to be no evidence of unstable lateral migration or plan form change of meander radius, meander length, or sinuosity.

Sediment Characteristics

Pavement samples within the bankfull channel were collected during the survey of the reach. Samples were obtained along each of the ten independent cross sections in the project reach (Table 3).

Table 3: Sediment sample sizes taken October 2007 at selected cross sections.

Cross Section	Feature	Dominant Particle Size				
		D_{95}	D_{84}	D_{50}	D_{35}	D_{15}
1	Riffle	760	350	100	64	32
2	Pool	1600	920	120	77	49
3	Riffle	370	250	130	79	37
4	Pool	1800	1400	100	67	24
5	Pool	360	170	62	41	16
6	Riffle	310	130	42	24	0.062
7	Riffle	1800	1400	130	46	0.16
8	Pool	1200	310	48	15	0.062
9	Pool	1600	730	54	21	0.24
10	Pool	1700	1100	100	43	12
Average Riffles		810	533	101	53	17.3
Average Pools		1377	772	81	44	16.9
Reach Average		1150	676	89	48	17.1

A gravel bar sample was collected (Table 4) to be used as a surrogate for stream subpavement particle size. This sample was collected according to the procedure utilized for the “bottomless bucket method.” The procedure to this approach is as follows: locate the sampling site along the lower 1/3 of a meander bend at an elevation equal to the thalweg elevation plus one half the elevation difference between the thalweg and bankfull elevations, locate the two largest particles that may be mobile at bankfull flow in the vicinity and average their intermediate axis, excavate and collect all material from an area the size of the mouth of a standard five gallon pail to a depth equal to twice the average intermediate axis of the two aforementioned particles, finally, wet sieve the material to obtain the particle size distribution. This analysis produces values that are used in various classification equations and may be used in conjunction with the pebble counts to help determine particle size distributions of the stream pavement and sub-pavement.

Table 4: Gravel bar sample

Dominant Particle Size	Bar Sample
D_{95}	
D_{85}	
D_{50}	
D_{35}	
D_{15}	

Photographs and Descriptions

Photograph 1: Upstream view at top of project reach showing first cross vane and bridge.

Photograph 2: View from left bank across stream at cross section 1.

Photograph 3: Eroded right bank at cross section 1.

Photograph 4: Cross vane near cross section 2.

Photograph 5: Bank erosion on right side of stream near cross section 2.

Photograph 6: Cross vane downstream of cross section 2, right arm of vane being flanked.

Photograph 7: Cross vane upstream of cross section 4.

Photograph 8: Exposed clay on right bank at cross section 4.

Photograph 9: Bank erosion on left bank at cross section 4.

Photograph 10: Cross vane located in between cross sections 4 and 5.

Photograph 11: Erosion on the left bank at cross section 6.

Photograph 12: Relief well near cross section 6.

Photograph 13: Clay exposure near cross section 8 on the right bank.

Photograph 14: View of cross vane downstream of cross section 8.

Photograph 15: Cross vane near cross section 9.

Photograph 16: Exposed silt on right bank at cross section 9.

Photograph 17: Cross vane located upstream of bridge at bottom of project reach.

Photograph 18: View from right bank across the stream at cross section 10.

Photograph 19: Eroded left bank at cross section 10.

Photograph 20: Downstream view of rip-rap and sheet pile.

Photograph 21: View upstream from bottom of project reach.

Photograph 22: View downstream from bottom of project reach.

Broadstreet Hollow Stream Restoration Project
Project Inspection - October 2007

7

8

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12

Broadstreet Hollow Stream Restoration Project
Project Inspection - October 2007


13


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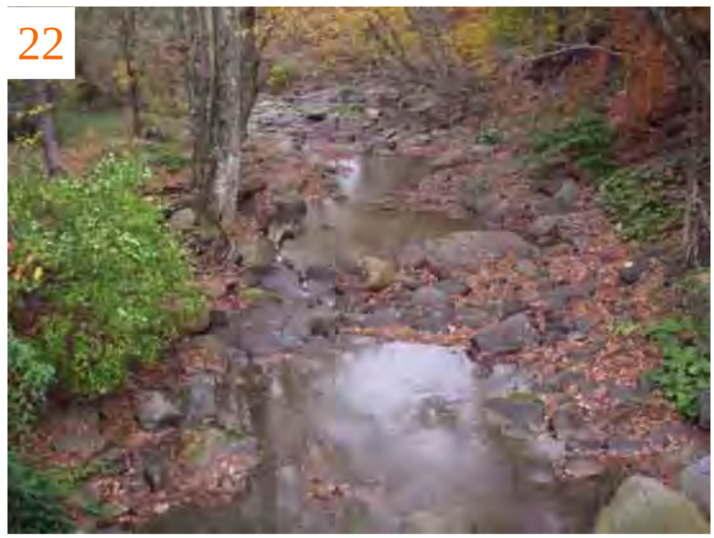
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GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

NYCDEP STREAM MANAGEMENT PROGRAM

"BROAD STREET HOLLOW" STREAM RESTORATION PROJECT

2007 MONITORING SURVEY

INDEX OF DRAWINGS

REV	DATE	DESCRIPTION	APP.

REVISIONS

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT
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FAX (518) 622-0344

BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

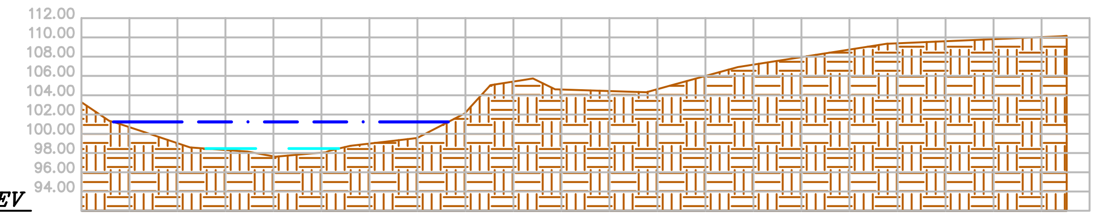
LEXINGTON GREENE COUNTY, NY

TITLE SHEET

PROJECT:
DATE: 01/07/08
SCALE: AS NOTED
DRAWN BY: NSH
DESIGN BY:

DRAWING: **BSH-1**

SHEET 1 OF 5



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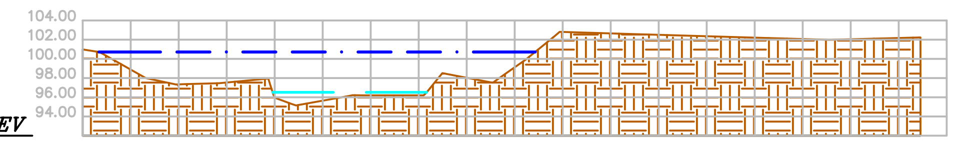

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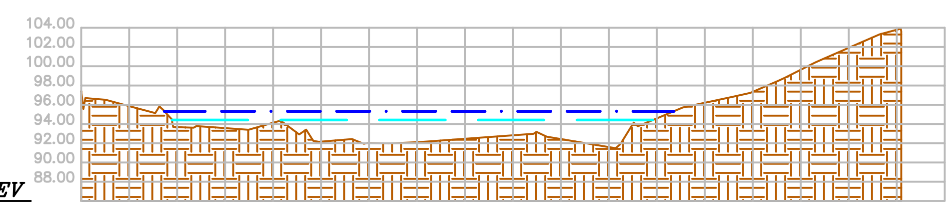

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SECTION XS3

REV	DATE	DESCRIPTION	APP.

REVISIONS

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT
BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12413
PHONE (518) 622-3620
FAX (518) 622-0344

BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.
LEXINGTON GREENE COUNTY, NY

CROSS SECTIONS 1-3

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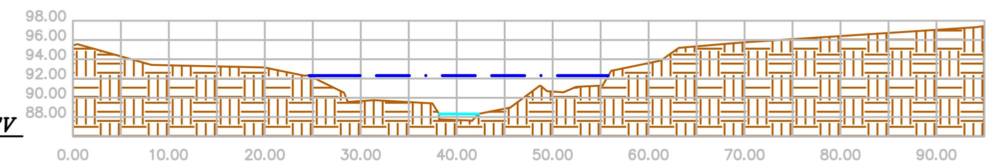
SCALE: 1:20
DRAWN BY: NSH
DESIGN BY:

DRAWING:
BSH-2

SHEET 2 OF 5



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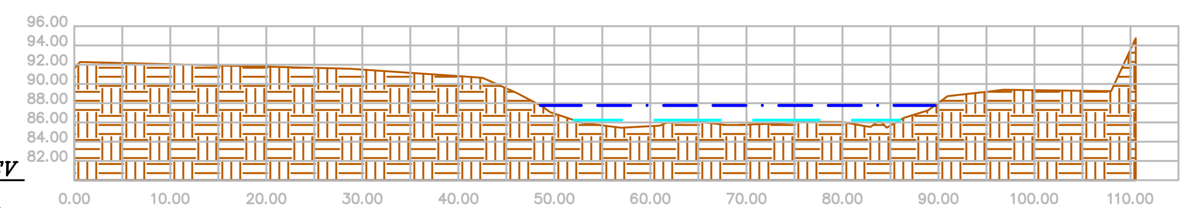
GROUP 2007XS
SECTION XS4



DATUM ELEV
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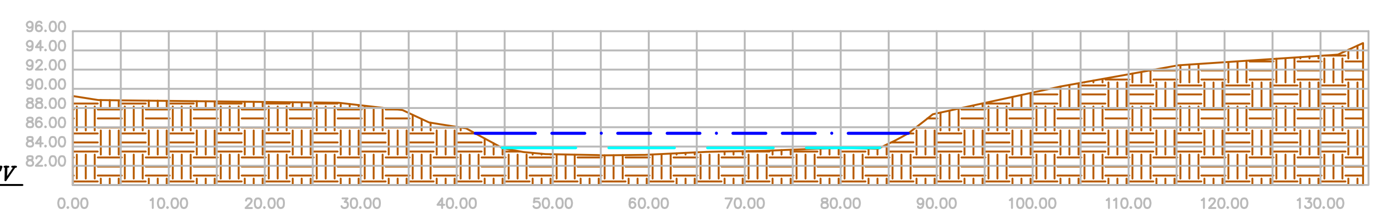
GROUP 2007XS
SECTION XS5



DATUM ELEV
80.00
GROUP 2007XS
SECTION XS6

REV	DATE	DESCRIPTION	APP.

REVISIONS

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT
BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12413
PHONE (518) 622-3620
FAX (518) 622-0344

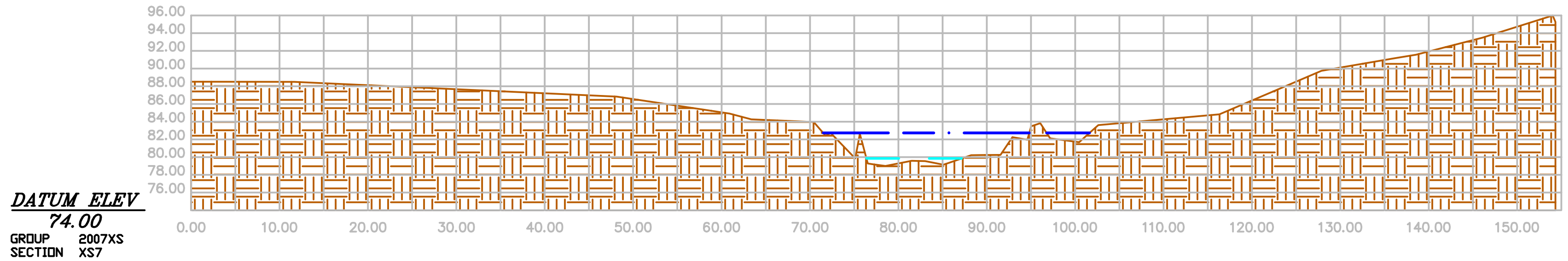
BROADSTREET HOLLOW

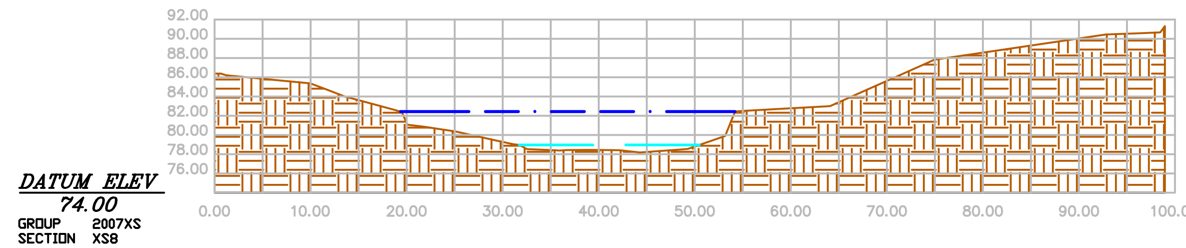
BROADSTREET HOLLOW RD.
LEXINGTON GREENE COUNTY, NY

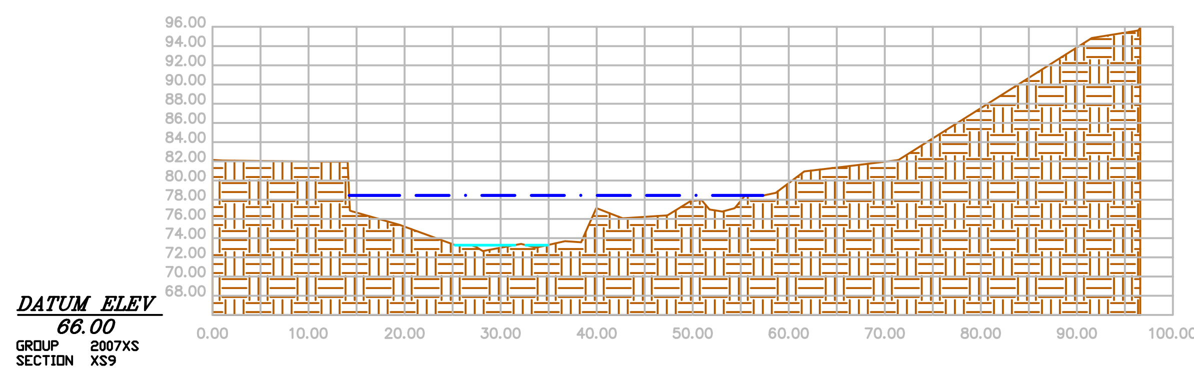
CROSS SECTIONS 4-6

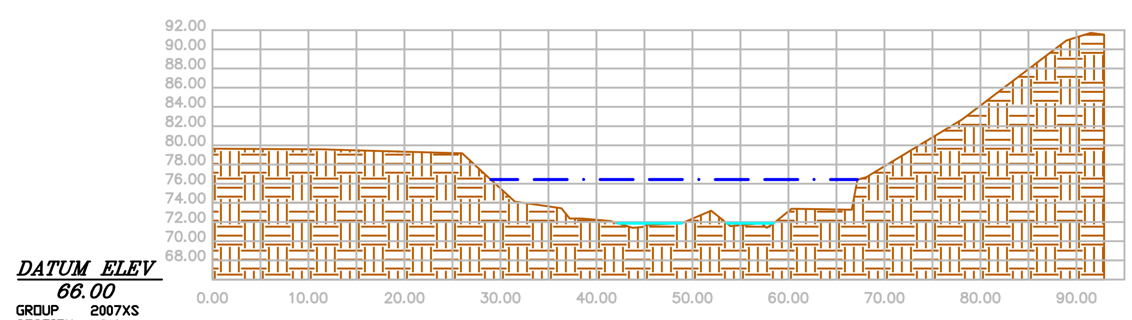
PROJECT:
DATE: 01/07/08
SCALE: 1:20
DRAWN BY: NSH
DESIGN BY:

DRAWING:
BSH-3
SHEET 3 OF 5









REV	DATE	DESCRIPTION	APP.

REVISIONS

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

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FAX (518) 622-0344

BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

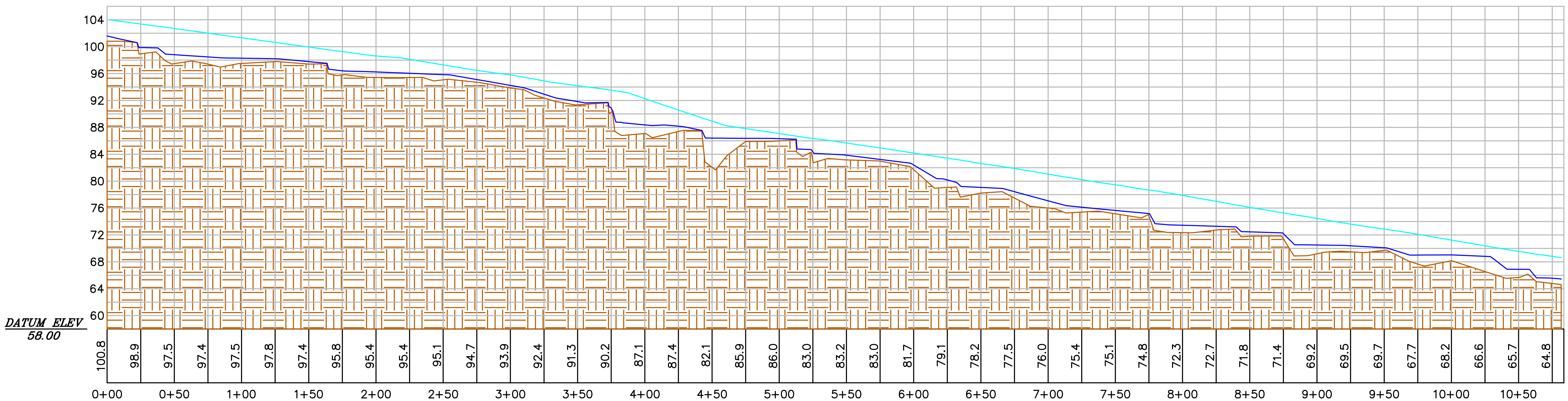
LEXINGTON GREENE COUNTY, NY

CROSS SECTIONS 7-10

PROJECT:
DATE: 01/07/08
SCALE: 1:20
DRAWN BY: NSH
DESIGN BY:

DRAWING: BSH-4

SHEET 4 OF 5



REV	DATE	DESCRIPTION	APP.

REVISIONS

Legend

Bankfull

Thalweg

Water Surface

GREENE COUNTY SOIL & WATER CONSERVATION DISTRICT

BOX 907 GREENE COUNTY OFFICE BUILDING, CAIRO, NY 12413
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BROADSTREET HOLLOW

BROADSTREET HOLLOW RD.

LEXINGTON

GREENE COUNTY, NY

PROFILE

PROJECT:
DATE: 01/07/08
SCALE: AS NOTED
DRAWN BY: NSH
DESIGN BY:

DRAWING:

BSH-5

SHEET 5 OF 5

Broadstreet Hollow Project Site
Summary of Survey Data
Updated: Jan.24, 2008

Broadstreet Hollow 2007 Survey
Cross Section Data

Cross Section	Station	Feature	Area (ft^2)	Width (ft)	Max Depth (ft)	Mean Depth (ft)	Width to Depth Ratio (W/D)	Riffle Max Depth Ratio (D_{max}/D)	Pool Max Depth Ratio (D_{max}/D)	Bank Height (ft)	Bank Height Ratio (D_{top}/D_{max})	Pool Width Ratio (W_{pool}/W_{bkf})
1	0+75	Riffle	79.56	34.87	3.62	2.28	15.28	1.59		8.14	2.25	
2	1+75	Pool	151.83	45.45	5.58	3.34	13.61		1.67	7.44	1.33	1.13
3	2+93	Riffle	128.63	53.08	3.84	2.42	21.90	1.58		5.74	1.49	
4	3+94	Pool	76.65	31.17	4.66	2.46	12.68		1.90	7.61	1.63	0.77
5	4+87	Pool	71.42	41.10	2.32	1.74	23.65		1.34	5.29	2.28	1.02
6	5+68	Riffle	80.49	45.12	2.29	1.78	25.29	1.28		4.27	1.86	
7	6+21	Riffle	60.29	28.17	3.73	2.14	13.16	1.74		4.95	1.33	
8	6+54	Pool	111.98	34.82	4.25	3.22	10.83		1.32	4.82	1.13	0.86
9	7+93	Pool	134.05	43.07	5.80	3.11	13.84		1.86	9.30	1.60	1.07
10	8+74	Pool	140.05	38.19	4.92	3.67	10.41		1.34	7.77	1.58	0.95
Average for Riffles			87.24	40.31	3.37	2.16	18.91	1.55			1.73	
Average for Pools			114.33	38.97	4.59	2.92	14.17		1.57		1.59	0.97
Reach Averages			103.50	39.50	4.10	2.62	16.07				1.65	

Cross Section	Width	Flood-Prone Width	Entrenchment
1	34.87	44.76	1.28
6	45.12	56.36	1.25
7	28.17	69.53	2.47
Reach Averages			1.67

Broadstreet Hollow Project Site
Summary of Survey Data
Updated: Jan.24, 2008

Broadstreet Hollow 2007 Survey
Stream Pattern Data

Attribute	Sample Number												Average
	1	2	3	4	5	6	7	8	9	10	11	12	
Meander Length (ft)	941.15												941
Radius of Curvature (ft)	266.07	397.78											332
Meander Width (ft)	201.1	201.73											201
Pool to Pool Length (ft)	126.94	195.92	13.76	18.82	95.57	110.9	58.97	36.31	0	0			66

Meander Length Ratio (L_m/W_{bkf})	23.35	Valley Length	958
Radius of Curvature Ratio (R_c/W_{bkf})	8.23	Channel Length	1094
Meander Width Ratio (W_{blt}/W_{bkf})	5.00	Sinuosity	1.14
Pool to Pool Spacing Ratio	1.63	Bankfull Width (W_{bkf})	40.31

Broadstreet Hollow Project Site
Summary of Survey Data
Updated: Jan.24, 2008

Broadstreet Hollow 2007 Survey
Profile Data

Attribute	Sample Number												Totals
	1	2	3	4	5	6	7	8	9	10	11	12	
Glide Length	4.61	11.48	18.81	9.07	6.03								50.00
Glide Drop	-0.11	-0.54	-0.01	-0.12	-0.07								-0.86
Glide Slope	-0.025	-0.047	-0.001	-0.013	-0.012								-0.017
Pool Length	9.41	13.79	44.08	32.70	23.53	25.00	62.28	34.80	32.08	29.38	20.52		327.57
Pool Drop	1.51	1.62	3.84	1.65	1.85	0.82	0.99	1.04	2.40	-0.23	-0.35		15.13
Pool Slope	0.160	0.117	0.087	0.050	0.079	0.033	0.016	0.030	0.075	-0.008	-0.017		0.046
Riffle-Run Length	22.27	126.94	195.92	13.76	18.82	95.57	110.90	58.88	36.31	24.76			704.13
Riffle-Run Drop	0.20	1.75	5.01	0.01	0.67	4.25	4.58	1.57	2.35	1.56			21.93
Riffle-Run Slope	0.009	0.014	0.026	0.001	0.036	0.044	0.041	0.027	0.065	0.063			0.031

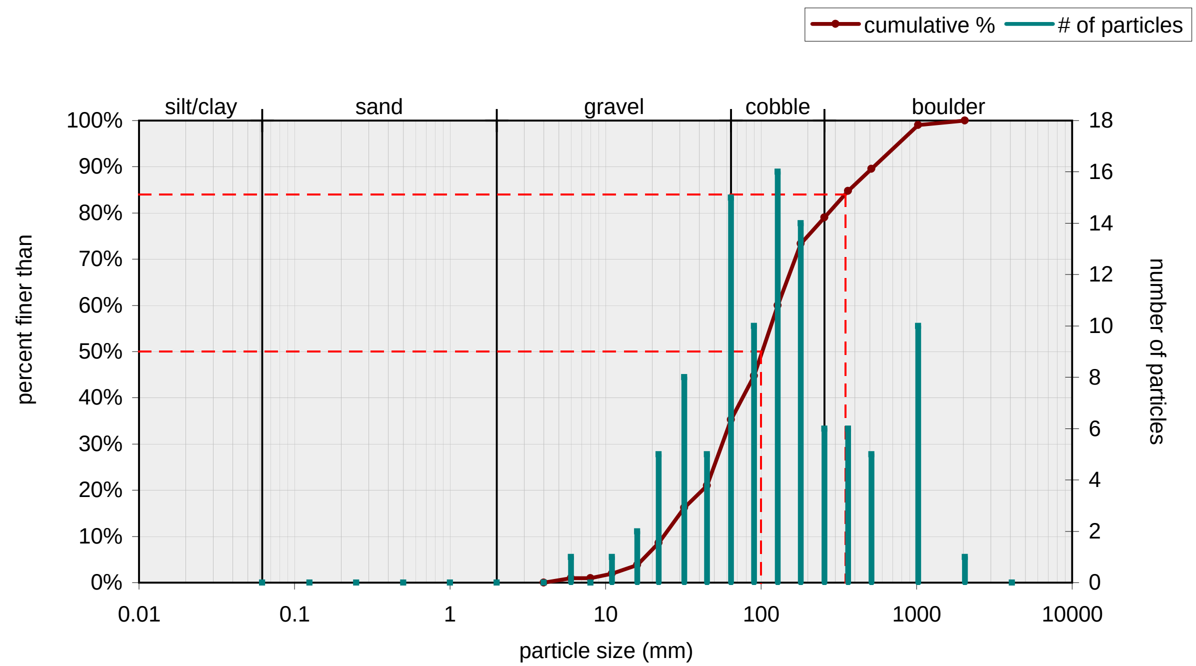
Overall Riffle-Run Length	704.13	Overall Pool-Glide Length	377.57	Riffle-Run Slope Ratio (S_{rif}/S_{chan})	0.931
Overall Riffle-Run Drop	21.93	Overall Pool-Glide Drop	14.27	Pool-Glide Slope Ratio (S_{pool}/S_{chan})	1.129
Overall Riffle-Run Slope	0.0312	Overall Pool-Glide Slope	0.0378	Percent Riffle	65.1%
Overall Channel Slope	0.0335	Valley Slope (ft/ft)	0.0378	Percent Pool	34.9%

Bankfull Channel

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**0**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**0**
coarse sand	0.5 - 1	**0**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**0**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**0**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**5**
coarse gravel	22 - 32	**8**
very coarse gravel	32 - 45	**5**
very coarse gravel	45 - 64	**15**
small cobble	64 - 90	**10**
medium cobble	90 - 128	**16**
large cobble	128 - 180	**14**
very large cobble	180 - 256	**6**
small boulder	256 - 362	**6**
small boulder	362 - 512	**5**
medium boulder	512 - 1024	**10**
large boulder	1024 - 2048	**1**
very large boulder	2048 - 4096	**0**
total particle count:		105
bedrock	-------------	
clay hardpan	-------------	
detritus/wood	-------------	
artificial	-------------	
total count:		105

Note: taken at xs1

Cross Section #1



Size (mm)	
D16	32
D35	64
D50	100
D65	150
D84	350
D95	760

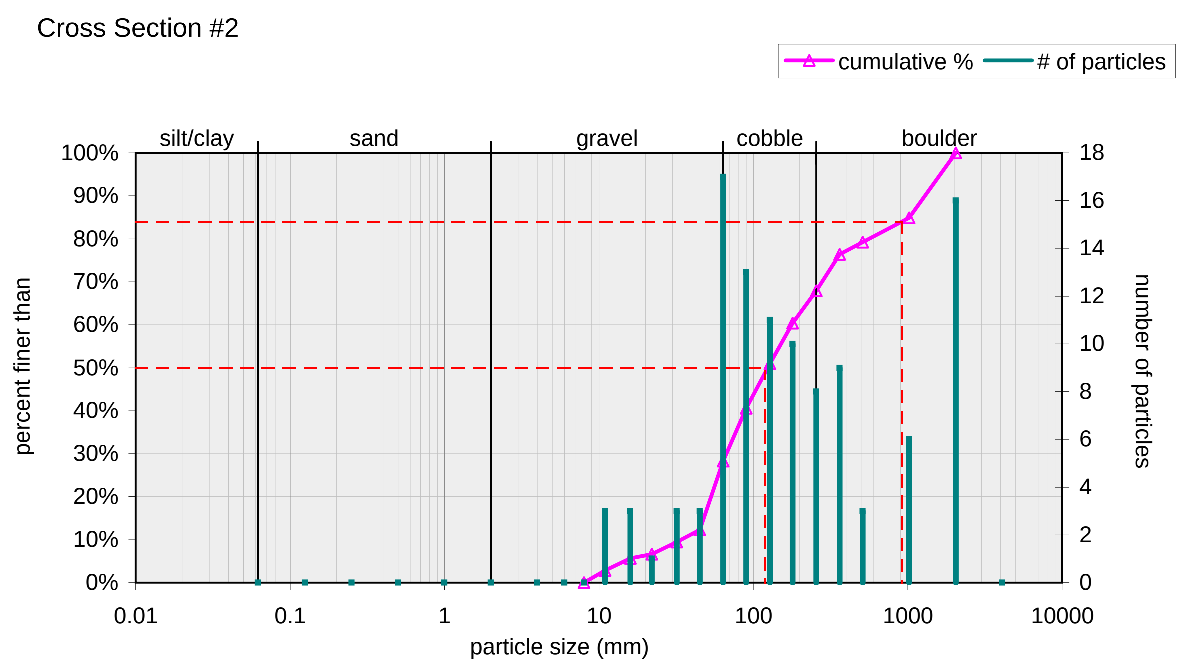
Size Distribution	
mean	105.8
dispersion	3.3
skewness	0.02

Type	
silt/clay	0%
sand	0%
gravel	35%
cobble	44%
boulder	21%

Cross Section #2

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**0**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**0**
coarse sand	0.5 - 1	**0**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**0**
fine gravel	4 - 6	**0**
fine gravel	6 - 8	**0**
medium gravel	8 - 11	**3**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**3**
very coarse gravel	32 - 45	**3**
very coarse gravel	45 - 64	**17**
small cobble	64 - 90	**13**
medium cobble	90 - 128	**11**
large cobble	128 - 180	**10**
very large cobble	180 - 256	**8**
small boulder	256 - 362	**9**
small boulder	362 - 512	**3**
medium boulder	512 - 1024	**6**
large boulder	1024 - 2048	**16**
very large boulder	2048 - 4096	**0**
total particle count:		106
bedrock	---------------------	
clay hardpan	---------------------	
detritus/wood	---------------------	
artificial	---------------------	
total count:		106

Note: taken at xs2



Size (mm)	
D16	49
D35	77
D50	120
D65	220
D84	920
D95	1600

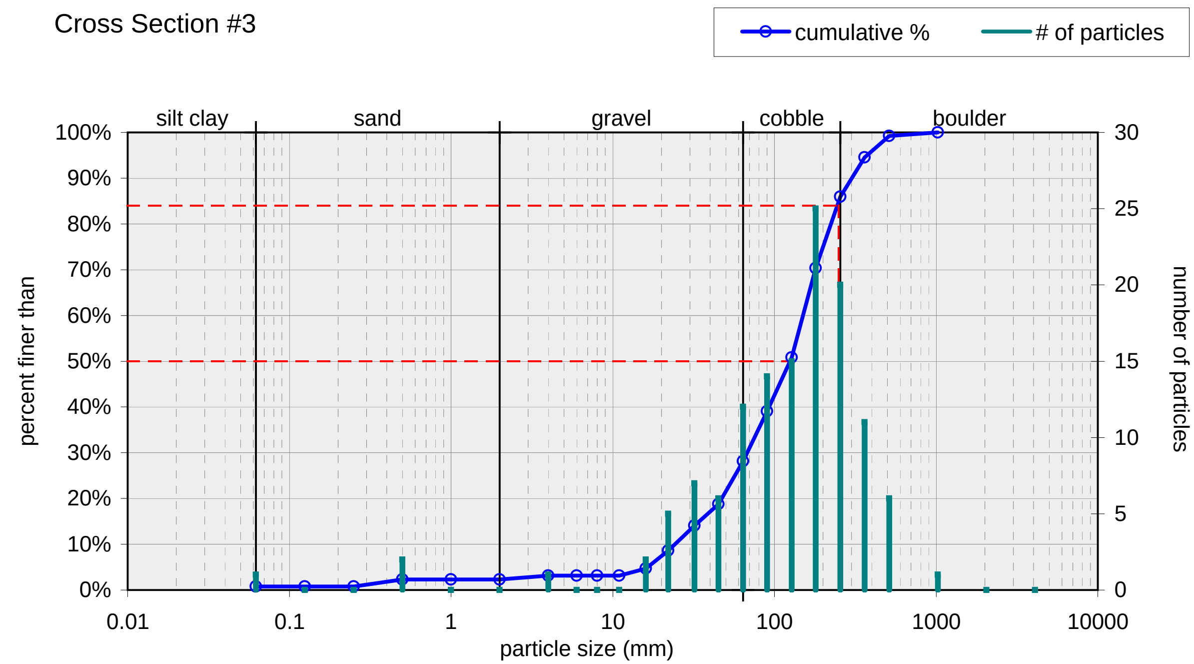
Size Distribution	
mean	212.3
dispersion	5.1
skewness	0.22

Type	
silt/clay	0%
sand	0%
gravel	28%
cobble	40%
boulder	32%

Cross Section #3

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**1**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**2**
coarse sand	0.5 - 1	**0**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**1**
fine gravel	4 - 6	**0**
fine gravel	6 - 8	**0**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**5**
coarse gravel	22 - 32	**7**
very coarse gravel	32 - 45	**6**
very coarse gravel	45 - 64	**12**
small cobble	64 - 90	**14**
medium cobble	90 - 128	**15**
large cobble	128 - 180	**25**
very large cobble	180 - 256	**20**
small boulder	256 - 362	**11**
small boulder	362 - 512	**6**
medium boulder	512 - 1024	**1**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		128
bedrock	---------------------	
clay hardpan	---------------------	
detritus/wood	---------------------	
artificial	---------------------	
total count:		128

Note: taken at xs3

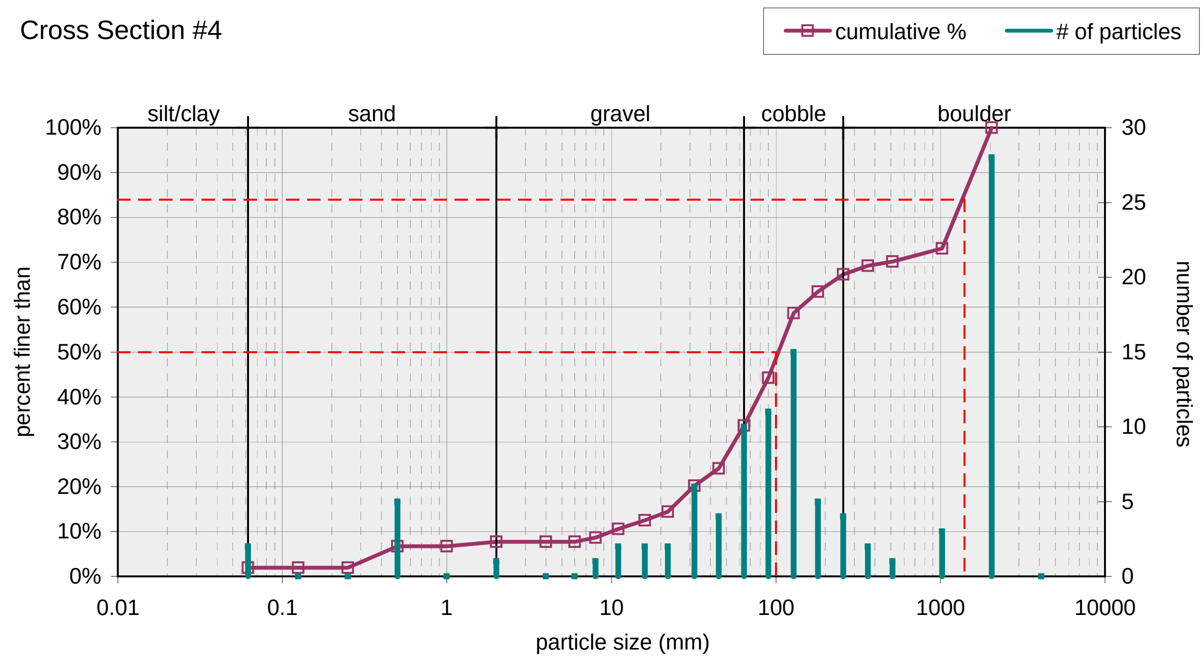


Size (mm)	
D16	37
D35	79
D50	130
D65	160
D84	250
D95	370

Size Distribution	
mean	96.2
dispersion	2.7
skewness	-0.14

Type	
silt/clay	1%
sand	2%
gravel	26%
cobble	58%
boulder	14%

Cross Section #4		
Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**2**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**5**
coarse sand	0.5 - 1	**0**
very coarse sand	1 - 2	**1**
very fine gravel	2 - 4	**0**
fine gravel	4 - 6	**0**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**2**
coarse gravel	22 - 32	**6**
very coarse gravel	32 - 45	**4**
very coarse gravel	45 - 64	**10**
small cobble	64 - 90	**11**
medium cobble	90 - 128	**15**
large cobble	128 - 180	**5**
very large cobble	180 - 256	**4**
small boulder	256 - 362	**2**
small boulder	362 - 512	**1**
medium boulder	512 - 1024	**3**
large boulder	1024 - 2048	**28**
very large boulder	2048 - 4096	**0**
total particle count:		104
bedrock	--------------------	
clay hardpan	--------------------	
detritus/wood	--------------------	
artificial	--------------------	
total count:		104
Note:	taken at xs4	



Size (mm)	
D16	24
D35	67
D50	100
D65	210
D84	1400
D95	1800

Size Distribution	
mean	183.3
dispersion	9.1
skewness	0.20

Type	
silt/clay	2%
sand	6%
gravel	26%
cobble	34%
boulder	33%

Cross Section #5

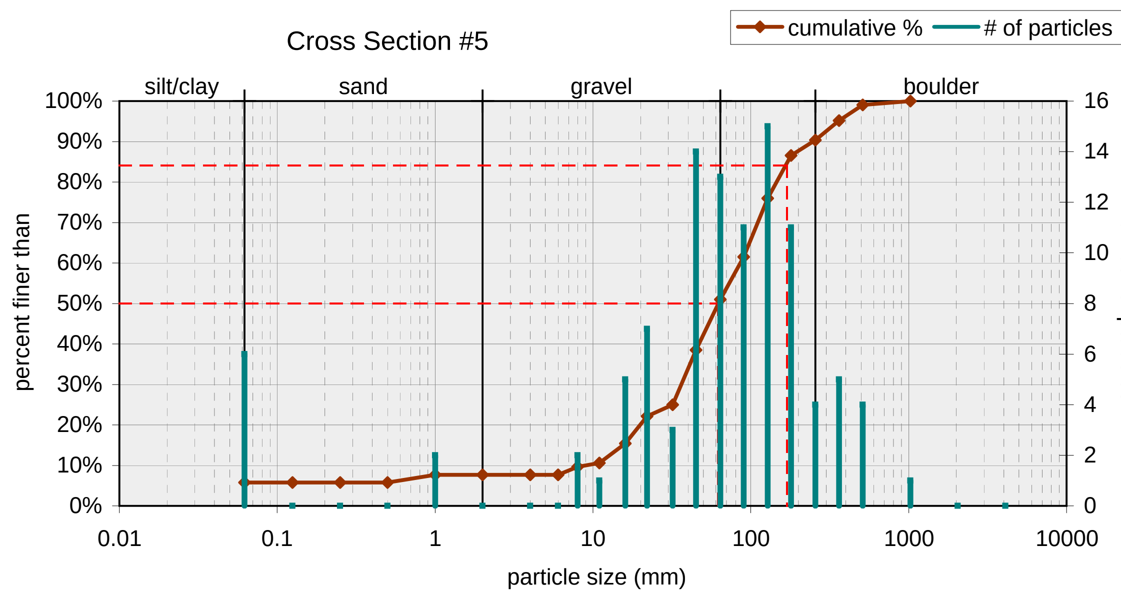
Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**6**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**0**
coarse sand	0.5 - 1	**2**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**0**
fine gravel	4 - 6	**0**
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**5**
coarse gravel	16 - 22	**7**
coarse gravel	22 - 32	**3**
very coarse gravel	32 - 45	**14**
very coarse gravel	45 - 64	**13**
small cobble	64 - 90	**11**
medium cobble	90 - 128	**15**
large cobble	128 - 180	**11**
very large cobble	180 - 256	**4**
small boulder	256 - 362	**5**
small boulder	362 - 512	**4**
medium boulder	512 - 1024	**1**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**

total particle count: 104

bedrock --------------------	
clay hardpan --------------------	
detritus/wood --------------------	
artificial --------------------	

total count: 104

Note: taken at xs5



Size (mm)	
D16	16
D35	41
D50	62
D65	98
D84	170
D95	360

Size Distribution	
mean	52.2
dispersion	3.3
skewness	-0.07

Type	
silt/clay	6%
sand	2%
gravel	43%
cobble	39%
boulder	10%

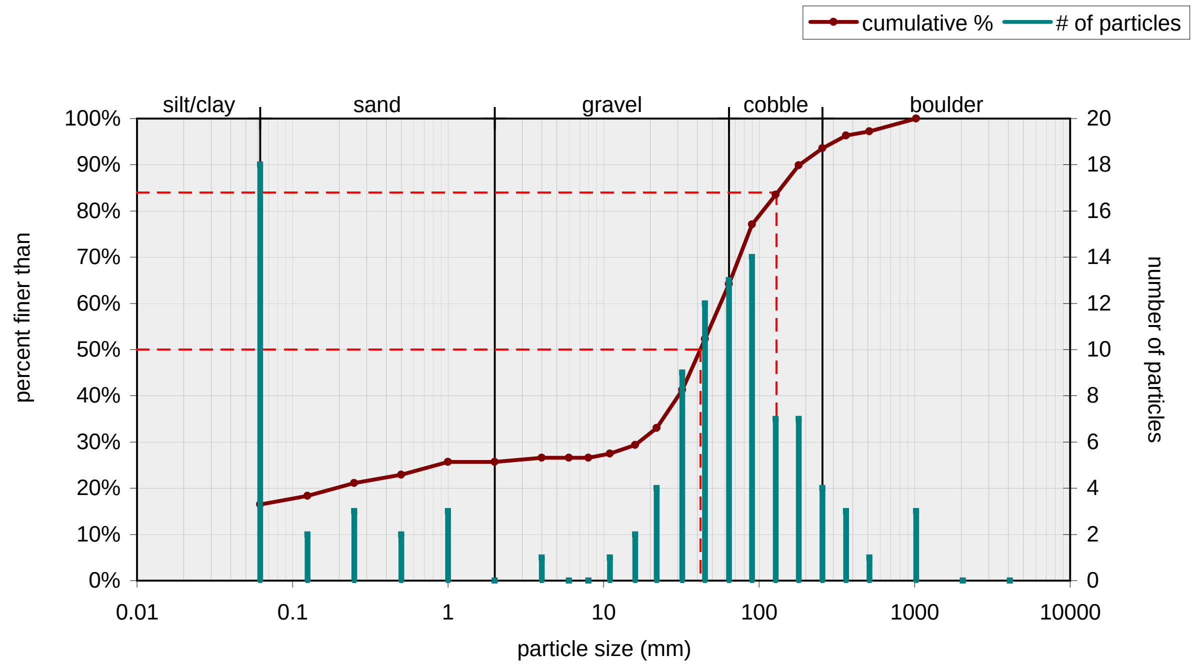
Bankfull Channel

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**18**
very fine sand	0.062 - 0.125	**2**
fine sand	0.125 - 0.25	**3**
medium sand	0.25 - 0.5	**2**
coarse sand	0.5 - 1	**3**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**1**
fine gravel	4 - 6	**0**
fine gravel	6 - 8	**0**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**4**
coarse gravel	22 - 32	**9**
very coarse gravel	32 - 45	**12**
very coarse gravel	45 - 64	**13**
small cobble	64 - 90	**14**
medium cobble	90 - 128	**7**
large cobble	128 - 180	**7**
very large cobble	180 - 256	**4**
small boulder	256 - 362	**3**
small boulder	362 - 512	**1**
medium boulder	512 - 1024	**3**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		109

bedrock -------------	
clay hardpan -------------	
detritus/wood -------------	
artificial -------------	
total count:	109

Note: taken at xs6

Cross Section #6



Size (mm)	
D16	0.062
D35	24
D50	42
D65	65
D84	130
D95	310

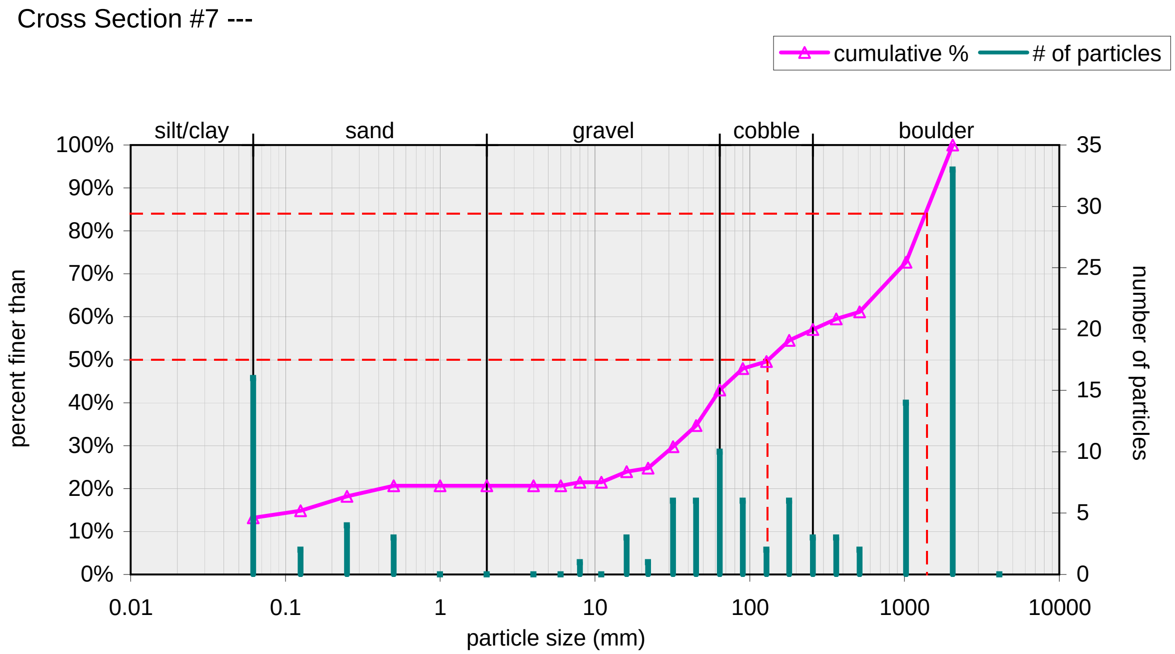
Size Distribution	
mean	2.8
dispersion	340.3
skewness	-0.64

Type	
silt/clay	17%
sand	9%
gravel	39%
cobble	29%
boulder	6%

Cross Section #7

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**16**
very fine sand	0.062 - 0.125	**2**
fine sand	0.125 - 0.25	**4**
medium sand	0.25 - 0.5	**3**
coarse sand	0.5 - 1	**0**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**0**
fine gravel	4 - 6	**0**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**6**
very coarse gravel	32 - 45	**6**
very coarse gravel	45 - 64	**10**
small cobble	64 - 90	**6**
medium cobble	90 - 128	**2**
large cobble	128 - 180	**6**
very large cobble	180 - 256	**3**
small boulder	256 - 362	**3**
small boulder	362 - 512	**2**
medium boulder	512 - 1024	**14**
large boulder	1024 - 2048	**33**
very large boulder	2048 - 4096	**0**
total particle count:		121
bedrock	---------------------	
clay hardpan	---------------------	
detritus/wood	---------------------	
artificial	---------------------	
total count:		121

Note: taken at xs7



Size (mm)	
D16	0.16
D35	46
D50	130
D65	640
D84	1400
D95	1800

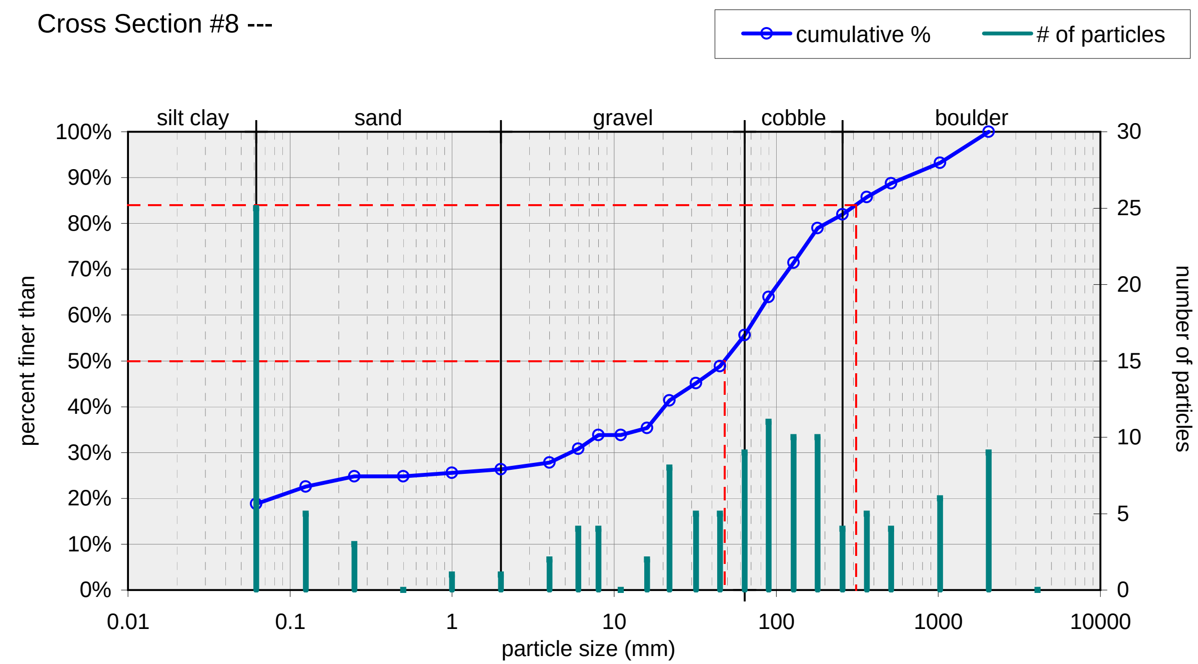
Size Distribution	
mean	15.0
dispersion	411.6
skewness	-0.47

Type	
silt/clay	13%
sand	7%
gravel	22%
cobble	14%
boulder	43%

Cross Section #8

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**25**
very fine sand	0.062 - 0.125	**5**
fine sand	0.125 - 0.25	**3**
medium sand	0.25 - 0.5	**0**
coarse sand	0.5 - 1	**1**
very coarse sand	1 - 2	**1**
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**4**
fine gravel	6 - 8	**4**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**8**
coarse gravel	22 - 32	**5**
very coarse gravel	32 - 45	**5**
very coarse gravel	45 - 64	**9**
small cobble	64 - 90	**11**
medium cobble	90 - 128	**10**
large cobble	128 - 180	**10**
very large cobble	180 - 256	**4**
small boulder	256 - 362	**5**
small boulder	362 - 512	**4**
medium boulder	512 - 1024	**6**
large boulder	1024 - 2048	**9**
very large boulder	2048 - 4096	**0**
total particle count:		133
bedrock --------------------		
clay hardpan --------------------		
detritus/wood --------------------		
artificial --------------------		
total count:		133

Note: taken at xs8



Size (mm)	
D16	0.062
D35	15
D50	48
D65	95
D84	310
D95	1200

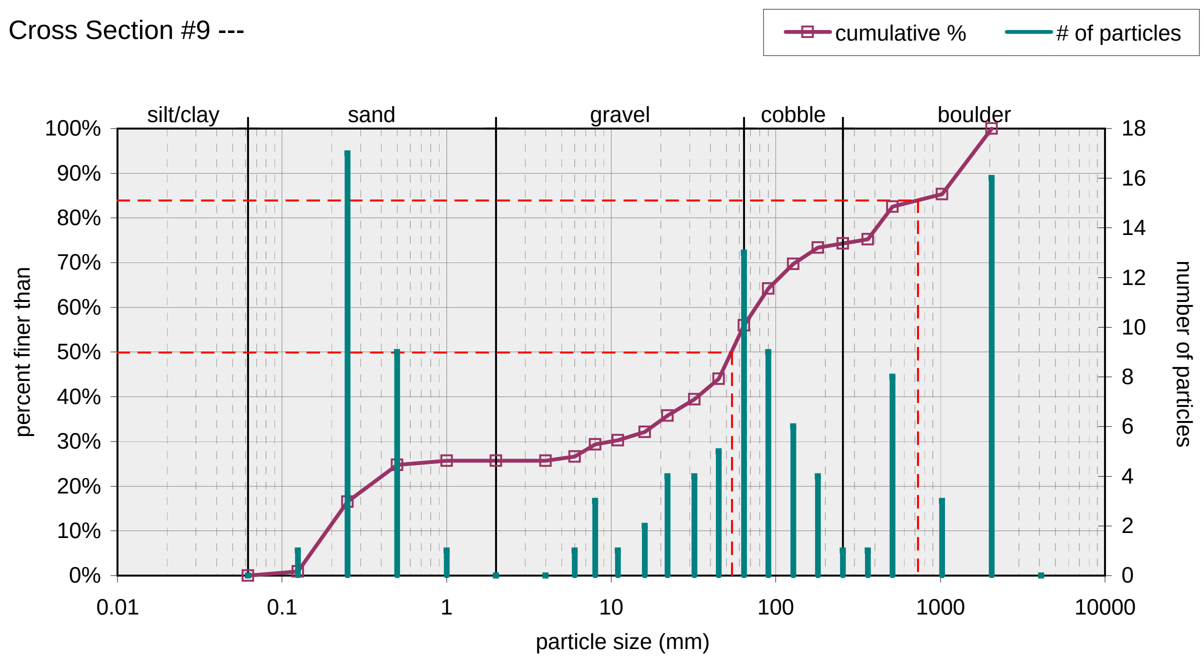
Size Distribution	
mean	4.4
dispersion	390.3
skewness	-0.54

Type	
silt/clay	19%
sand	8%
gravel	29%
cobble	26%
boulder	18%

Cross Section #9

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**0**
very fine sand	0.062 - 0.125	**1**
fine sand	0.125 - 0.25	**17**
medium sand	0.25 - 0.5	**9**
coarse sand	0.5 - 1	**1**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**0**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**4**
coarse gravel	22 - 32	**4**
very coarse gravel	32 - 45	**5**
very coarse gravel	45 - 64	**13**
small cobble	64 - 90	**9**
medium cobble	90 - 128	**6**
large cobble	128 - 180	**4**
very large cobble	180 - 256	**1**
small boulder	256 - 362	**1**
small boulder	362 - 512	**8**
medium boulder	512 - 1024	**3**
large boulder	1024 - 2048	**16**
very large boulder	2048 - 4096	**0**
	total particle count:	109
bedrock	--------------------	
clay hardpan	--------------------	
detritus/wood	--------------------	
artificial	--------------------	
	total count:	109

Note: taken at xs9



Size (mm)	
D16	0.24
D35	21
D50	54
D65	95
D84	730
D95	1600

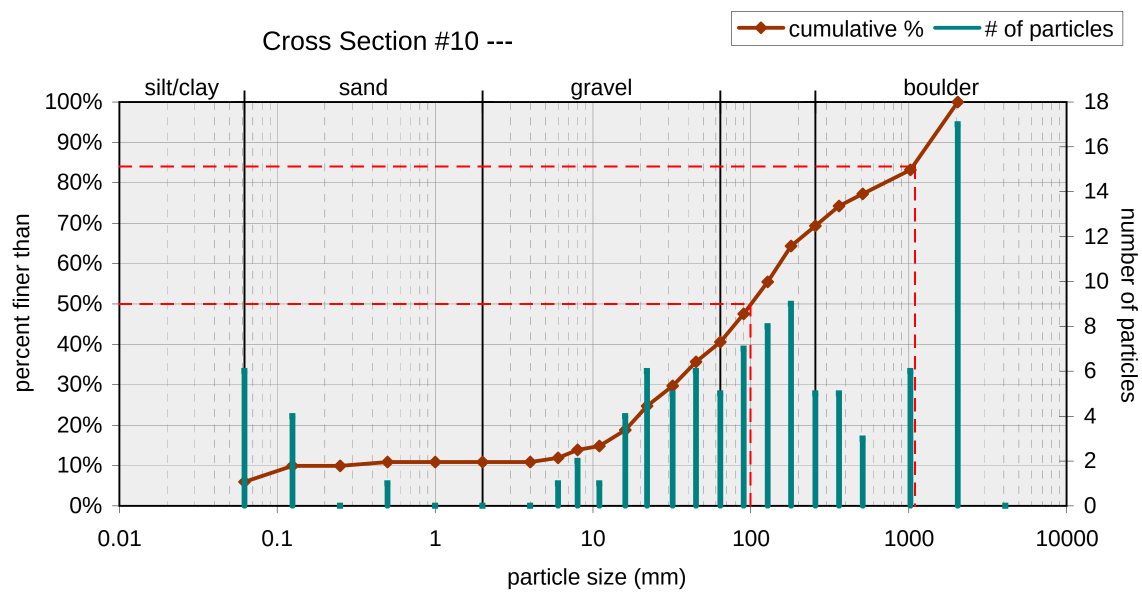
Size Distribution	
mean	13.2
dispersion	119.3
skewness	-0.33

Type	
silt/clay	0%
sand	26%
gravel	30%
cobble	18%
boulder	26%

Cross Section #10

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**6**
very fine sand	0.062 - 0.125	**4**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**1**
coarse sand	0.5 - 1	**0**
very coarse sand	1 - 2	**0**
very fine gravel	2 - 4	**0**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**4**
coarse gravel	16 - 22	**6**
coarse gravel	22 - 32	**5**
very coarse gravel	32 - 45	**6**
very coarse gravel	45 - 64	**5**
small cobble	64 - 90	**7**
medium cobble	90 - 128	**8**
large cobble	128 - 180	**9**
very large cobble	180 - 256	**5**
small boulder	256 - 362	**5**
small boulder	362 - 512	**3**
medium boulder	512 - 1024	**6**
large boulder	1024 - 2048	**17**
very large boulder	2048 - 4096	**0**
total particle count:		101
bedrock	--------------------	
clay hardpan	--------------------	
detritus/wood	--------------------	
artificial	--------------------	
total count:		101

Note: taken at xs10



Size (mm)	
D16	12
D35	43
D50	100
D65	190
D84	1100
D95	1700

Size Distribution	
mean	114.9
dispersion	9.7
skewness	0.04

Type	
silt/clay	6%
sand	5%
gravel	30%
cobble	29%
boulder	31%