ATTACHMENT Q

TROUT STREAM RESTORATION REPORT

New August 2014

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CONSTITUTION PIPELINE
NEW YORK TROUT STREAM CROSSINGS

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1.0 INTRODUCTION

This report summarizes the work completed to date by Kleinschmidt Associates (Kleinschmidt) for the Constitution Pipeline New York State stream crossings permitting process. Field visits were performed that included Constitution personnel; Kleinschmidt, AECOM, and VHB consultants; New York State Department of Environmental Conservation (NYSDEC) staff; and U.S. Army Corps of Engineers (USACE) staff to review selected stream crossings for trout stream restoration activities. Prior to these field visits, NYSDEC staff selected approximately 90 stream crossing sites of interest from the over 200 stream crossings listed in the Constitution Comprehensive Waterbody Table. These field visits were conducted on July 18-19, 2013, July 22-23, 2013, July 31- August 1, 2013, August 7-8, 2013, September 26, 2013, and April 23-25, 2014. A summary of agency staff comments from the field visits was provided to the NYSDEC and USACE on September 5, 2013 following the July and August site visits.

Based on the NYSDEC's and USACE's comments in the field, further field investigations were conducted by Kleinschmidt at over 50 stream crossings in September through October of 2013 and again in July of 2014. The 50 stream crossings were either noted during the agency visits as stream crossings of concern or were identified by Kleinschmidt as having similar characteristics as those stream crossings of concern previously identified. It is Kleinschmidt's opinion that site-specific restoration techniques are necessary for 31 stream crossings. Through field investigations, these proposed stream crossings were identified as having a higher potential for adverse impacts to trout habitat or a higher potential for channel instability leading to erosion of the stream bed and bank. It is Kleinschmidt's opinion that the remainder of the streams investigated will be protected by implementing the stream crossing methods described in Section 6 (Waterbody Crossings) of the Constitution New York Environmental Construction Plan (ECP) to re-establish stable stream bed and banks. Streams that are crossed by conventional boring, horizontal directional drilling, or the direct pipe method will not require any stream restoration.

To prescribe site-specific restoration techniques, Kleinschmidt biologists and engineers completed topographic surveys (channel slope and cross section dimension); geomorphic characterization (extent of bank and bed erosion and a site stability assessment); and trout habitat characterization for the sites with a significant threat to stream stability or trout habitat. These data, along with drainage area analysis from StreamStats (Attachment C), were used to group streams with similar characteristics for which similar site-specific restoration techniques may be applied at the stream crossings. These techniques supersede, or are in addition to, the typical stream restoration methods outlined in the Constitution ECP to re-establish stable streams after pipeline installation.

With a few exceptions, the stream crossing sites are generally stable in bed and banks. This is most likely a result of the rural and forested land cover that predominates in these watersheds, largely intact riparian buffers with woody vegetation, and very coarse bed material, which provides resistance to channel incision and bank instability. However, some crossing sites have a greater potential to become unstable after pipeline installation and may require some additional stabilization measures, as described in this report. Based on the field assessment and agency comments, restoration techniques were individually assigned to each of these crossings to minimize the impact of the pipeline crossing to the trout habitat and overall channel stability.

Streams with significant threats to channel stability or trout habitat were considered Priority 1 streams. Restoration of Priority 1 streams may include grade control, bank stabilization, riparian planting, and replacement of native substrate. Streams without significant threat to channel stability or trout habitat, but requiring bank stabilization, were considered Priority 2 streams. Priority 2 streams typically will require only riparian planting to stabilize the stream banks and the replacement of native substrate in the channel to adequately stabilize the crossing. All streams not classified as Priority 1 or Priority 2 streams will follow the standard stream restoration techniques outlined in the Constitution ECP. Site-specific restoration techniques are proposed for both Priority 1 and Priority 2 streams in this report.

At the time of this report, the NYSDEC, the USACE, Constitution, and Kleinschmidt were unable to access approximately five sites requested by the agencies to review due to lack of survey permissions (i.e. non-access parcels). Site visits will be conducted by Constitution, the NYSDEC, the USACE, and Kleinschmidt once access is permitted to ensure the appropriate stream restoration technique as defined in this restoration report or within the ECP is employed. Constitution anticipates that survey access to these parcels will be obtained during Fall 2014, with field visits and agency coordination occurring immediately following.

This report outlines the proposed stream bed and/or bank restoration design approaches and techniques for each group of streams identified as either Priority 1 or Priority 2. These restoration approaches and techniques conform to the concepts of natural channel design and emphasize the use of native and local materials as well as bioengineering approaches for bed and bank stabilization. Where appropriate, typical approaches outlined in the Constitution ECP are integrated herein. The bed and bank stability structure design guidance from the U.S. Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Stream Corridor Restoration Workgroup (NRCS 2007) also is incorporated into the restoration techniques. Finally, a planting plan for stream banks and riparian buffer is provided.

2.0 STREAM CHARACTERIZATION

Twenty-two streams are classified as Priority 1 streams and nine are classified as Priority 2 streams, based on the agencies' comments. Those streams not classified as Priority 1 or 2 are generally stable and are expected to be adequately restored by following the BMPs outlined in the Constitution ECP (Section 9.3.1, Attachment 2 – Best Management Practices Figures). The sections below further describe the site-specific restoration techniques for Priority 1 and Priority 2 streams.

2.1 PRIORITY 1 STREAMS

During follow-up site visits for Priority 1 streams, the field team surveyed a minimum of three cross sections (one at the pipeline crossing, one 100' upstream, and one 100' downstream), recorded a minimum of three photographs at the cross sections, measured flow, noted stream geomorphology, and identified habitat features pertinent to restoring the site. The field teams investigated signs of instability in the vicinity of the pipeline crossing, including headcuts and active bank erosion. Headcuts are generally known as unstable breaks in grade that migrate upstream, causing vertical instability and channel erosion, potentially exposing the pipeline, if left unaddressed. Data gathered during field visits was synthesized to determine restoration techniques to provide suitable trout habitat in these streams and protect the pipeline crossing (Figure 1 and Attachment B).

Based on the information collected during the site visits, the Priority 1 streams were categorized into five groups to establish the restoration approach for each group (Table 1). Table 1, below, presents site-specific restoration measures and refers to typical best management practices included in Attachment A, in addition to the BMP figures in the Constitution ECP. These five groups are based on bank stability, bed stability, drainage area, and valley type, with site-specific restoration techniques assigned for each stream, based on the assessed risk to stream stability, trout habitat, and risk of exposure of the pipeline. These proposed site-specific restoration techniques are recommended to compliment the typical construction ROW on-site mitigation measures, as presented in Section 6.8 and Section 9.3 of the Constitution ECP (Waterbody Crossing Procedures, Waterbody and Wetland Crossing Restoration). The restoration techniques proposed in Table 1 will be implemented after the pipeline installation under the direction of a stream geomorphologist familiar with natural channel designs. Descriptions of each stream group are provided in Section 3, along with a narrative outlining the restoration design approaches for each group and descriptions of the restoration techniques proposed for the Constitution project.

In compliance with the Federal Energy Regulatory Commission (FERC) guidelines, the impacts to the stream are limited to the 75’ wide construction ROW. Thus any stream bed or bank restoration work will be completed entirely within this area in the stream channel and within the permitted construction ROW on the banks to a distance defined in the Constitution ECP, and as permitted by the regulatory agencies.

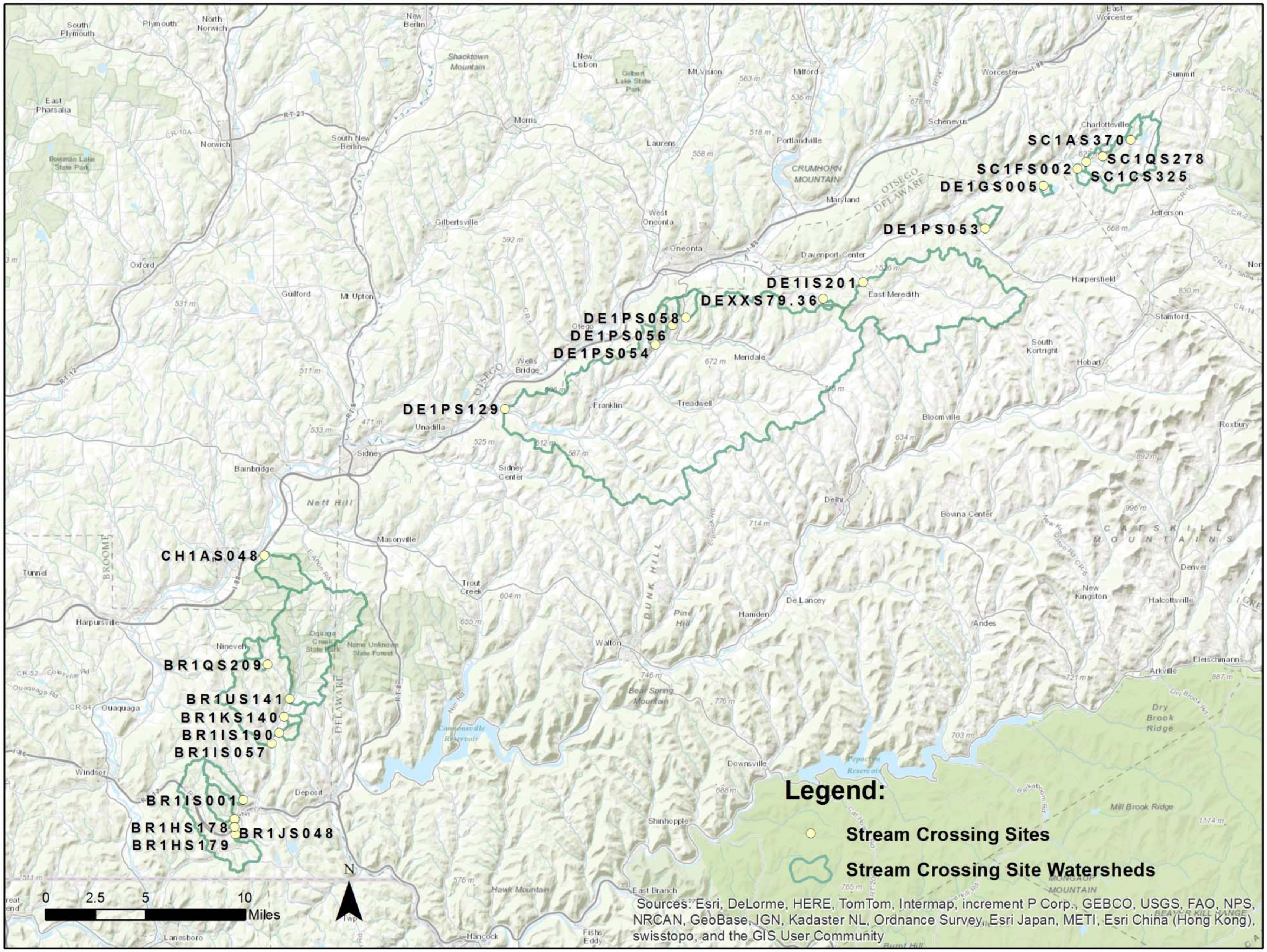


FIGURE 1. LOCATION OF THE PRIORITY 1 STREAM RESTORATION SITES ALONG THE PROPOSED CONSTITUTION PIPELINE.

TABLE 1. PRIORITY 1 STREAM RESTORATION SITES GROUPED BY STREAM CHARACTERISTICS.

Group Number	Waterbody ID	Waterbody Name	Drainage Area (mi^2)	Channel Slope	Bankfull Flow* (CFS)	Bankfull Width (ft)	Bankfull Depth (ft)	Dominant Substrate(s)	Mesohabitat Type(s)	Bed Stability	Bank Stability	Valley Confinement	Vertical Grade Control BMP Figure No.**	Bank Stabilization BMP Figure No.**	Habitat Improvement BMP Figure No.**
1	BR-1H-S179	UNT to Fly Creek	0.1	10%	4	9	1.2	Boulder/ Cobble	Step pool, Riffle	Stable	Stable	Partially Confined	-	37, 66	-
1	BR-1I-S190	UNT to Oquaga Creek	0.6	7%	27	14	1.3	Boulder/ Cobble	Step pool, Riffle	Stable	Minor bank erosion, stable	Partially Confined	-	37, 66, 70	-
1	DE-1P-S053	UNT to Middle Brook	0.8	7%	39	13	1.6	Boulder/ Cobble	Step pool, Riffle	Stable	Stable	Partially Confined	-	37, 66, 70	-
2	DE-1P-S054	UNT to Ouleout Creek	1.0	3%	47	11	0.8	Cobble/ Gravel	Step pool, Riffle	Stable	Stable	Partially Confined	111	37, 66	LW
2	BR-1Q-S209	UNT to Dry Brook	0.2	6%	8	5*	0.4*	Cobble/ Gravel, Silt	Step pool	Moderatel y unstable	Stable	Unconfined	111	37, 66	-
2	DE-XX-S79.36	Prosser Hollow Brook	0.1	~15%	7	5*	0.4*	Cobble/ Boulder	Step pool	Stable	Minor erosion, stable	Confined	112	37, 67	-
2	BR-1K-S140	UNT to Oquaga Creek	0.3	6%	16	8*	0.5*	Boulder/ Cobble	Step pool, Riffle	Stable	Stable	Partially Confined	111, 112	37, 66	-
2	SC-1Q-S278	UNT to Clapper Hollow Creek	0.2	10%	13	14	1.6	Boulder/ Cobble	Step pool, Riffle	Incising, unstable	Undercut, failing	Confined	112	37, 66,70	-
2	BR-1J-S048	UNT to Fly Creek	1.7	7%	72	16	1.6	Boulder/ Cobble	Step pool, Riffle	Incised but stable	Minor erosion, stable	Unconfined	114	37, 66	LW
2	SC-1F-S002	UNT to Charlotte Creek	0.4	3%	21	10	1.1	Cobble/ Boulder	Step pool, Riffle	Stable	Minor erosion	Unconfined	111	37, 66	-
3	DE-1G-S005	UNT to Charlotte Creek	0.2	1%	12	7*	0.5*	Cobble/ gravel	Riffle	Stable	Stable	Unconfined	-	37, 66	LW
3	DE-1P-S056	UNT to Ouleout Creek	0.8	1%	37	26	1.1	Cobble/ Gravel	Riffle, Step pool	Stable	Stable	Unconfined	-	37, 66	LW
3	DE-1P-S058	UNT to Ouleout Creek	1.0	3%	47	40	1.1	Cobble/Sand	Riffle	Stable	Stable	Unconfined	-	37, 72	LW
3	BR-1I-S001	UNT to Marsh Creek	1.7	3%	72	41	1.5	Cobble/ Boulder	Step pool	Stable	Recent isolated scour	Partially Confined	-	37, 66, 67	LW
3	SC-1A-S370	UNT to Clapper Hollow Creek	0.6	0.6%	29	11*	0.7*	Sand/ Gravel/Silt	Riffle, Run	Stable	Some scour	Unconfined	-	37, 72	LW
4	BR-1U-S141	Oquaga Creek	3.0	0.6%	497	59	2.4	Cobble/ Gravel	Riffle	Stable	Stable	Partially Confined	-	37, 66, 67	116
4	CH-1A-S048	Landers Creek	3.2	2%	72	44	1.0	Cobble	Pool-Riffle	Stable	Stable	Partially Confined	-	37, 66, 70	LW
4	SC-1C-S325	Clapper Hollow Creek	8.0	3%	269	26	0.9	Cobble/ Boulder	Riffle, Run	Stable	Minor erosion, stable	Partially Confined	-	37, 66, 70, 72	-
4	DE-1I-S201	Kortright Creek	26.5	2%	751	46	1.8	Cobble/ Gravel	Pool-Riffle	Stable	Stable	Partially Confined	-	37, 66, 70, 72	116
5	BR-1H-S178	UNT to Fly Creek	7.9	1.2%	265	34	1.9	Cobble/ Boulder	Pool-Riffle	Stable	Bank scour (25-50%)	Partially Confined	-	37, 67, 70	116
5	BR-1I-S057	Oquaga Creek	30	0.5%	840	69	3.1	Cobble/ Boulder	Pool-Riffle	Stable	Minor erosion, Riprap on LB	Unconfined	-	37, 66, 70	116
5	DE-1P-S129	Ouleout Creek	106	0.9%	2450	102	4.7	Cobble/ Boulder	Pool-Riffle	Stable	Minor erosion, stable	Unconfined	-	37, 66, 70, 72	116

* Calculated using USGS' StreamStats
** Based on Constitution ECP and Attachment B

UNT = Un-named tributary
CFS = cubic feet per second

LW = Large Wood, as specified in Section 5.0

2.2 PRIORITY 2 STREAMS

During the field visits, agency staff indicated the need to restore riparian vegetation and promote the establishment of shade over the stream to minimize the impacts to high-quality trout habitat. The streams that were generally stable, but would significantly benefit from riparian planting were classified as Priority 2 streams. Kleinschmidt biologists and engineers visited these sites with the agency staff and recorded channel dimensions, existing bank condition, and suitability for trout habitat. Based on this information, site-specific restoration techniques were selected that have the potential to quickly re-establish riparian vegetation and minimize the impact of the pipeline crossing on these Priority 2 stream crossings (Figure 2 and Table 2).

These proposed site-specific restoration techniques are recommended to compliment the typical waterbody crossing mitigation measures, as presented in Section 6.8 (Waterbody Crossing Procedures) and Section 9.3 (Waterbody and Wetland Crossing Restoration) of the Constitution ECP. The restoration techniques proposed in Table 2 will be implemented after pipeline installation and will be installed under the direction of a stream geomorphologist familiar with the construction of bioengineered stream banks.

TABLE 2. PRIORITY 2 STREAM RESTORATION SITES

Waterbody ID	Waterbody Name	Restoration BMP Figure No.*
BR-1B-S049	UNT to Fly Creek	37, 67, 72
BR-1C-S150	Dry Brook	37, 66
BR-1I-S055	Marsh Creek	37, 67
BR-1G-S189	UNT to Oquaga Creek	37, 66
CH-1L-S250/ BR-1L-S220	UNT of Cornell Creek	37, 67, 72
CH-1X-S063	UNT to Susquehanna River	37, 66
DE-1H-S026	Rock Creek	37, 66
DE-1F-S078	UNT to Carrs Creek	37, 67
SC-1C-S180	UNT to Schoharie Creek	37, 67, 72

* Based on the Constitution ECP

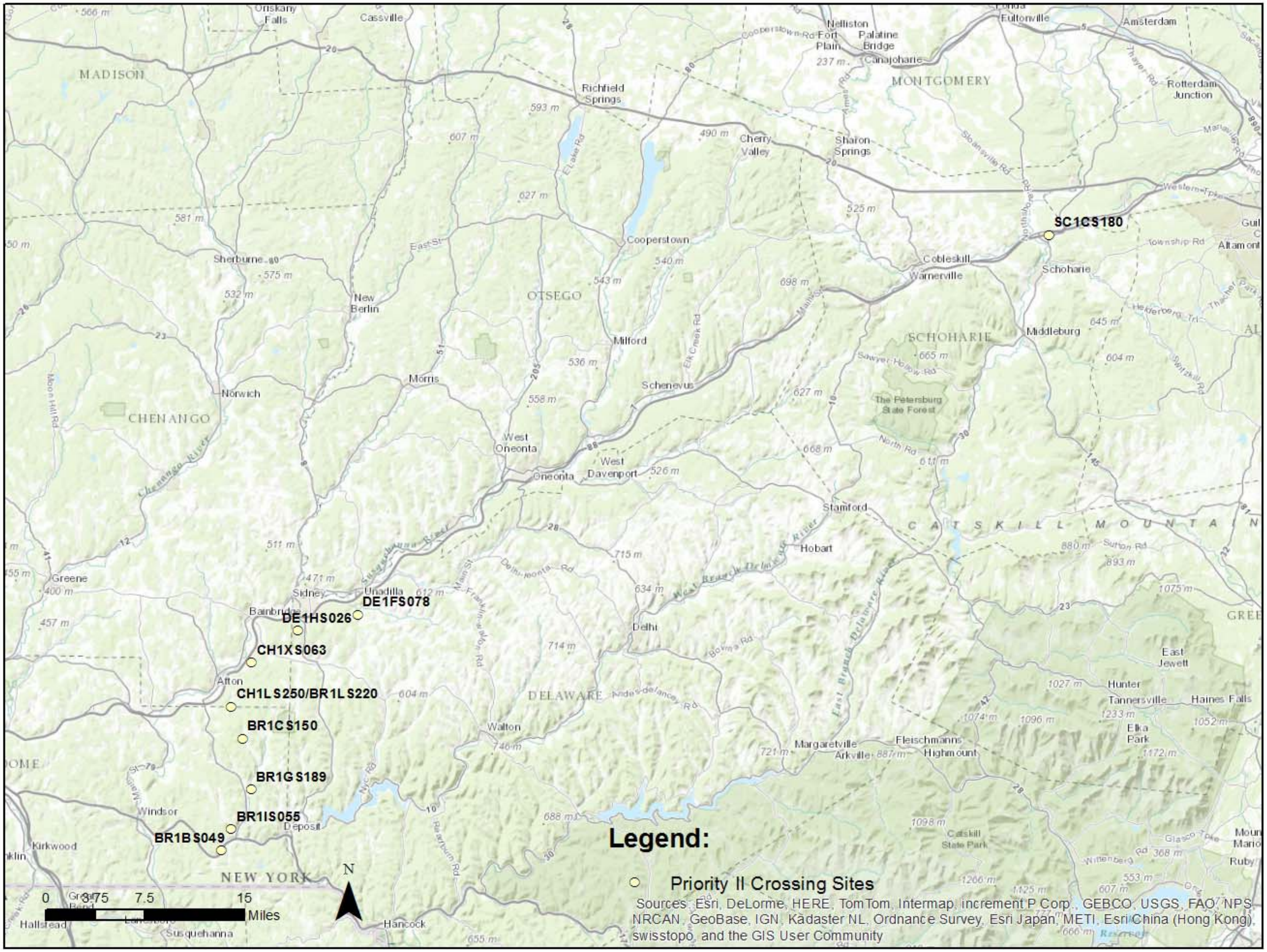


FIGURE 2. LOCATION OF THE PRIORITY 2 STREAM RESTORATION SITES ALONG THE PROPOSED CONSTITUTION PIPELINE

3.0 PRIORITY 1 STREAM GROUP DESCRIPTIONS

Based on observations and measurements gathered in the field, agency comments, and a desktop analysis of the Priority 1 stream crossings, the streams were grouped to simplify the restoration approaches. The streams were grouped into five categories with varied restoration techniques for vertical grade control, bank stabilization, and habitat improvement (Table 1). All riparian zones outside of the 10-foot permanent ROW on Priority 1 sites will be planted with native woody plants to re-establish shade over the stream, which was a primary concern of all agencies during the site visits.

3.1 GROUP 1

The streams in Group 1 have drainage areas less than one square mile and tend to be steep, step-pool channels dominated by boulder and cobble-sized bed material. These channels are generally confined, meaning the valley hillslopes meet the channel banks, resulting in steep banks and little to no floodplains. Given the steep slope of these streams, they are prone to incision from disturbances such as large, infrequent floods. However, given the lack of development within their watersheds, the extensive woody riparian vegetation observed at these sites, and the coarse substrate (i.e., boulders and cobbles), these sites are generally considered to be vertically stable under current conditions. No visual evidence of recent or active channel incision was observed at these sites. Due to lack of observed recent or historic bank erosion, these sites are also deemed laterally stable.

FIGURE 3. EXAMPLE OF STREAM IN GROUP 1 (BR-1I-S190).

Because of the steepness of these streams, the proposed restoration approaches for Group 1 focuses on channel grade control after pipeline installation. As these channels were considered relatively stable under current conditions, replacement of native bed material and reconstruction of step-pool morphology using existing onsite boulder and cobble material is recommended, rather than the extensive use of engineered grade controls structures. Minimal pre-existing bank erosion was documented at the sites in this group, therefore bank stabilization measures will likely only be required where bank disturbance occurs. Due to naturally steep banks, Kleinschmidt recommends bioengineered bank stabilization measures for disturbed banks at most of these sites. Bioengineering methods utilize woody and herbaceous plantings, as well as erosion control fabric (Constitution ECP Section 5.22.2) to create earthen banks that are stable in the short and long term (e.g., Allen and Leech 1997).

Habitat improvement is limited at these sites due to small channel size. These are step-pool streams with boulders and in-stream large woody debris, which create pools, steps, and riffles. Recreating this morphology using stockpiled, native bed material will be most beneficial to habitat rather than artificially augmenting stream habitat with constructed structures. The riparian vegetation is important for bank stability and stream shading in many streams, thus the reseeding and planting of riparian vegetation, as set forth in Section 6, will promote establishment of riparian cover in a timely manner. As outlined in the Constitution ECP (Attachment 2, Figure 66: Stream Plantings), "restoration of crossings of state designated fishery waterbodies shall include plantings of native woody species to restore the stream-shading conditions within a 25' riparian buffer." Re-establishing bank and riparian vegetation for stream shading and bank stabilization will be important at all sites. Table 3 and the Planting section below discuss this in more detail.

3.2 GROUP 2

Group 2 streams are similar to those in Group 1; however, they have been deemed either vertically unstable (e.g., SC-1Q-S278, UNT to Clapper Hollow Creek), have an immediate downstream threat to their vertical stability (BR-1J-S048, UNT Fly Creek), or were deemed to have a greater potential to become vertically unstable after crossing construction (remaining sites). Site SC-1Q-S278 is incised likely due to hydrologic impacts from historic farming practices and/or recent historic flooding. This incision has de-stabilized the banks as well. Site

BR-1J-S048 is currently stable near the pipeline crossing; however, a perched culvert on an existing farm road located approximately 160 feet downstream of the pipeline crossing is at risk of causing vertical instability at the crossing site, should the culvert fail and the headcut move upstream.

Restoration at these sites focuses on more extensive grade control within the construction ROW. Buried log grade controls, such as Figure 111 in Attachment A, or boulder cross vanes, such as Figures 112 and 114 in Attachment A, are recommended for streams in this group. More extensive bank stabilization may also be needed where banks have been undermined by channel incision. This includes bank re-grading and more extensive bioengineered bank stabilization, and potentially hard (rock) bank toe stabilization, using native boulders and cobble where feasible. Habitat improvement approaches are similar to those in Group 1 with emphasis on shading and the restoration of existing step-pool and riffle morphology using native bed material.

FIGURE 4. EXAMPLE OF STREAMS IN GROUP 2: PERCHED CULVERT DOWNSTREAM OF BR-1J-S048 (LEFT) AND INCISED CHANNEL AT SC-1Q-S278 (RIGHT).

3.3 GROUP 3

Streams in Group 3 share a similar drainage area as the previous two groups; however, they are less confined and tend to have a gentler slope (2-3%) than streams in Group 2. Being less confined implies that the valley walls do not always extend to the channel, thus the floodplain is well connected to the channel and the potential for significant bank erosion is reduced. In some cases, finer bed material such as cobble and gravel predominate. These streams are generally considered to be vertically and laterally stable under current conditions, although some isolated bank erosion may exist.

FIGURE 5. EXAMPLE OF STREAM IN GROUP 3 (DE-1G-S005, LOOKING UPSTREAM).

Stream banks tend to be less steep on these streams, and restoring the grade of the bank, seeding/planting, and installing erosion control blanket should suffice without the need for significant bioengineering approaches for most sites. As noted in Table 1, BR-1I-S001 had less stable banks and Kleinschmidt recommends additional bioengineering methods at this site. As in previous groups, the use of native bed material to re-establish the bed is important. Streams in this group continue to be relatively narrow, limiting the use of typical habitat enhancing structures. Use of in-stream wood will provide habitat complexity, and Kleinschmidt recommends installing 6-10 pieces of large, native wood (saved from grubbing the ROW) at these crossings. Placement of the large wood should be directed by a geomorphologist familiar with placement of such structures in a stream. The placement of the large wood will occur both in the channel and on the floodplain, to provide cover for aquatic species and to replicate natural succession of trees in the riparian zone (See Section 5).

3.4 GROUP 4

Group 4 streams are generally wider, gently-sloped (0.5-3%) streams with larger drainage areas (>3 square miles). In general, these streams are partially confined and have a predominantly cobble or gravel substrate, with some boulders interspersed along the reach. Vertical instability is less of a concern at these sites due to their milder slope (no evidence of channel incision was encountered during the field visits). These streams are moderately well connected to the floodplains, and are not very active in lateral migration, as indicated by the relatively stable stream banks and partially confined landscape.

Due to the width of these streams and a smaller concern of vertical instability, the restoration approaches for Group 4 focus on re-stabilization of disturbed banks, replacement of native bed material, and habitat enhancement structures rather than channel spanning structures. Bioengineering methods may be required for stabilizing the disturbed banks, which are generally steeper at these sites. In-stream wood structures, such as rootwads and placed large wood can meet dual goals of protecting disturbed banks and providing habitat. Branch packing and live stakes along the banks of the disturbed areas are proposed at some crossings to quickly stabilize the shorelines and protect the steep banks.

FIGURE 6. EXAMPLES OF STREAMS IN GROUP 4 (LOOKING UPSTREAM ON BR-1U-S141 [LEFT PHOTO] AND DE-1I-S201 [RIGHT PHOTO])

3.5 GROUP 5

The final group of streams is characterized by large drainage areas, mild slopes, and unconfined valleys. Because these streams are less confined and experience higher flood flows, they tend to have wider floodplains with the potential for more active lateral migration. More extensive bank erosion was noted at the Group 5 sites, indicating this lateral migration. These streams generally have cobble dominated beds, with gravel and boulders intermixed within the reach. As with Group 4, vertical instability is less of a concern at these sites due to the mild gradient, coarse bed material, and generally accessible floodplains. For example, stream BR-1I-S057, Oquaga Creek (Figure 7), has boulder-sized riprap placed along its left bank. This material was likely placed there to inhibit bank erosion, but may actually be enhancing scour at the toe of the bank due to the improper placing of the riprap.

FIGURE 7. EXAMPLE OF STREAM IN GROUP 5 (BR-1I-S057)

More extensive bank erosion was noted at these sites. Bioengineered, bank stabilization methods are recommended throughout the length of the construction ROW to protect the stream banks from further erosion and to provide habitat and riparian cover for trout and other aquatic species. Habitat enhancement structures such as those discussed under Group 4 are proposed at these sites.

4.0 BEST MANAGEMENT PRACTICES FOR STREAM CROSSING RESTORATION

The designs and best management practices (BMPs) outlined in the Constitution ECP for restoring stream banks and the stream restoration techniques presented as Figures No. 111-118 (Attachment A) in this report are designed to give priority to native plantings and natural channel design, although they do not explicitly exclude hard engineering approaches. This is also in accordance with the direction of the NYSDEC and the USACE during the field visits. These streams are dynamic systems and the intention is to use practices that will provide suitable trout habitat, while also protecting the pipeline from exposure at the stream crossing. To protect these trout streams and the water quality, the construction period for the twenty-two Priority 1 streams will be between June 1 and September 30, as specified in the Constitution ECP, unless otherwise authorized by direct agency consultation. Most Priority 2 streams will have similar timing restrictions, as will several streams not listed as Priority 1 or Priority 2 streams, as determined by regulatory agencies.

As stated in the Constitution ECP (Section 9.3, Waterbody and Wetland Crossing Restoration), "*Constitution will utilize the following criteria to restore disturbed waterbodies to as close to their pre-construction condition as practical*," including the following measures (Constitution ECP, Section 9.3.1: Waterbody Crossings; unless otherwise noted):

- Revegetate disturbed riparian areas with conservation grasses and legumes or native plant species as specified by the Environmental Inspector (EI) or conditioned by applicable regulatory agencies.
- Clean stone or native cobbles will be used for the upper one (1) foot of trench backfill in waterbodies that contain coldwater fisheries.
- For open-cut crossings, waterbody crossing banks will be stabilized and temporary sediment barriers will be installed within 24 hours of completing in-stream construction activities.
- For dry-ditch crossings, streambed and bank stabilization will be completed prior to returning flow to the waterbody channel.
- All waterbody banks will be returned to preconstruction contours or to a stable angle of repose as determined by the EI and approved by applicable regulatory agencies.
- Application of riprap for bank stabilization will comply with applicable regulatory agency approvals. In general, Constitution, to the extent practical, will employ natural stream bank rehabilitation techniques (e.g. planting native plant species to stabilize the banks) before utilizing riprap stabilization. The use of riprap will generally be limited to areas where flow conditions preclude effective vegetative stabilization techniques such as seeding and erosion control fabric.
- Disturbed riparian areas will be revegetated with conservation grasses and legumes or native woody plant species.
- Permanent slope breakers will be installed across the construction right-of-way at the base of slopes greater than 5 percent that are less than 50 feet from the waterbody, or as needed to prevent sediment transport into the waterbody.
- Sediment barriers will be installed as outlined in other sections of this Plan and as approved or specified by the EI. As approved by the EI, earthen berms may be utilized as sediment barriers adjacent to the waterbodies.
- Once the construction sequence and conditions are appropriate, Constitution will attempt to install the pipe within 24 hours at minor conventional trench stream crossings and within 48 hours at intermediate conventional trench stream crossings. (Section 6.1: Construction Restrictions)

- Allow a riparian strip at least 25 feet wide, as measured from a waterbody's mean high water mark, to permanently revegetate with native plant species across the entire construction ROW. [Wetland and Waterbody Construction and Mitigation Procedures; V (D)]

Furthermore, it is suggested that the stream restoration be completed at the same time as the pipeline installation to minimize additional impacts from subsequent activity in the stream channel at a later date. To the greatest extent practical, native bed material will be stockpiled separately from other excavated material and utilized for the restoration of the construction ROW within the stream channel. Should any additional stone be necessary, only clean stone sized to match the pre-construction conditions, as specified by the EI, will be used. Where practical, the stream banks within the construction ROW will be graded back to slopes of 3:1 (H:V), or less steep, as specified by the EI. Areas of the stream bank that are re-graded shall be blended into the existing conditions at the edge of the construction ROW so that the site will not experience accelerated erosion, to the extent practical.

Due to the complexity of these sites and the potential for natural channel processes to occur prior to construction, the actual location and installation of each structure and BMP will be determined at the time of excavation by a geomorphologist familiar with these designs and desirable trout habitat. Further, in compliance with the Federal Energy Regulatory Commission (FERC) guidelines, the impacts to the stream are limited to the 75' wide construction ROW. Thus any stream bed or bank restoration work will be completed entirely within this area in the stream channel and within the permitted construction ROW on the banks to a distance defined in the Constitution ECP.

The BMPs provided in this document (Attachment A, Figures 111-118) shall supplement the methods outlined in the Constitution ECP. These designs are based on work by the USDA - NRCS, and will provide guidance for creating habitat complexity and protecting the pipeline at the stream crossings. In general, the Constitution ECP shall govern the construction site activities, including, but not limited to, the pipeline installation, waterbody crossing methods, dewatering methods, erosion and sediment control, soil stabilization, and vegetation establishment. The work outlined in the Constitution ECP shall be directed by the on-site EI, as described in the ECP. BMPs in the ECP that may pertain to the stream crossing rehabilitation may include, but not be limited to Figures 5, 6, 19, 23, 24, 28, 29, 29A, 30, 32, 33, 34, 35, 37, 40-43, 53, 54, 58, 66-73, and 77, with those BMPs presented in Attachment 2 of the Constitution ECP. The designs outlined in the ECP and this document shall be overseen by an on-site EI to protect the integrity of the pipeline and provide suitable trout habitat in the restored reach.

The EI, in coordination with an experienced geomorphologist shall restore to the greatest extent practical, the stream bed geomorphology to pre-construction conditions. The geomorphologist, in coordination with the EI, will direct the contractor where to install pools, riffle, and stream restoration BMPs. The bed morphology is important to maintain, as this is the natural balance the stream has reached and is generally a stable system. Kleinschmidt recommends that a geomorphologist familiar with stream geomorphology and trout habitat complete an assessment prior to construction to document the channel dimension and profile. As part of this pre-construction assessment, the geomorphologist will collect the following measurements: bankfull width, a cross section between the bankfull elevations, bank slope above the bankfull elevation, approximate substrate gradation, and multiple photographs of the site (looking both upstream, downstream, and at the hill slopes) These measurements should be collected 12.5 feet above the crossing, at the crossing, and 25 feet below the crossing to capture the stream dimensions across the construction ROW. During the restoration of the crossing the geomorphologist will use the pre-construction data and photographs to direct the restoration of the stream reach, in addition to the BMPs indicated in the Constitution ECP and Table 1. Habitat will also be maintained by placing any habitat structures below the base flow water surface elevations where practical and creating areas for trout to use for cover and feeding within the restored construction ROW.

5.0 BMP IMPLEMENTATION

Sections 3 and 4 of this report outlined general stream crossing restoration approaches for Priority 1 and 2 streams, while this section discusses the implementation of several BMPs proposed as part of the stream restoration. Table 1 and Table 2 list the recommended restoration approach for each Priority 1 and Priority 2 site, including recommendations for stabilizing the bed and banks of the stream channel, as well as any recommended habitat improvement measures. Attachment A provides BMP Figures 111 to 118.

5.1 VERTICAL GRADE CONTROL APPROACHES

As part of every site restoration, the upper portion (1 to 2 feet depending on site conditions) of native stream bed substrate should be segregated from other excavated material for use in restoring the stream. This material has been naturally sized for the stream and the use of this material should aid in reducing the impacts of the crossing on the trout habitat and water quality. Further, existing boulder and cobble bed material should provide sufficient grade control if replaced similar to the pre-construction condition. Native stream bed material shall be excavated down to a minimum of 1 foot, or until mineral soil is reached, stockpiled, and then replaced along the disturbed stream bed to a depth of two feet or greater, replicating pre-construction stratification and gradations as much as possible. If minimal gravel material is present to fill in the pore space of cobble and boulder material and the native substrate was well graded prior to construction, then supplemental, clean gravel material may be mixed in with coarse bed material before being replaced in the stream bed,. This will help maintain flow above the channel bed during low flow periods and provide a stabilizing matrix for the boulder and cobble material.

Figure 111: Buried Log Grade Control: While some cobble and gravel sized material exists in the stream beds, it may exist in a relatively thin layer overlaying mineral soil. While the channel is stable to moderately stable under existing conditions, simply replacing bed material after channel disturbance may result in vertical instability during a high flow event given the steep slope of sites where this BMP is proposed. Thus, additional grade control is necessary. Kleinschmidt recommends installing a buried log grade control approximately 5 feet upstream of the crossing trench and immediately downstream of the crossing trench, taking into consideration the natural channel profile.

The top elevation of this structure should match the thalweg elevation of the replaced coarse bed material in the reconstructed channel (Attachment A: Figure 111). Two logs shall be installed at each structure (check log and footer log), and 6 to 12 inches of native bed material (rip rap if no on-site material is large enough) shall be added to the existing coarse bed material for a length of 3 feet below the structure to prevent scour. Logs should have a minimum diameter of 8 inches (although logs larger than 12 inches are preferable) and can be harvested from native trees felled for the pipeline ROW. Logs should tie in to banks a minimum of 3 feet on either side.

Figures 112 and 114: Boulder Cross Vanes: These structures are designed to protect the pipeline from moderate to severe vertical incision often caused by downstream vertical instability. Up to two boulder cross vanes are recommended at each crossing to ensure channel stability near the pipeline crossing (Attachment A: Figures 112 and 114). However, all vanes should be field located to take into account the existing stream profile and geomorphology, as vanes will need to be located at an existing pool to avoid altering the stream profile. Boulders should be a minimum of two feet in diameter and be installed on footer stones at least as large as the top boulders. Boulder vanes shall be tied back into banks at least 3 feet on either side and shall be installed up to the bankfull elevation, at a minimum. Rip rap material (6 to 12 inches) shall be placed in the scour zone of the vane to augment replaced native coarse bed material if the native substrate is not adequately sized.

5.2 BANK STABILIZATION APPROACHES

At a minimum, banks shall be re-graded to match the pre-construction grade and shall be seeded and mulched according to the Constitution ECP. While this approach is adequate for some stream crossings, many Priority 1 and 2 streams will benefit from bioengineering, as specified in Table 1 and Table 2. Below is a brief description of several of the BMPs proposed for the stream restorations. Figures 37, 66, 67, 70 and 72 in Attachment 2 of the Constitution ECP provide bank stabilization BMPs methods.

Figure 37: Erosion Control Blanket: Erosion control blanket shall be installed within the riparian zone of all stream crossings in accordance with Section 5.22.2 of the Constitution ECP and Figure 37 of Attachment 2 in the ECP. All erosion control blanket within the 25-foot riparian corridor shall be jute matting, anchored per manufacturer's specifications.

Figure 66: Stream Plantings and Figure 70: Live Stakes in Native Substrate: Existing stream banks will benefit from re-grading the banks to a maximum of 2H:1V slope and restoring the pre-construction grade, to the greatest extent possible. Figure 66 calls for planting live stakes and wattles on 3-foot centers above the bankfull elevation, or as specified by the EI, to promote the establishment of riparian vegetation, which will provide the root structure that can prevent bank erosion during high flows. For all Priority 1 streams, live stakes and wattles shall be installed in

the construction ROW, but outside the 10-foot wide permanent ROW, which will be maintained in an herbaceous state. All plantings will be based on species selected from Table 3, selected specifically to stabilize the pipeline crossing. Plants installed in the permanent ROW will be selected from the “Inside Permanent ROW” planting zone (Table 3), as these herbaceous plants will not jeopardize the integrity of the pipeline at maturity. Figure 70 will be useful in establishing native woody vegetation below the bankfull elevation and will also establish roots to prevent erosion of the stream bank (Constitution ECP, Attachment 2, Figures 66 and 70). The EI may require, or the contractor may request, that potted plants be used in place of live stakes for up to 75% of the live stakes to be installed in the riparian zone. The use of potted plants is acceptable, as long as potted material is at least 12” above the ground surface, of suitable species, and in good condition, as determined by a biologist familiar with plants commonly found in the riparian buffers of New York streams. Both of these BMPs work to restore riparian vegetation and will be beneficial to both the bank stability and trout habitat.

Figure 72: Fiber Roll: The banks of those streams comprised of more cohesive soil, rather than cobble material are more susceptible to erosion post-construction. The installation of a fiber roll will help to hold the finer material in place, in addition to providing a growing media for riparian plants. Fiber rolls (Constitution ECP, Attachment 2: Figure 72) should be installed at the toe of the stream bank, be at least half submerged underground, and should have native species of live stakes installed behind them to promote the establishment of the riparian buffer. Fiber rolls shall be anchored as specified in Figure 72, with the ends of the fiber roll buried in the stream bank to prevent scouring.

Figure 67: Branch Packing: For those streams where one or both banks are confined by adjacent valley walls, or for slopes greater than 2H:1V, branch packing (Constitution ECP, Attachment 2: Figure 67) provides increased slope stability, while also promoting the establishment of native vegetation. Standard re-seeding and erosion control fabric may not sufficiently stabilize these banks. Kleinschmidt recommends branch packing due to its simplicity and efficacy; however, other bioengineering approaches may be considered such as brush layers, or an analogous bioengineering method that incorporates use of live woody material. Native woody material shall be used, preferably harvested from a close proximity to the crossing.

Note that planted rip rap has not been recommended as a bank treatment for these sites. This is because none of the crossing sites are on stream bends where additional slope stabilization above and beyond what woody vegetation-based bioengineering methods can provide. However, should riprap be deemed necessary to stabilize the banks of a site in the field, the rip rap stream bank stabilization BMP (Constitution ECP, Attachment 2: Figure 42) could be combined with Figure 70 to develop a planted riprap BMP.

5.3 HABITAT IMPROVEMENT STRUCTURES

LW (Large wood placement): In some streams, either the existence of in stream large wood (tree falls) or the existence of a mature riparian canopy indicated that large wood may be an appropriate habitat improvement measure. For channels that are generally unconfined, with low banks, and have adequate space in the channel to accommodate large wood, logs that are a minimum of 15 feet long and a minimum of 8 inches in diameter shall be located in the stream by a geomorphologist familiar with in-stream wood placement. Branches, limbs, and root wads may be kept on the logs as these provide additional habitat and cover. Placement should follow the guidelines discussed in the State of Oregon's "Guide to Placement of Wood, Boulders and Gravel for Habitat Restoration" (State of Oregon, 2010), and shown in Figure 8. Care should be taken to place the logs to avoid exacerbating bank erosion during high flows.

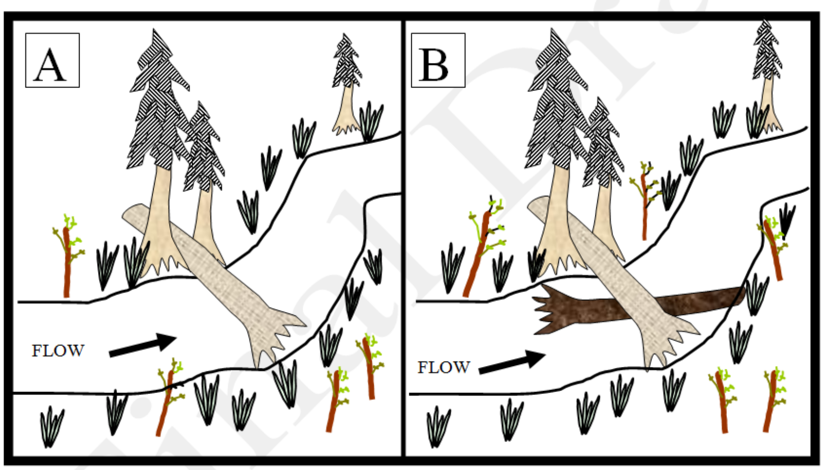


FIGURE 8. LARGE WOOD PLACEMENT. PANEL A SHOWS A SINGLE LOG PLACED BETWEEN TWO STANDING TREE TO CREATE A PIVOT AND LOCK POINT. PANEL B SHOWS AN "X" PATTERN WHERE THE TOP LOG PINS THE BOTTOM LOG DOWN TO REDUCE MOVEMENT (OREGON 2010).

Figure 116: Rootwad Flow Deflectors: Uprooted trees should be salvaged when the ROW is cleared and then used to form bank protection and increase habitat diversity. The majority of the trunk should be buried in the stream bank to provide additional stability to the banks as well as in-stream habitat (Attachment A: Figure 116). Root wads should be installed only where banks will already be disturbed from the crossing (i.e., minimize new bank disturbance for the sole purpose of installing root wads), unless necessary to provide erosion protection.

6.0 PLANT SELECTION

Native plant species will be used to plant the 25-foot riparian buffers within the construction ROW for those streams specified in Table 1 and Table 2, in addition to seeding as specified in Table 3. All other disturbed riparian areas will be revegetated with conservation grasses and legumes or native woody plant species as specified in the Constitution ECP (Section 9.3.1). Efforts will be made to plant species on the restored stream banks that existed on the banks before construction, so that similar plant communities will reestablish after the installation of the pipeline. The selection of plant species, seed mixes, and the location of plantings installed during restoration of the Priority 1 and 2 stream crossing will be directed by the EI and an on-site biologist who is familiar with the local plant species and the preferred growing environment for those species. The species and spacing will be based on the BMP figures in the Constitution ECP, with plant species selected from Table 3 of this report. Depending on the construction timing, planting may be spaced over multiple time periods to provide the best chance for plant establishment (e.g., waiting to plant trees until late fall or early spring; or installing seed in the spring), at the discretion of the EI.

The use of native woody plants is critical to stabilizing the stream banks and promoting the establishment of shade along the riparian corridor as quickly as possible. Should a high-flow event occur soon after the restoration, the live stakes will aid in protecting the soil, unlike seeding, which leaves the soil more unstabilized until the seed establishes adequate roots. The use of a combination of seeding, erosion control blanket, live stakes, and branch packing will stabilize the bank to a much greater depth (2 to 3 feet) immediately after construction, which is an improvement over just erosion control blanket and seed. This additional bank stabilization will be necessary on many of the steep banks along these streams and although it is a higher cost up front, Kleinschmidt recommends this technique for long-term stability and improved habitat restoration. Further, the agencies requested native plantings on many of the Priority 1 and 2 streams, as native plantings have proven to be the best way to re-establish the function of the riparian vegetation. However, in order to protect the pipeline, no woody vegetation (e.g. live stakes, wattles, or branch packing) will be installed in the 10-foot wide permanent ROW.

The live stakes, branch packing, and live fascines will be installed according to the specifications in the Constitution ECP Attachment 2 and at the direction of a geomorphologist who is familiar with such restoration activities. All material will be of good quality and recently harvested to provide the ideal conditions for success in stabilizing the stream bank and providing shading for the stream.

The use of on-site vegetation to create the live fascines, branch packing, wattles, and live stakes is encouraged, so long as this material is sustainably harvested, of species that are fast growing, and suitable for riparian plantings. Trees used as rootwad flow deflectors, buried log grade controls, or as placed large wood may be harvested from within the adjoining construction ROW, at the direction of the EI.

The Constitution ECP will guide establishment of plant material, and the necessary monitoring efforts to ensure the site is adequately stabilized. Specifically, for the purposes of monitoring and maintenance, riparian vegetation shall be considered a wetland and shall be monitored as such, according to Section 11.1 of the Constitution ECP. To the extent practical, shade will be restored to the stream by planting quick-growing species (Table 3) to provide cover for trout and other riparian species, while also protecting the integrity of the pipeline.

TABLE 3. PLANTING LIST BY STREAM ZONE.

PLANTING ZONE	LIVE STAKES (installed per spacing on BMP Figures)	POTTED TREE AND SHRUB SPECIES (installed per spacing on BMP Figures)	SEED MIX (from ECP Tables 10.4-2 and 10.4-4)
Below Bankfull – outside Permanent ROW	Redosier Dogwood Silky Willow Black Willow Buttonbush Common Ninebark	Redosier Dogwood Grey Dogwood Silky Willow Black Willow Red Maple Cottonwood Buttonbush Speckled Alder Common Ninebark	Mix #1 Mix #3 Mix #6 Wet Site Mix
Above Bankfull – outside Permanent ROW	Redosier Dogwood Silky Willow Black Willow Common Ninebark	Redosier Dogwood Grey Dogwood Silky Willow Black Willow Red Maple Cottonwood Common Ninebark	Mix #1 Mix #3 Mix #6 Wet Site Mix
Inside Permanent ROW*	N/A	N/A	Mix #1 Mix #3 Mix #6 Wet Site Mix

* No woody species are recommended for this zone to protect the pipeline integrity.

7.0 SUMMARY

This report outlines site specific design approaches to restoring and maintaining stability at selected stream crossings for trout stream restoration activities through a combination of vertical grade control, bank stabilization, and habitat improvements. The on-site EI, with coordination from an experienced geomorphologist, will direct the restoration of the stream crossings, including restoring the stream dimensions, planting riparian vegetation, and placing BMP structures to maintain existing trout habitat and protect the pipeline from exposure. It is Kleinschmidt’s opinion that site-specific restoration techniques as discussed in this report are necessary for the 31 Priority 1 and Priority 2 stream crossings and that the restoration of these stream crossings will protect the riparian and aquatic environment from significant impacts associated with the pipeline installation.

8.0 REFERENCES

Allen, H.H. and J.R. Leech. (1997). *Bioengineering for Streambank Erosion Control*. US Army Corps of Engineers Waterways Experiment Station Environmental Impact Research Program, Technical Report EL-97-8.

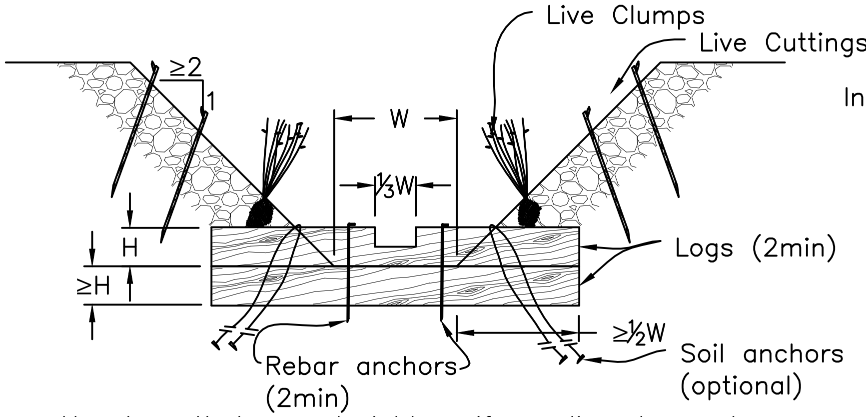
Constitution Pipeline Company LLC (2013), *Constitution Pipeline: Environmental Construction Plan*, *Construction Activities in New York*. Submitted November 2013 by Constitution Pipeline Company, LLC, 2800 Post Oak Boulevard (77056), PO Box 1396, Houston, TX 77251-1396.

NRCS (2007). *Stream Restoration Design*. Part 654, National Engineering Handbook.

State of Oregon (2010). Guide to Placement of Wood, Boulders and Gravel for Habitat Restoration, Final Draft. 33p. < http://www.oregon.gov/dsl/PERMITS/Pages/forms.aspx?> Accessed: July 26, 2014.

ATTACHMENT A

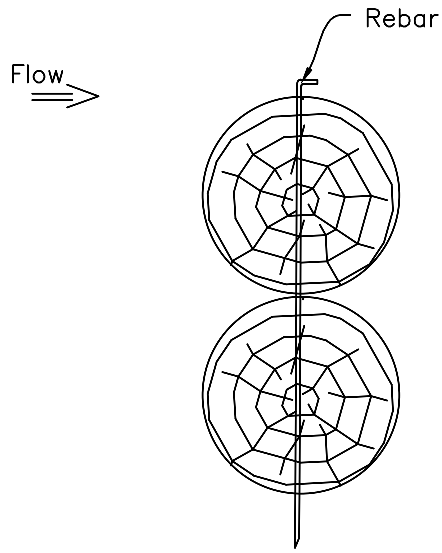
TYPICAL STREAM RESTORATION BMP FIGURES



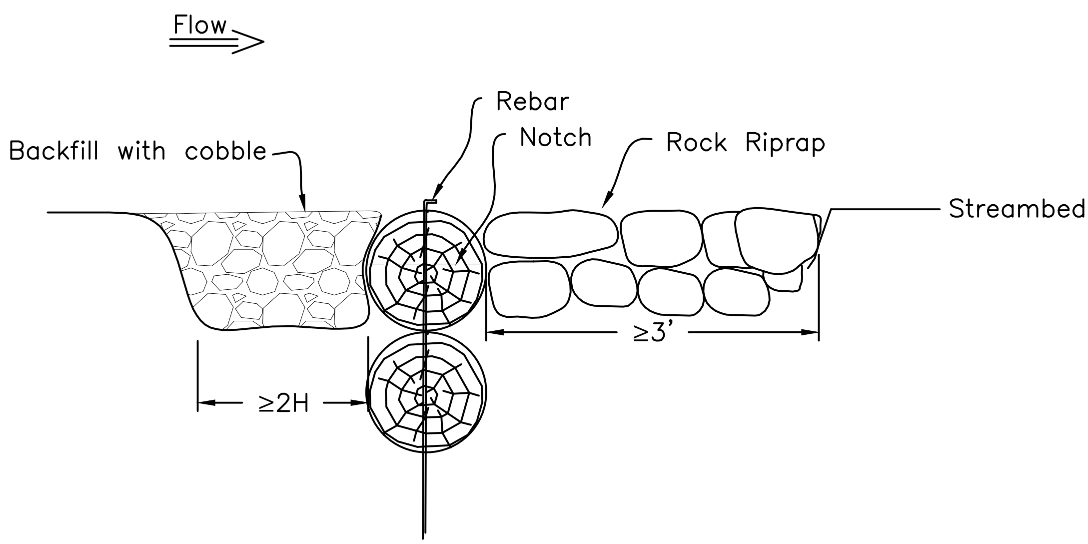
Install live clumps and live cuttings into adjacent protection during construction. Extend to below stream bed.

H=8" MIN

Use logs that are straight, uniform diameter and free of rot, disease or insect infestation.



Drill 5/8" dia. hole and drive #5 rebar through. Bend end at top.



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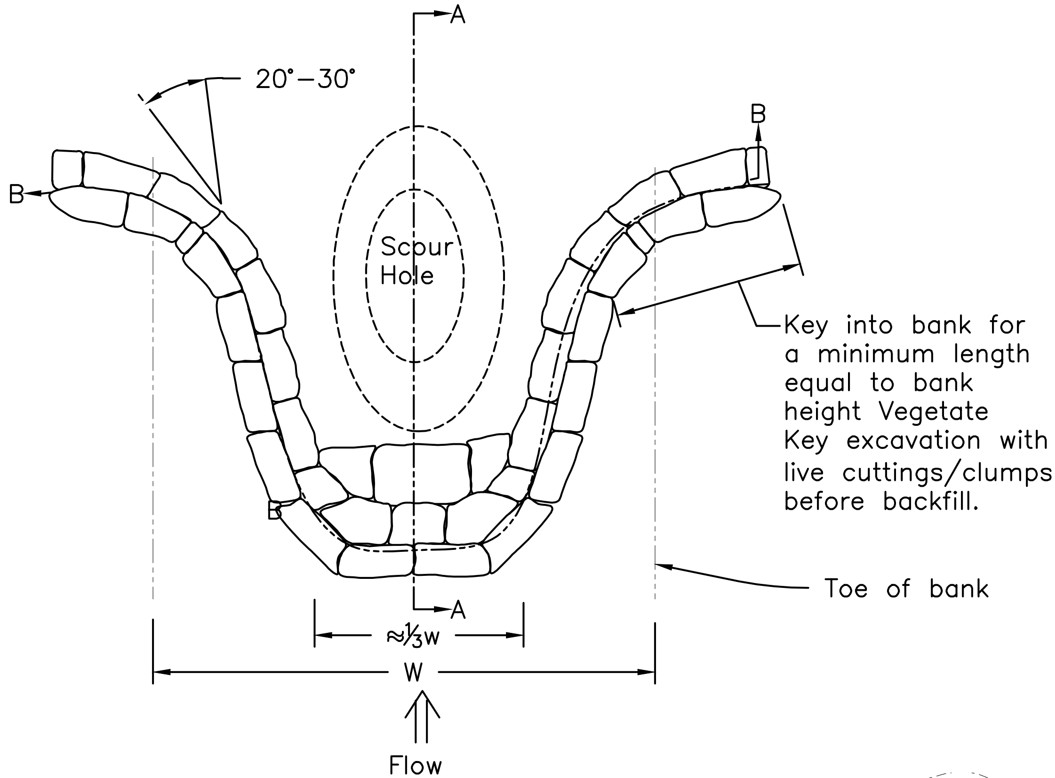
CONSTITUTION PIPELINE COMPANY, LLC

STANDARD ENVIRONMENTAL DETAIL

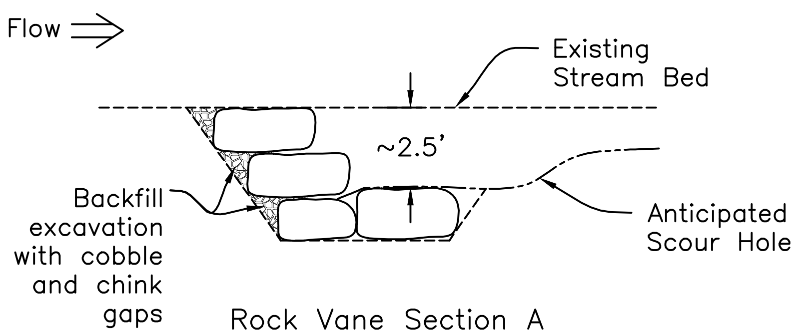
BURIED LOG GRADE CONTROL – SMALL STREAM

FIGURE NO. 111

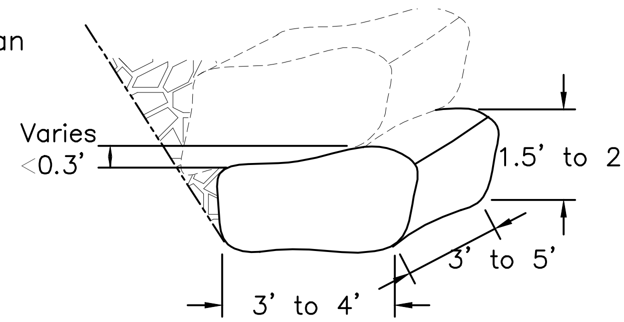
CONSTITUTION PIPELINE



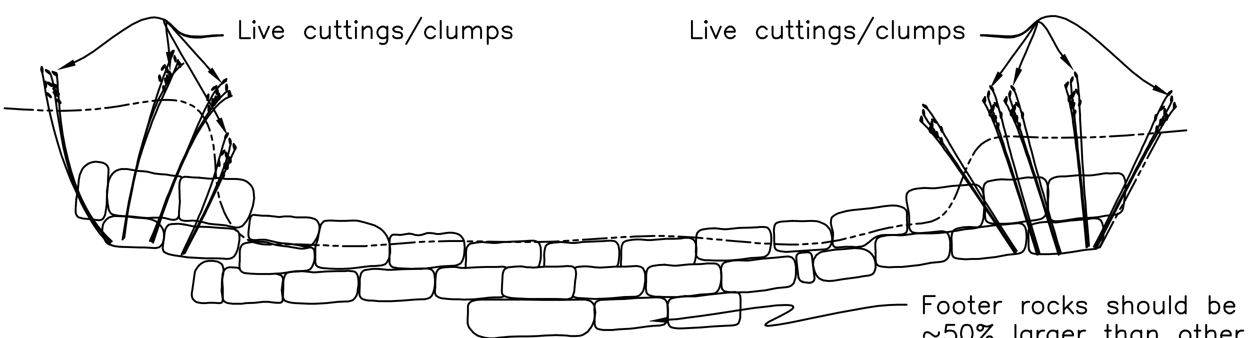
Rock Vane Plan



Rock Vane Section A



Typical Rock Dimensions and Placement



Rock Vane Section B

Notes: The rocks should be rectangluar or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream.

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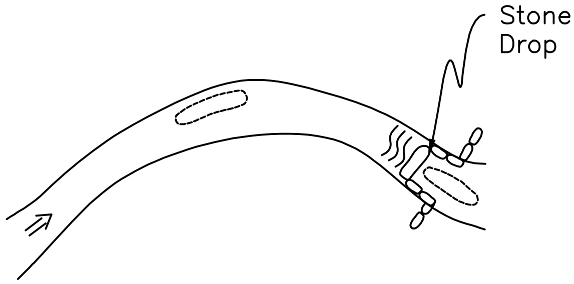
STANDARD ENVIRONMENTAL DETAIL

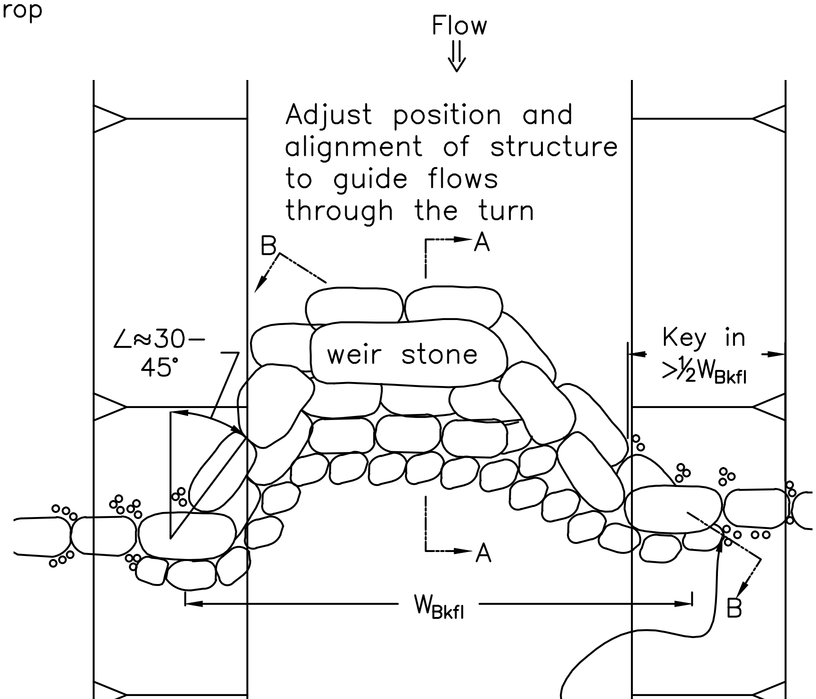
SMALL CROSS VANE

FIGURE NO. 112

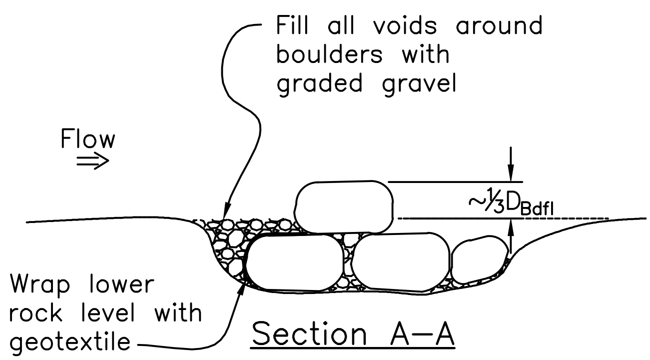
CONSTITUTION PIPELINE



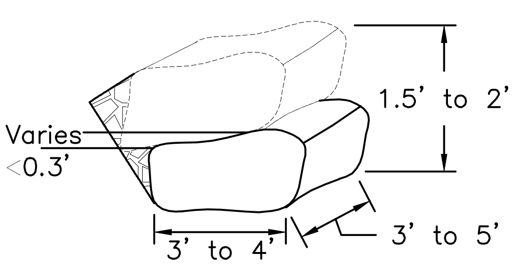
Layout



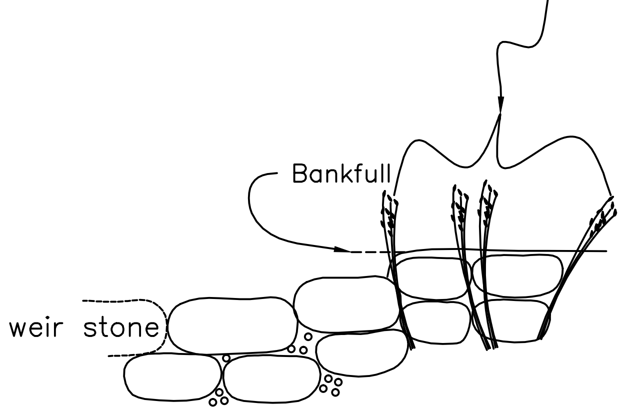
Plan



Section A–A



Typical Rock Dimensions and Placement (stone size to be stable at highest design discharge)



Section B–B

Notes: The rocks should be rectangluar or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream. Fill gaps with smaller stones.

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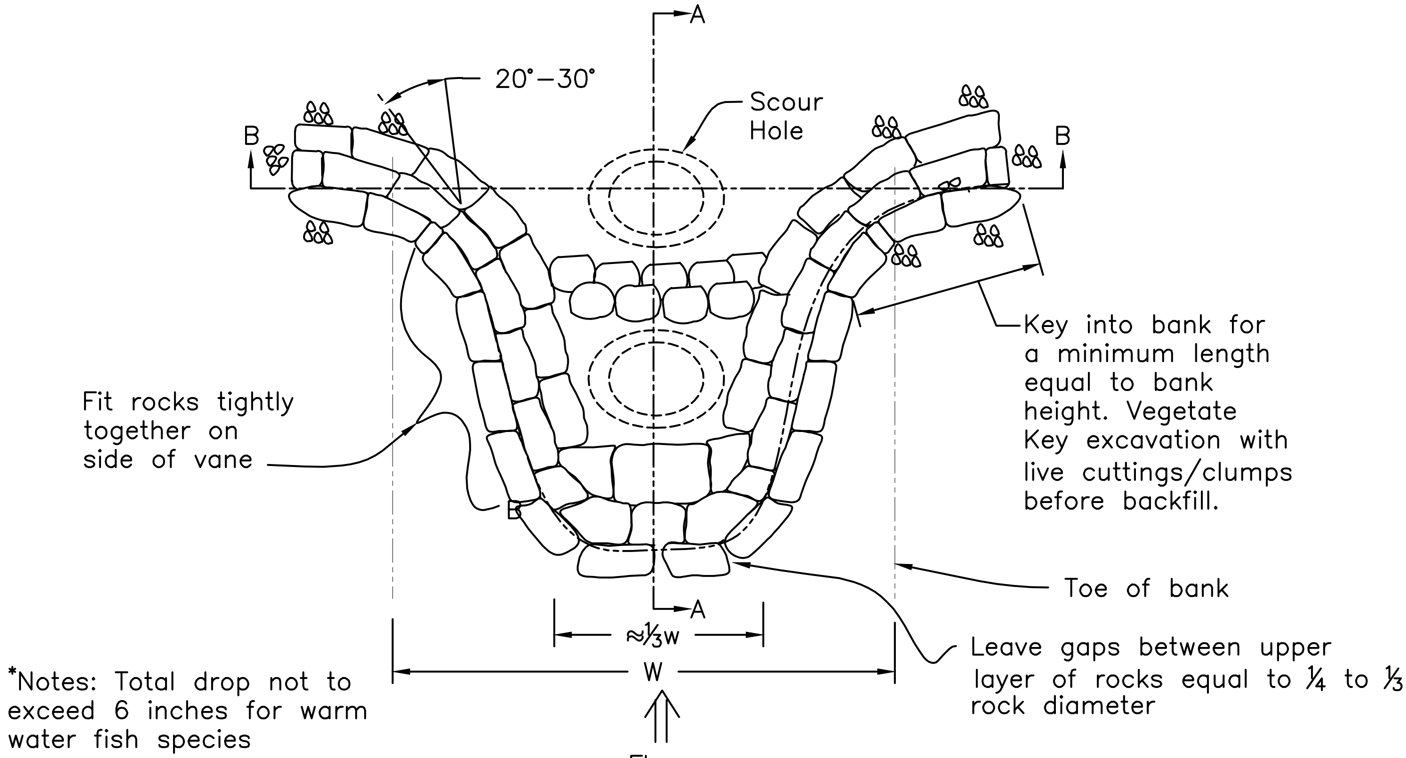
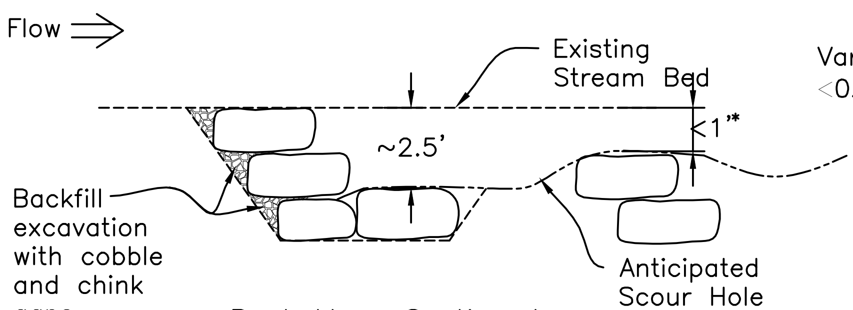
CONSTITUTION PIPELINE COMPANY, LLC
STANDARD ENVIRONMENTAL DETAIL

STONE DROP – SMALL STREAM
FIGURE NO. 113

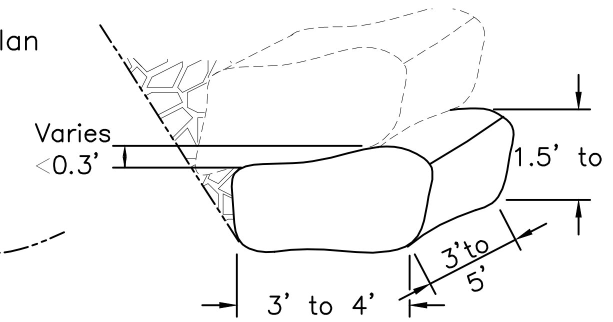
CONSTITUTION PIPELINE



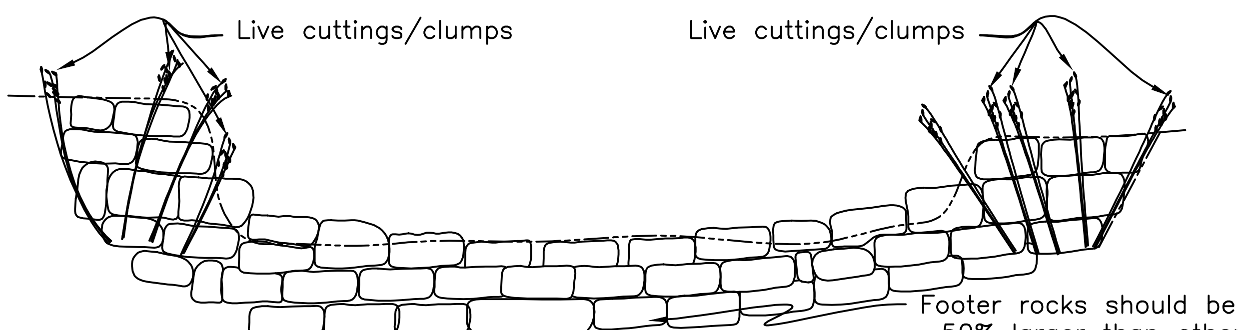
Rock Vane Plan



Rock Vane Section A



Typical Rock Dimensions and Placement
(stone sized to be stable at highest design discharge)



Rock Vane Section B

Notes: The rocks should be rectangluar or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream. Fill gaps with smaller stones.

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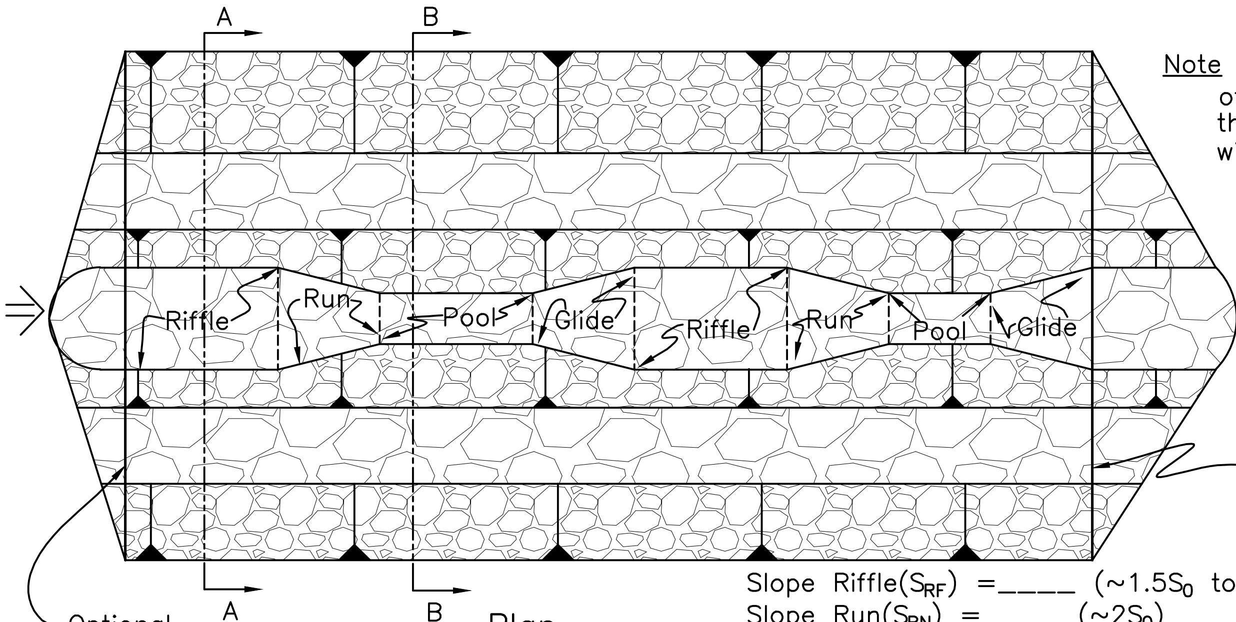
STANDARD ENVIRONMENTAL DETAIL

STEPPED POOL ROCK CROSS VANE
(OPTION 2)
FIGURE NO. 114

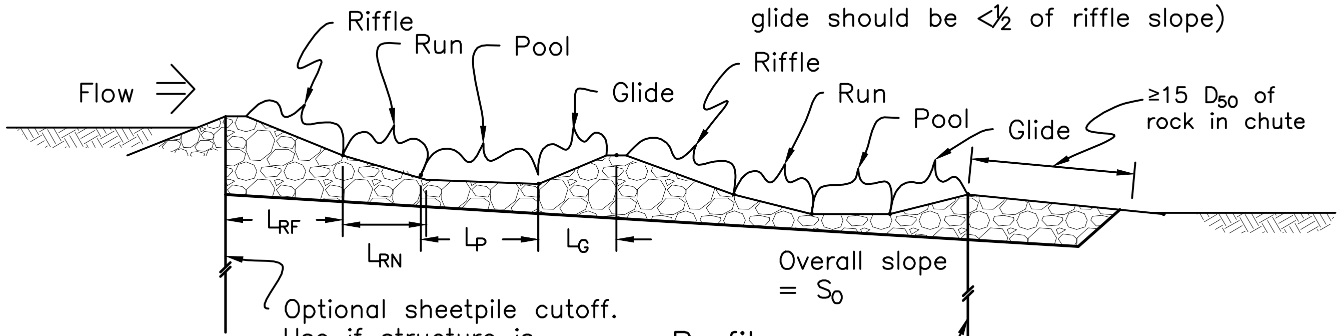
CONSTITUTION PIPELINE



Note Bottom width of pool is ~½ the bottom width of riffle

Plan

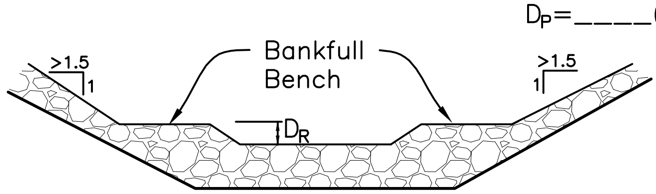
Slope Riffle(S_{RF}) =_____ (~$1.5S_0$ to $2S_0$)
Slope Run(S_{RN}) =_____ (~$2S_0$)
Slope Pool(S_P) =_____ (0 to $½S_0$)
Slope Glide(S_G) =_____ ($-S_{RN}$)
(Slope from beginning of run to the end of the glide should be <½ of riffle slope)



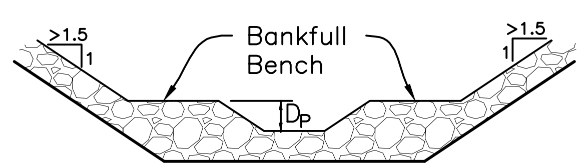
Profile (centerline)

L_{RF}=_____
L_{RN}=_____(~$⅔L_{RF}$)
L_P =_____(~L_{RF})
L_G =_____(~L_{RN})
(Length of riffle ~½ length of entire pool including run, pool and glide as shown on the plans)
L_{RF}≈½ (L_{RN} + L_P + L_G)

D_R=_____(Bankfull depth)
D_P=_____(~2 to $3D_R$)



Section A–A – Riffle



Section B–B – Pool

Note:
- Chute rock size to be stable at highest design discharge (use rock chute design and apply results to riffle slope)
- Minimum rock thickness shall not be less than $2D_{50}$
- Design was originally developed for a Rosgen C stream

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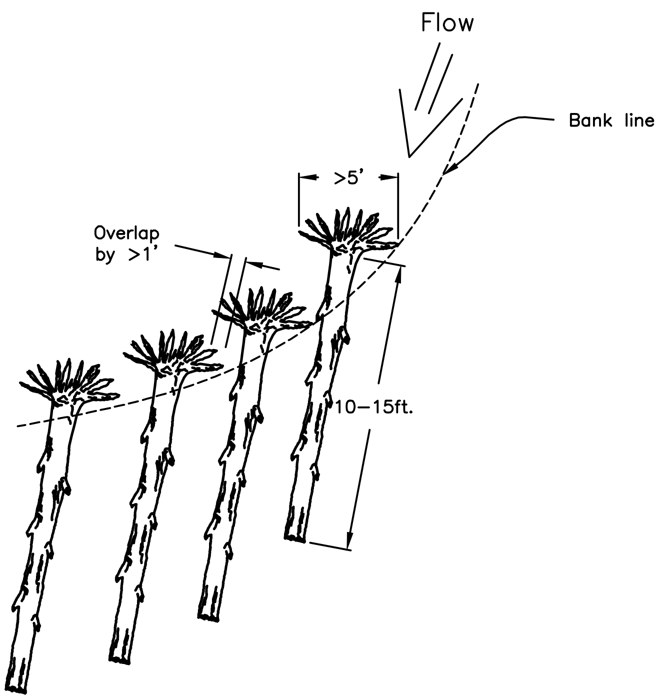
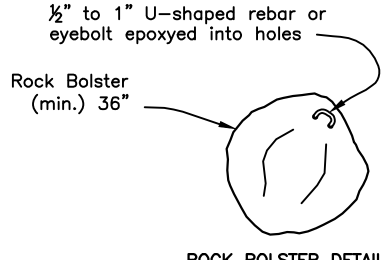
CONSTITUTION PIPELINE COMPANY, LLC
STANDARD ENVIRONMENTAL DETAIL

STEP POOL – ROCK CHUTE
FIGURE NO. 115

CONSTITUTION PIPELINE

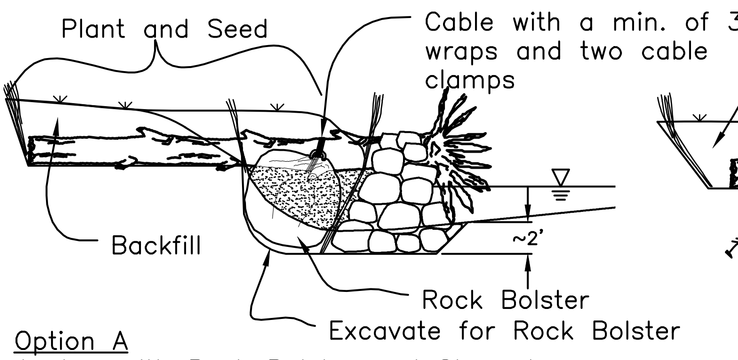




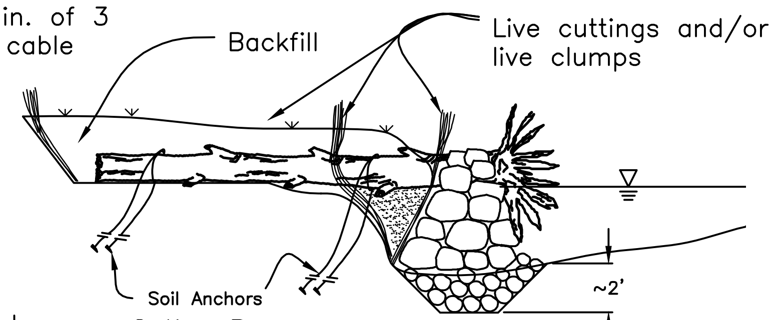
ROCK BOLSTER DETAIL
N.T.S.

Notes:

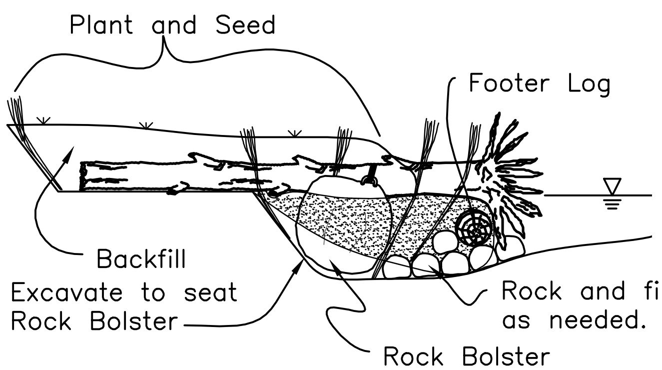
Secure logs to rock bolsters at overlap with a minumum of three wraps of ⅜" diameter galvanized non–greased, wire rope. Drill holes in rock bolsters with gas or pneumatic drill. The min. depth should be 6". Holes must be clean of all dust, debris, oil, and soap following drilling. Insert a U–shaped or eyebolt rebar into holes several times to dispense and completely mix epoxy and eliminate air pockets.
Epoxy resin systems shall meet the requirements of ASTM C881, Type IV Grade 3. Test strength of bond after minumum cure time recommended by the epoxy manufacturer.



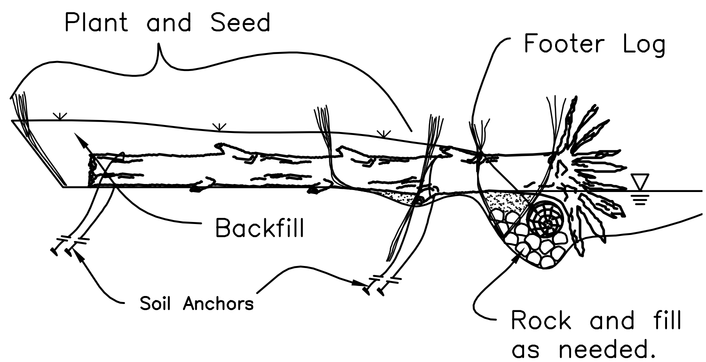
Option A
Anchor with Rock Bolster and Stone toe.



Option B
Anchor with Soil Anchors and Stone toe.



Option C
Anchor with Rock Bolster and Log toe.



Option D
Anchor with Soil Anchors and Log toe.

N.T.S.

NOTE: DESIGNS WERE DEVELOPED BY THE USDA-NRCS AND ADAPTED TO THIS PROJECT BY KLEINSCHMIDT ASSOCIATES PA/PC

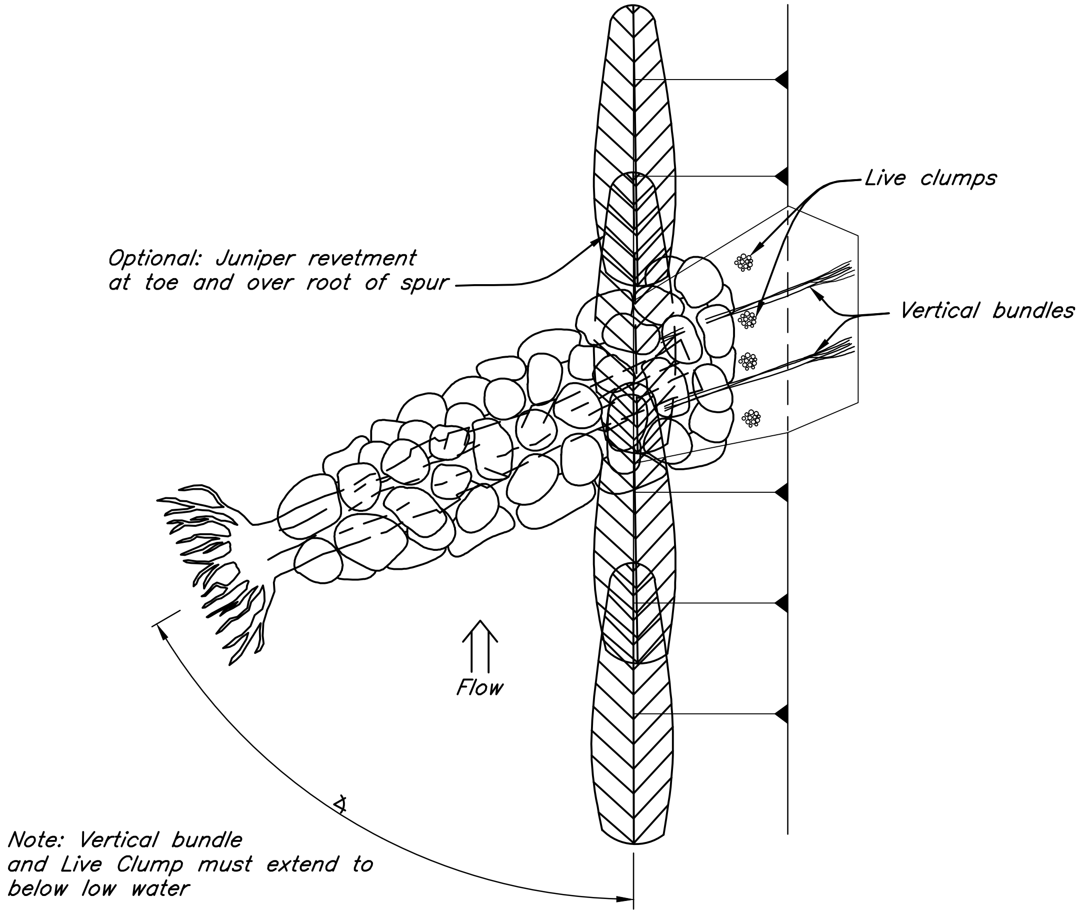
NEW YORK

NO.	DATE	BY	REVISION DESCRIPTION	CHK.	APP.

CONSTITUTION PIPELINE COMPANY, LLC
STANDARD ENVIRONMENTAL DETAIL

ROOTWAD IN LOW BANK
FIGURE NO. 116

CONSTITUTION PIPELINE



ROCK BARB WITH ROOT WAD (PLAN)

N.T.S.

L_1=16' MIN

L_2=4' MIN

L_3=6' MIN

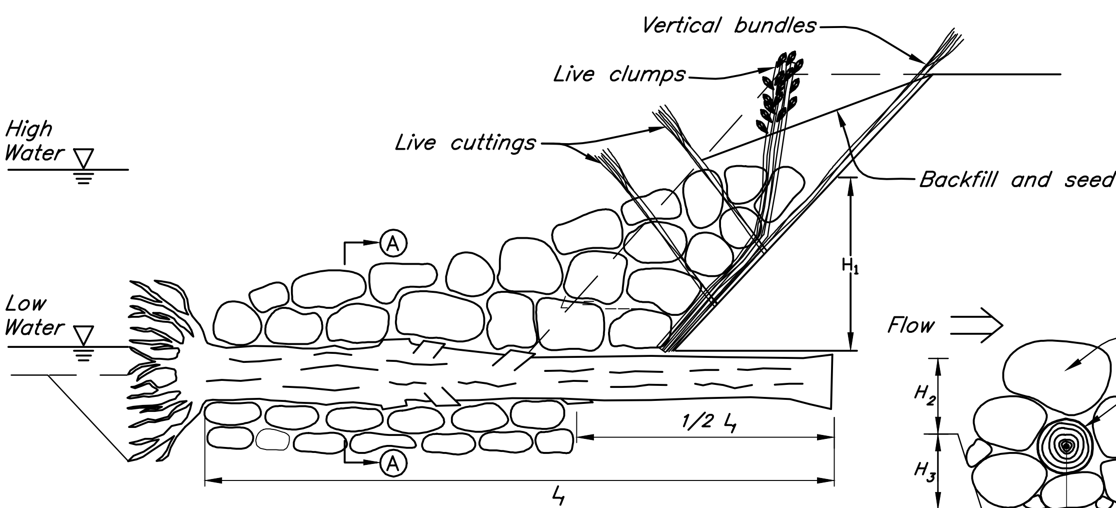
H_1=3' MIN

H_2=2' MIN

H_3=2' MIN

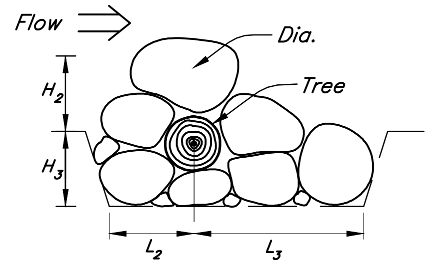
∢=20°

Dia=8" MIN



ROCK BARB WITH ROOT WAD (PROFILE)

N.T.S.



SECTION A–A

N.T.S.

NOTE: DESIGNS WERE DEVELOPED BY THE USDA-NRCS AND
ADAPTED TO THIS PROJECT BY KLEINSCHMIDT ASSOCIATES PA/PC

NEW YORK

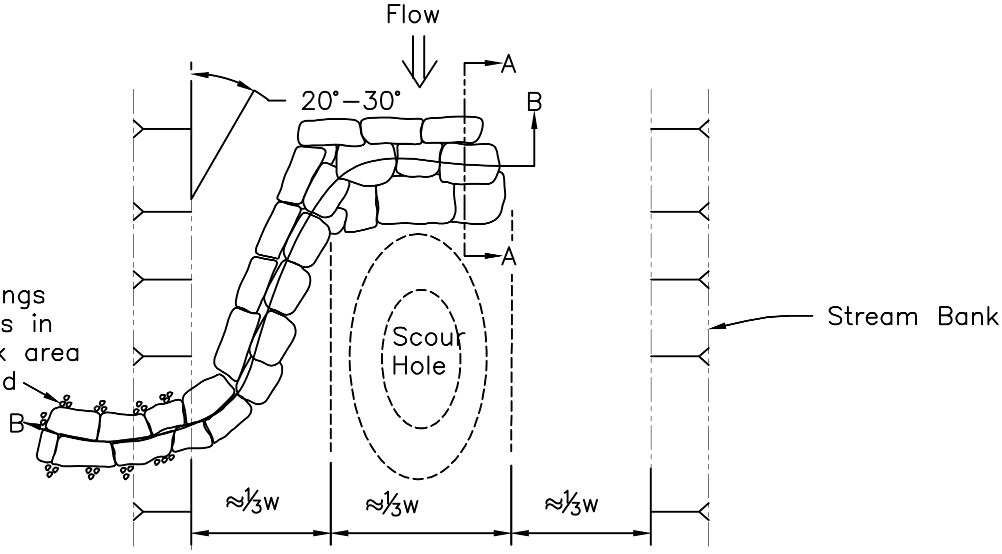
NO.	DATE	BY	REVISION DESCRIPTION	CHK.	APP.

CONSTITUTION PIPELINE COMPANY, LLC

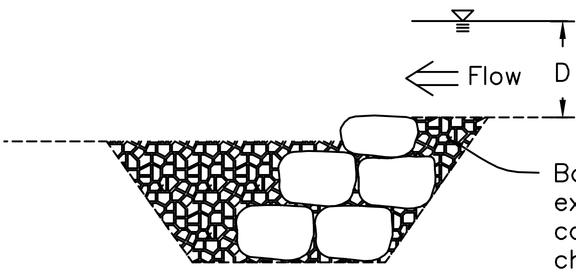
STANDARD ENVIRONMENTAL DETAIL

ROCK BARB WITH ROOT WAD
FIGURE NO. 117

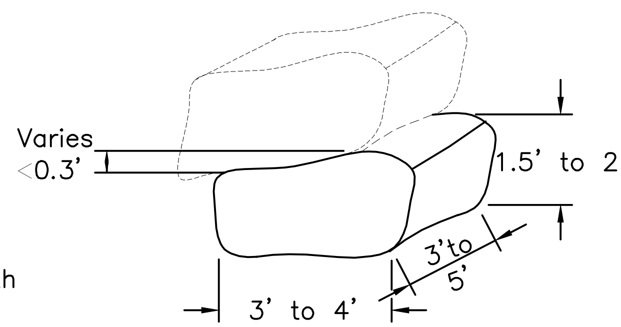
CONSTITUTION PIPELINE



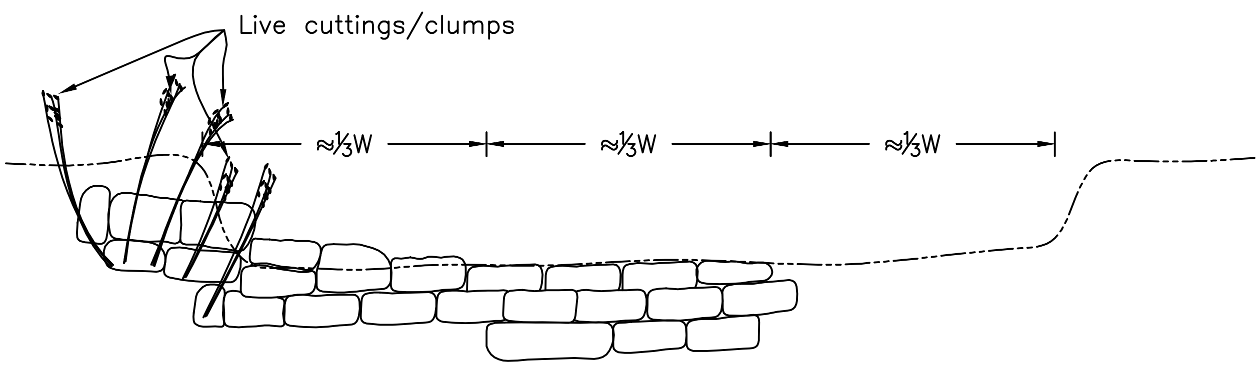
Hook Vane Plan



Rock Vane Section A



Typical Rock Dimensions and Placement (stone sized to be stable highest design discharge)



Section B

Notes: The rocks should be rectangular or nearly so at the rock to rock contact. The rock to rock contact should be solid. If rocks are not perfectly flat, the thicker end should be placed downstream.

N.T.S.

NEW YORK

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NO.	DATE	BY	REVISION DESCRIPTION	CHK.	APP.

CONSTITUTION PIPELINE COMPANY, LLC

STANDARD ENVIRONMENTAL DETAIL

HOOK VANE

FIGURE NO. 118

CONSTITUTION PIPELINE

ATTACHMENT B

SITE FIELD VISIT SUMMARIES FOR PRIORITY 1 STREAMS

BR 1H S178
UNT to Fly Creek
Latitude: 42.037390
Longitude: -75.516366

KA Site Visit (Nov. 2013) Summary: Site relocated since July/August Agency site visit. Low gradient stream, very little sinuosity, well defined banks, bordered by scrub vegetation and wetland riparian species and some scattered trees. Backwatered by chain of small beaver dams. Cobble-dominated substrates, and broad floodplain.

Agency Site Visit (July/August 2013) Notes: Use coffer dam and flume, stream is trapped but eroding banks toward RTE 17- possible need for vanes or armor to direct flow away from road. Need to check with DOT to see what they would like to see due to proximity to Rte. 17. Due to fact sites upstream and downstream have been disturbed DEC and USACE recommended potentially moving site upstream or downstream. Consider using rock vanes to direct flow away from banks, DS site: 4' cutbank in open/exposed area - more space for bore pit. DOT may prefer that banks be armored. USACE and DEC would prefer natural channel restoration.

USACE/DEC Comments: Seek to stabilize stream bank and protect road. Use natural channel design to protect the road - vanes and j-hooks. Consider crossing in an area that is already disturbed, either upstream or downstream.

July site pictures:

LOOKING DOWNSTREAM:

LOOKING UPSTREAM:

November site pictures:

CROSSING

CROSSING: LOOKING DOWNSTREAM

DOWNSTREAM BANK EROSION

CROSSING: LOOKING UPSTREAM

BR 1H S179
UNT to Fly Creek
Latitude: 42.03182
Longitude: -75.515703

KA Site Visit (November 2013) Summary

This is a headwater stream that is at a high elevation; steeply sloped (>3%), and comprised of continuous riffles meandered slightly through relatively young growth deciduous forest. Substrate is predominantly cobble. It is bordered by a gravel road/driveway that leads to an adjacent camp in a clearing. Banks at the immediate crossing are well defined and lightly vegetated. Stream is likely too small to maintain a trout population and lacks suitable spawning substrates.

Agency Site Visit (July/August 2013) Notes

This is a stable stream through a maturing red maple forest. The channel is incised downstream, and would need grade control (rock riffle or cross vanes) to ensure headcut doesn't develop further.

USACE/DEC Comments
Border-line trout habitat: good substrate and bugs, but lacks pools. There would likely be time of year restrictions.

November 2013 site pictures

TRANSECT A

TRANSECT A LOOKING DOWNSTREAM

TRANSECT A LOOKING UPSTREAM

July 2013 site pictures

UPSTREAM

DOWNSTREAM

BR 1J S048
UNT to Fly Creek
Latitude: 42.042839
Longitude: -75.516640

KA Site Visit (November 2013) Summary

Moderate to steeply sloped stream with scrub riparian vegetation, and clearings beyond that. The clearing on river right is used as a staging area, and on river left is agriculture. No sinuosity, riffle pocket pool steps. Banks are well defined; however, there is no flood plain. Substrates are dominated by cobble. Culvert appears to be made from an old riveted boiler and is a barrier for upstream fish passage. The outfall of the culvert is perched and has formed a plunge pool and banks in the vicinity are unstable. Habitat is suitable for trout and area upstream is wooded and more meandering likely very good for trout.

Agency Site Visit (July/August 2013) Notes

Access road would cross existing undersized culvert (~40" diam.) that is perched by ~4' on the downstream end and gravel has been depositing upstream of the culvert for some time. Flow has also been coming over the culvert with enough force to carry 12" rocks with it onto the top of the road. Any culvert replacements need to meet DEC regulations on their website. Dave mentioned installing grade control downstream and upstream to prevent exposure of the pipe from head cutting - cross vanes or step pools. Step pools could be vanes across stream with lowpoint at middle. There would be a need to design between the access road and the pipeline (~180') to protect pipe - this area is not currently in ROW and would need to be added. Mark and John (Williams) would prefer not to do full restoration - high cost, but for now the impacted areas were not changed. Consider moving, finding, or potentially building new access road. If the current stream crossing is used bury pipe deep to protect from head cutting should access road culvert fail.

USACE/DEC Comments

Concerned with receiving pit on left bank of stream - enough space for pit? Need to delineate wetlands on left bank side of channel.

November 2013 site pictures

LOOKING DOWNSTREAM PAST THE CULVERT THE ACCESS ROAD

CROSSING: LOOKING DOWNSTREAM UNDER

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

ACCESS ROAD: LOOKING DOWNSTREAM

ACCESS ROAD: LOOKING UPSTREAM

BR-1I-S001
UNT to Marsh Creek
Latitude: 42.057032
Longitude: -75.507101

KA Site Visit (April 2014) Summary

A reroute moved this stream ~300-feet downstream from the previous visits to avoid a landslide zone. Both the left and right banks are relatively steep and significant slope stabilization will be necessary to minimize erosion after installing the pipeline. The crossing is on bedrock and the DEC/USACE had concerns with the method used to close the trench over the pipe. They stated that concrete articulated mats have not worked on other sites and recommended avoiding the use of these methods. Since the substrate is ledge and has minimal habitat suitability for trout, the key issues are water quality related, minimizing loss of tree canopy, and preventing bankside erosion. USACE asked that the crossing be placed downstream of the 1.5' drop already existing in the bedrock to avoid further grade control after installation. The new crossing is ~10' downstream of the gradient change/step pool area. A Williams employee indicated that typically after blasting, the large sections of rock will be removed from the channel and replaced in the trench after the pipe is installed. USACE was concerned with "losing the stream" if the bedrock is significantly fractured. The use of flowable grout was discussed to minimize changing the groundwater flow. This would increase the length of time they needed to be in the stream, requiring a variance. USACE also wanted to clarify where the soil stockpile area was. The construction crew stated that it would likely need to be in the agricultural field at the top of the right bank due to space limitations near the stream. Overall, Agency and Williams staff felt that the new location is at a better crossing. Timing restrictions will apply to this (T) stream.

KA Site Visit (November 2013) Summary

This stream is a boulder dominated step-pool/pool riffle system with significant bedrock control through the area of the pipeline crossing. A recent flood event was evident in the July site visit, as several hundred cubic yards of cobble and boulders had been mobilized and there was an approximately 7’ vertical bank on the left bank ~125’ downstream of the pipeline crossing. The stream was generally well confined and straight in the 200’ near the crossing, but more than 100’ downstream of the pipeline crossing there is an almost 90° right turn, followed by a 90° left turn, as the stream turns away from the bedrock dominated hillslope. The bedrock is either acting as the channel substrate, or is covered by less than 1’ of cobble within the 200’ closest to the pipeline crossing. This may make restoration difficult, as any structure will have to be bolted to the bedrock. The pipeline engineers will use a concrete coated pipe surrounded by filler material (sand) on all stream crossings, and there was some discussion at this site during the agency site visit about how to protect the trench they will have to dig into the bedrock to cross the stream. Some ideas included concreting in the trench after placing the pipe or placing large boulders in the trench.

Due to the bedrock present and the large mobilization of material this spring/summer, the pool structure is minimal, with a small pool ~120' upstream of the crossing, a large/long still water pool from 25-75' downstream of the crossing, and a pool ~125' downstream of the crossing at the 7' vertical left bank. The stream is shaded by a mature hemlock stand, so the stream should be cool, but due to the substrate and recent flooding, this habitat may be poor trout habitat in the immediate vicinity of the pipeline crossing. During the previous flooding event, the bedrock was scoured clean and several hundred cubic yards of material were deposited downstream of the crossing, near the vertical left bank. Since the flood, the stream has established again and while there is still significant flow through the mobilized cobble, ~75% of the flow is through the main channel downstream of the crossing. All flow is in the main channel down to a point about 40' downstream of the crossing.

The banks are generally stable, other than the 7'vertical bank along ~50' on the left bank 125' downstream of the crossing. There is a partially connected floodplain ~2' above the water level along the left bank near the crossing. Just downstream of the crossing on the right bank there is a abandoned floodplain ~5' above the water level for ~30' downstream, then it drops to a slightly connected floodplain about 2.5-3' above the water level for ~25', then it drops to a connected floodplain about 1' above the water level for ~50'.

There is a highly incised tributary forming on the right bank ~125' upstream of the crossing, which drains down a very steep slope and drains from an alfalfa field. This may concentrate significant flow from the bedrock under the steep slope, as the drainage area is not adequate to supply the volume of water to form the channel that exists on the slope currently.

Agency Site Visit (July/August 2013) Notes

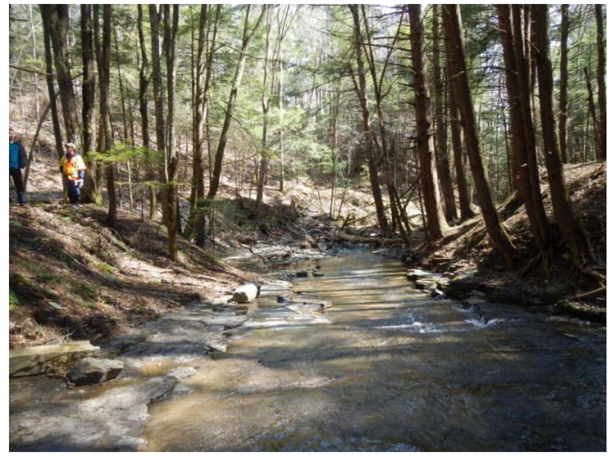
Mature hemlock stand in wide valley with steep sideslopes. Stream has huge bed load and high carrying capacity (12" rock). There is bedrock as the base of the stream - need to jackhammer, rip or blast through it to create. Observed surface water flowing underground at this location. Trench 1' bigger than the pipe in all dimensions (~5' wide trench at least 6' deep) - how do we ensure no washout/scour on the trench? - concrete cap? fill with 3-5' rocks? sand is placed around joints and concrete coated pipe to protect it, but there still needs to be protection over the trench. Vegetation is needed on all banks and likely on the 125' wide slope that will be exposed during construction. NOTE: DEC indicated that many of the stream crossings that were observed on site visits have been exposed to several 100 and 500 year storm events in last 10 to 12 year period.

USACE/DEC Comments

Vegetation needed on stream banks to protect steep slopes. Minimize impact to Hemlock trees as much as possible.

April 2014 site pictures

Reroute Crossing



Reroute looking downstream

Reroute looking upstream

Reroute looking upstream

November 2013 site pictures

Previous crossing

Previous Crossing: looking downstream

Previous Crossing: looking upstream

July 2013 site pictures

PREVIOUS CROSSING: DOWNSTREAM

PREVIOUS CROSSING: UPSTREAM

PREVIOUS STREAM CROSSING

BR-1I-S057
Oquaga Creek
Latitude: 42.097285
Longitude: -75.479807

KA Site Visit (November 2013) Summary

This riffle-pool stream has been significantly altered from its natural condition, as both banks are heavily armored in sections and there are agricultural fields right up to the top of the bank on the left bank, and within 35' of the top of bank on the right bank. The substrate was primarily cobble, with some boulders and some gravel near the edges of the stream. The system appeared fairly stable, as there was minimal evidence of downcutting or active scouring. There is a large riffle ~250' DS of the crossing that may potentially move upstream, and this is what the agencies wanted to protect the pipeline against, in addition to maintaining the bank protection. There was also some discussion of placing cross vanes or J-hooks on the right bank, downstream (and upstream?) of the crossing, to minimize the movement of the channel. The only floodplain is the agricultural fields, which are approximately 4-6' above the average water surface elevation. There was minimal evidence of flooding in these fields during either visit.

The stream banks were generally stable in the current condition, although significant armoring (3-6' boulders) had been placed along the channel. On the right bank, a rock wall (old bridge abutment?) was constructed from ~390' to ~200' US of the crossing. This "wall" served to protect the right bank as the stream made a left hand turn of about 45°. There was also armoring placed along the left bank from ~60' US of the crossing to ~110' DS of the crossing. This armor was just large boulders (3-5' along the long axis) placed against the bank – some of which were eroding between the boulders. There is also additional riprap placed on the RB ~250' downstream of the crossing, extending through ~450' below the crossing.

It did not appear that the crossing had been moved 100' downstream as was discussed at the Agency meeting in July, based on the centerline staked in the field. The right bank was generally well vegetated and had a 35-60' wide riparian buffer established along the 200' closest to the crossing. The left bank was vegetated above Transect B, but in the 200' closest to the crossing there was only sparse vegetation/shrubbery growing between and above the boulder riprap. There is a deep pool (~5' deep) along the left bank of the section ~50' upstream of transect A through ~25' upstream of transect C that provided deepwater cover under some smaller vegetation.

Agency Site Visit (July/August 2013) Notes

Moved crossing downstream ~100' to use disturbed bank and cross at riffle area that may be used by the farmer to cross his equipment. Trout were seen in the stream and Dave requested that trees be planted along the stream banks to provide shade for the stream as much as possible. The left bank is not well established - loose gravel/cobble. Potential for vanes to direct flow off of the right bank and provide grade control.

USACE/DEC Comments

Plant trees along banks to stabilize toe of slope and banks.

November 2013 site pictures

CROSSING

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

DOWNSTREAM

UPSTREAM

BR-1I-S190
UNT to Oquaga Creek
Latitude: 42.105863
Longitude: -75.473277

KA Site Visit (November 2013) Summary

This site is a high gradient (avg. 7.3% slope) headwater stream that appears to be very flashy as evidenced by the low flows during the visit (measured at 0.10 CFS) and the 6' wide bankfull width. I would call it a step pool system with a cobble/boulder substrate that includes several steps downstream of the crossing and some large woody debris across/in the stream. The site is pretty straight, after the bend at cross section B, and is generally confined by the hill on the left bank the whole way down to the road. There is an abandoned floodplain on the right bank that could potentially convey flow during very large events, but it is about 2' above the channel bottom. There are also a small tributary over the right bank, below cross section C. At cross section A and cross section C, the left bank is very confined; the right bank has ~20' wide abandoned floodplain. Cross section B is confined on the right bank, with a ~20' abandoned floodplain on the left bank, on the inside of the bend. The banks are very steep in spots, but there is not much evidence of recent mass wasting or overhanging banks, other than at the bend in cross section B. The extent of bank scour is minimal (~10% along the reach), as the stream appears generally stable, although very steep with significant steps downstream. Regarding trout habitat, there are some deeper pools present that could be trout habitat, and there is evidence of year-round flows.

Agency Site Visit (July/August 2013) Notes

This stream appears to be very flashy and is located on a steep gradient, which lends itself to high velocities. The stream is contained in banks of about 15' in height. It would be best to install grade control to protect the pipe crossing. The DEC's suggestion to return the LB grade to 3:1 or less is a good one, as this section would be unstable if we tried to rebuild it to match the existing grade.

USACE/DEC Comments

There is the potential for spawning and rearing of young trout at this site. Consider sloping the left bank at 3:1 rather than meeting existing grade which is over steepened.

November 2013 site pictures

TRANSECT A (CROSSING)

TRANSECT A (CROSSING) LOOKING DOWNSTREAM

TRANSECT A (CROSSING) LOOKING UPSTREAM

July 2013 site pictures

DOWNSTREAM

UPSTREAM

BR-1K-S140
UNT to Oquaga Creek
Latitude: 42.117447
Longitude: -75.467883

KA Site Visit (July 2014) Summary
The stream crossing moved approximately 100 yards upstream. Channel upstream is similar to channel at previous alignment in terms of banks, bed, and stability. This 2nd order stream is slightly confined, with floodplain bench, connected to mildly sloped valley wall. Low banks (~ 1 ft), narrow band of trees adjacent to stream, with pastures beyond. Channel is composed of cobble to boulder material, shallow steps, gravel and finer material below. Vertically stable. Negligible active lateral movement. There is a perched culvert downstream of nearby road.

KA Site Visit (November 2013) Summary
This stream comes off relatively steep forested hill. This unnamed stream is a small tributary to Oquaga Creek and separates two fields that appear to be mowed at least annually. The crossing is approximately 175 ft upstream from Route 241 where it crosses under the road in a 36 inch culvert. Habitat consists of a series of shallow run/ pools interrupted by rubble and cobble. Both banks are steep near the crossing and approximately 12' tall, presenting challenges for bank stabilization. The stream slope is steeper upstream and there is a headcut downstream that makes the area unstable and will require grade control to protect the pipe crossing. Substrate is primarily boulder, cobble gravel and some fines. While this stream is poor for trout habitat, it may provide limited insect drift for trout inhabiting downstream sections.

Agency Site Visit (July/August 2013) Notes
Both banks are steep near the crossing and approximately 12' tall, presenting challenges for bank stabilization. The stream slope is only steeper upstream and there is a headcut downstream that makes that area unstable and will require grade control to protect the pipe crossing. Bank stabilization and cross vanes may be needed to protect the steep banks, minimize slumping, and to protect the toe of the slope.

USACE/DEC Comments
This is borderline habitat, as it has good habitat and good bugs.

July 2014 site pictures

AT PIPELINE CROSSING, D/S

D/S OF CROSSING, D/S

STONE WALL CROSSING CHANNEL

STONE WALL ON RIVER LEFT

November 2013 site pictures

CROSSING

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

DOWNSTREAM

UPSTREAM

BR-1Q-S209
UNT to Dry Brook
Latitude: 42.155608
Longitude: -75.484742

KA Site Visit (April 2014) Summary

A steeply sloped (6%) 1st order stream with some flow, though mostly standing water, which is discontinuous moving downstream. The current alignment places the crossing close to a gravel road just downstream of an existing power line right of way. The stream bed consists of cobble and gravel with mineral soil (sand and mud) exposed in between coarse material. Shallow step pools between tree roots indicate mild but active incision. The stream has low banks that are mostly undefined or ~ 1 ft tall, with no obvious bank erosion. The main channel splits into multiple unconfined channels downstream of pipeline alignment for brief period, then joins back to one main channel and has a low, broad floodplain. The stream is likely too small to maintain a trout population and lacks suitable spawning substrates. However, it drains directly to Dry Brook, which likely is trout habitat. Given the loose substrate, vertical stabilization will likely be needed downstream of pipeline trench.

July 2014 site pictures

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

SMALL BREAK IN STREAM PROFILE

BR-1U-S141
Oquaga Creek
Latitude: 42.130702
Longitude: -75.463144

KA Site Visit (April 2014) Summary

Site visited to verify wetland boundaries of BR-1H-W174 with USACE. No discussion of stream crossing location, other than the need to stabilize the left bank after construction due to the presence of the gully that has formed on this slope.

KA Site Visit (November 2013) Summary

The pipeline crosses Oquaga Creek approximately 350' upstream of a confluence with a small tributary on its right side. The right bank is relatively flat and the left bank is generally comprised of a steep hemlock forest. Downstream of the crossing the left bank is much steeper and higher than its right bank and the right floodplain is wider and utilized more frequently. As mentioned in the agency notes below, the crossing was moved upstream 75' where the left bank was not quite as steep. However, the left bank is still significantly steeper than the right bank at the crossing. The gradient is low (0.58%) and the stream remains fairly straight throughout the reach, but does have some gentle meanders. The stream appears to be stable at the crossing and has minimal bank scour. A trout was observed feeding in the run downstream of the crossing and there is evidence of flows year-round; this habitat appears suitable for trout.

Agency Site Visit (July/August 2013) Notes

Brook trout habitat need for stream bank restoration. Possibly cross vanes and maybe some j-hooks to direct flow and control grade. Crossing moved upstream about 75' to take advantage of flatter area at base of the left bank slope.

USACE/DEC Comments

Utilize flat areas at base of slope as much as possible. Consider natural stream design to control direction of flow and protect base of slope.

April 2014 pictures

CROSSING: LOOKING DOWNSTREAM

November 2013 site pictures

UPSTREAM BANKS

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

PREVIOUS CROSSING: LOOKING UPSTREAM

PREVIOUS CROSSING: LOOKING DOWNSTREAM

CH-1A-S048
Landers Creek
Latitude: 42.234778
Longitude: -75.489167

KA Site Visit (Nov. 2013) Summary: This section of Landers creek is about 1/4 mile upstream of Route 88 and about 1 mile from the confluence with the Susquehanna River. During the last hurricane it appears that the creek may have overtopped the road several hundred feet downstream of the crossing site. The right bank is steep and is close to the road. The left bank consists of a mild slope which leads up to the top of bank. This site consists of a new stream channel that was either formed during an earlier high flow event or modified by the local township at some point in time, as there is a small back channel which contains a wetland that is located adjacent to the steeper forested section of the hill/mountain. During extremely high flow events it appears that the back channel would be inundated. Except for a small amount of bank scour upstream of Transect B where the stream makes a left turn bank scour was minimal the stream appears generally stable at the crossing site. However, downstream of the crossing there are signs that stream flows are flashy and which have the potential to result in erosive forces. Substrate in the area was boulder, cobble and gravel with some fines/sand. Although no trout were observed during either visit, it is likely trout may frequent this portion of the creek.

Agency Site Visit (July/August 2013) Notes: Site was renamed from their matrix, look at shifting site upstream 75 but no more that 100 ft to gain more space between wetland and road. Tricky site, the agencies wanted to see site combine stream crossing with road bore in an effort to balance workspace on south side with wetland impact, and lack of work space on north side due to steep side slope close to road. At this point not sure road bore will also incorporate stream crossing.

USACE/DEC Comments: Concern with receiving pit on left bank of stream - enough space for pit? Need to delineate wetlands on LB side of channel.

July site pictures:

CROSSING: LOOKING DOWNSTREAM:

CROSSING: LOOKING UPSTREAM:

CROSSING:

November site pictures:

CROSSING

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

DE-1G-S005
UNT to Charlotte Creek
Latitude: 42.503444
Longitude: -74.724830

KA/Agency Site Visit (April 2014)

A confined 2ND order stream located in a hardwood forest that has an estimated 1% slope. Cobble dominates the riffle habitat at this crossing. The stream channel and banks are somewhat stable although some signs of mild erosion (undercut banks) were evident. The right bank was vertically incised and the left bank has a 30 ft wide flood plain. At the time of the agency visit, continuous flow in the stream was estimated to be 0.5 cfs. Bioengineering techniques are recommended to stabilize the steep right bank at this crossing and provide shade over this reach. Timing restrictions will apply at this crossing.

April 2014 site pictures

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

PREVIOUS CROSSING: LOOKING DOWNSTREAM

PREVIOUS CROSSING: LOOKING UPSTREAM

DE-1I-S201
Kortright Creek
Latitude: 42.434456
Longitude: -74.902907

KA Site Visit (November 2013) Summary

This site is comprised of moderate gradient, low sinuosity, with a repeating pattern of alternating run and riffle habitat dominated by cobble and large gravel substrate. The embankments are well defined and do not exhibit extensive evidence of erosion. The left bank (looking downstream) is defined by a former railroad right of way. The crossing location occurs at an alluvial bench which at high flows is an island, and there are two secondary (overflow) channels on the right bank that clearly convey water at such times; these are located within the hemlock forest. This type of bench/braided channel did not seem to be characteristic of the contiguous stream channel areas. The habitat in this section appears suitable for YOY, juvenile and small adult lifestages of trout, but did not observe any suitable trout spawning habitat.

Agency Site Visit (September 2013) Notes

Crossing is in a better location on straighter, riffle area. Will need to recreate and stabilize island area. Noted the side channel will need to be treated the same as the main stream, as bank full would be over the island.

Agency Site Visit (July/August 2013) Notes

Actual crossing is ~250 feet downstream but inaccessible. At low flow, stream is braided. Minor undercutting of banks. LWD present.

USACE/DEC Comments

DEC want replacement of habitat features. Toe wood structure is a suggested restoration. Surrounding Hemlock should be saved to the extent possible. High flow side channel is good nursery habitat and should be replicated.

November 2013 site pictures

CROSSING: SIDE CHANNEL

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

PREVIOUS CROSSING: DOWNSTREAM

PREVIOUS CROSSING: UPSTREAM

PREVIOUS PROPOSED CROSSING

DE-1P-S053
UNT to Middle Brook
Latitude: 42.472143
Longitude: -74.783504

KA Site Visit (November 2013) Summary

The crossing site here is in a steeply descending series of step pocket pools and riffle/drops. At this location, the stream is passing along the margin of abandoned fields that are gradually filling in with trees and is slightly sinuous within the confines of the slope and contours. The stream emerges from a steeply sloped forested area with no floodplain just upstream from the crossing site (which is where the original alignment had been proposed). About 500 ft downstream from the crossing, this stream enters the floodplain of Middle Brook and the gradient lessens considerably. Flow gauging was accomplished at this downstream area in order to find a cross-section with suitable hydraulics. The riparian zone of the stream is bounded by a narrow strip of older trees on both banks. The stream is narrow and somewhat incised, with roots of trees forming some of the bank and channel features. During the agency site visit in July this was one of the sites where DEC was concerned about head cut "unzipping" and instability. These may change following flood events, although erosion appears minimal. Gradient is high (well over 2%) in most of the reach. Substrates are predominantly cobble but there is a mix of fines in some areas. This area has limited value as trout habitat due to the steep gradient and poor connectivity, but may be used by a few small individuals. Its value may be more as a production area for aquatic insects that trout forage on further downstream and/or as a source of cool high quality water in the summer.

Agency Site Visit (July/August 2013) Notes

High gradient step pool stream that is incising. Immediately below the crossing is a tree in the middle of the stream that is holding back the head cut. A shift in centerline is being evaluated that would greatly improve the crossing between steps in the stream. NYSDEC is concerned with these types of sites with steps in the streams as there is potential for downcutting and head cuts that could expose pipe if step is affected. Engineering controls (engineered rock) in place (upstream & downstream of crossing) should be implemented. There should be consideration to burying the pipe deeper to limit exposure potential.

USACE/DEC Comments

Concerned about maintaining the step pool morphology of the stream. The pipeline must be protected by grade control structures.

November 2013 site pictures

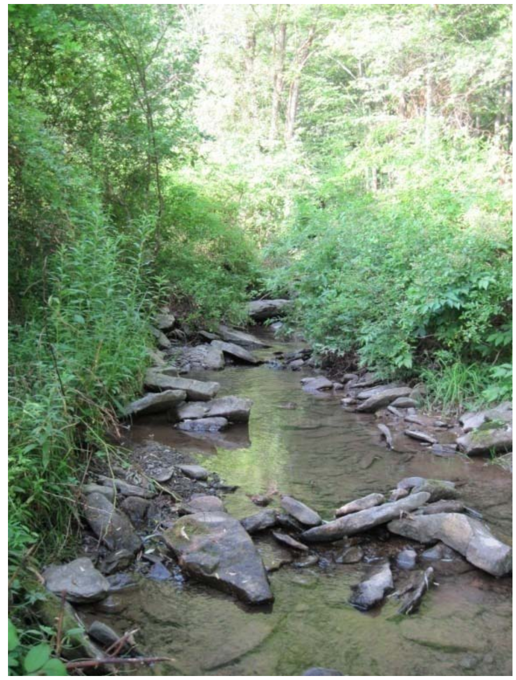
UPSTREAM TRANSECT: LOOKING UPSTREAM

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

DOWNSTREAM



UPSTREAM

DE-1P-S054
UNT to Ouleout
Latitude: 42.388239
Longitude: -75.106043

KA Site Visit (November 2013) Summary

This channel is predominantly a riffle reach of stream with a few pools scattered along it. The bed material is predominantly cobble, with some small boulders and gravel mixed in. The largest pool was located about 100' downstream of the crossing, and was caused by a log-jam upstream. Trout were observed in this pool during the site visit. This stream appears to be flowing year-round and would provide adequate trout habitat, as it is mostly shaded and has suitable substrate. This reach was generally stable; although the log jam downstream of the crossing could potentially move upstream and impact the pipeline crossing. There is an existing farm access road about 5' upstream of the crossing that is stable and has lower banks. Some erosion was evident along the areas of the reach where the side slopes were higher (~15% of the reach) and the water was confined to a narrower channel – however, this erosion did not appear to be recent, as no actively slumping banks were observed, other than in the area of the log jam. For the most part there was minimal meandering of the channel. There was an old logging/access road on the left bank of the channel, down to the location of the pipeline crossing. Above the crossing the area is primarily wooded. In the area downstream of the crossing, there is a ~25' wide riparian buffer on both sides of the stream, with pasture beyond that. The floodplain is almost non-existent (abandoned about 3' above the existing waterline and at the elevation of the pasture) downstream of the crossing. Upstream of the crossing, the floodplain may be accessed by the channel a few times a year, as it is about 18" above the existing water line.

Agency Site Visit (July/August 2013) Notes

The current crossing is located in an old hemlock forest with a steep valley. Stream is over-widened just upstream from proposed crossing. The stream is unstable and likely undergoes channel forming floods frequently. LWD is common and provides habitat and stabilization. Downstream from the proposed site the stream gradient lessens and becomes more agricultural.

USACE/DEC comments

The regulators want the crossing moved downstream onto a property with no access. There is an existing agricultural ford there that would make a better crossing.

November 2013 site pictures

CROSSING

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

PREVIOUS CROSSING: LOOKING DOWNSTREAM

PREVIOUS CROSSING: LOOKING UPSTREAM

PROPOSED NEW CROSSING

DE-1P-S056
UNT to Ouleout
Latitude: 42.403742
Longitude: -75.089877

KA Site Visit (November 2013) Summary

At this site there is a driveway with a culvert underneath it directly upstream of the crossing. The channel consists of a silty, gravelly, cobble substrate with a well-connected floodplain on the left bank. The right bank is partially connected to the channel and generally rises up about 3' at approximately a 5:1 slope above the bankfull elevation. The site did not appear to be great trout habitat, as it was a meandering channel though a silty substrate, but there is valuable aquatic insect habitat that may serve as a food source for trout downstream. There was minimal active erosion observed during the site visit in December, but the meandering channel did have some evidence of active erosion on the bends below the crossing. A ~2.5' deep pool lies below the culvert, right in the path of the crossing.

The culvert may serve as the upstream grade control of crossing. The channel steepens significantly downstream as it runs in a narrow ravine (bedrock controlled) so it is unlikely that a headcut would move upstream. The banks are well vegetated below the culvert, with an approximately 40' wide riparian buffer present for at least 100' downstream of the crossing. Upstream of the culvert/crossing, two ditches joined the primary stream just above the culvert, and it appears that a large pile of soil/stone was placed on the left bank to divert the stream into the culvert.

Agency Site Visit (July/August 2013) Notes

Existing culvert is perched with plunge pool. 36" culvert is likely large enough. Trout present in abundance. Groundwater supplies cold base flow. Crossing is at a private landowner driveway with adjacent wetlands and open fields. Although the present culvert appears to be satisfactory, it could be replaced with an open arch or box culvert sized at the required bankfull width. There was concern regarding shade removal as DE-1P-S056A is a great source of cold water, therefore the alder/shrubs should be replaced.

USACE/DEC comments

Crossing site is satisfactory. Concerned about thermal impacts particularly at the adjacent cold water seeps (58°F).

November 2013 site pictures

CULVERT

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM PAST CULVERT

July 2013 site pictures

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

CULVERT

COLDWATER SEEP

DE-1P-S058
UNT to Ouleout Creek
Latitude: 42.408642
Longitude: -75.076320

KA Site Visit (November 2013) Summary

There is an approximately 0.25 acre wetland over the top of the left bank at the crossing (Transect A). This area is connected to the stream and it collects runoff from the hillslope and directs it to the stream approximately 90' downstream of the crossing. The pool/riffle stream is generally stable downstream of transect A with good stream shading and mix of riffles and pools. The area from about 140' to 80' above transect A is laterally and vertically unstable due to the overtopping of an access road caused by a plugged culvert. There are two large trees that have fallen into or across the stream, which could provide a significant debris jam. The substrate is generally cobble and small boulders, with some soil exposed in the areas of the unstable area above transect B. The banks are generally stable and only have minor erosion along ~15% of the reach, aside from the erosion associated with the culvert upstream of the crossing.

The site was accessed via an existing roadway that had a culvert that was about 95% plugged by debris, which had recently caused the roadway to be overtopped and a channel to develop on the left bank downstream of the roadway and approximately 120' upstream of the proposed crossing. Both the historic and new channels contained flowing water. There is an active headcut (~18" tall) forming in the new channel caused by the stream overtopping the roadway. This headcut is upstream of the crossing and should not contribute to any instability at the crossing site.

Agency Site Visit (July/August 2013) Notes

Crossing has two channels. Trout present and congregated at the limited LWD. Though partially open, many old growth hemlocks are present. Trout are very abundant. This crossing location is an improvement from first crossing, however agency staff are concerned about the loss of hemlocks and the flowing water from wetland (DE-1P-S058B) being maintained. The potential materials associated with the clearing of hemlocks can be used as habitat logs or for bank stabilization.

USACE/DEC comments

Crossing site is satisfactory. Concerned about thermal impacts particularly at the adjacent cold water seeps (58°F).

November 2013 site pictures

TRANSECT A (CROSSING)

TRANSECT A LOOKING DOWNSTREAM

TRANSECT A LOOKING UPSTREAM

July 2013 site pictures

DOWNSTREAM

UPSTREAM

DE-1P-S129
Ouleout Creek
Latitude: 42.342429
Longitude: -75.254703

KA Site Visit (November 2013) Summary

Ouleout Creek is relatively wide, low gradient, and has a controlled base flow. As such flood events are relatively rare and of short duration. Stream width, geometry and slope are relatively constant through the site. There is pronounced riffle/run sequencing with a defined thalweg on river right (looking downstream). The river left side of the crossing has a depositional bench. The agricultural fields flanking the site are located on a historic flood plain, with a short false bank separating the fields from the bench. The historic flood plain is approximately 300 ft wide and terminates at the toe of a significant steep slope that rises approximately 40 or more feet above the stream to the base elevation of the surrounding topography. The riparian zone of the stream is wooded and the flood bench is populated with mature older trees, suggesting that it is not extensively inundated. The stream enters the site by coming around a sharp bend but then is straight with no meanders through the crossing site (~130' downstream of the bend in the stream) and some distance beyond. There is evidence of some minor bank slumping along the river right shoreline. Depths and velocities at the observed flow are suitable for adult and juvenile brook trout. Given the distance downstream from the bend in the stream, it is not anticipated that significant bank scour will occur at the location of the pipeline crossing, due to its location in a relatively straight reach.

Agency Site Visit (July/August 2013) Notes

Agriculture fields surround the stream. Well defined stream banks with a need for stabilization. Point bars and outer bends common. Active connection to floodplain. USACE Baltimore District owns a flood control dam upstream which can help control flows during construction.

USACE/DEC Comments

Location is satisfactory. Bank stabilization on outer bend at crossing is important and planting will be necessary to stabilize the bank after installation. Need to have a planting plan and stabilization plan in place. Concerned that loss of riparian trees will destabilize the bank. Grade control structures (rock riffle) suggested to minimize risk of exposing the pipeline.

November 2013 site pictures

CROSSING

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

CROSSING : LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM

DE-XX-S79.36
Prosser Hollow Creek
Latitude: 42.422307
Longitude: -75.941614

Agency Site Visit (April 2014) Notes

This stream is confined with steep valley walls on either side and small, discontinuous floodplain benches in some places. It is steep in grade (approx 4-6%) and has a mix of boulder and cobble bed material in the bed. Given its steep grade and the sparseness of the boulder material, additional grade control measures are recommended. The DEC suggested that hardened step pools be used to convey the flow through this reach and that live stakes be used to quickly re-establish vegetation on the steep banks on either side of the stream. Hardened step pools could use large boulders covered with existing bed material.

April 2014 site pictures

CROSSING

CROSSING: LOOKING UPSTREAM

CROSSING: LOOKING DOWNSTREAM

SC-1A-S370
UNT to Clapper Hollow Creek
Latitude: 42.537432
Longitude: -74.639312

Agency Site Visit (April 2014) Summary

This is as braided stream system, likely caused by significant debris jams that have formed and subsequently silted in behind them. There was a primary channel carrying approximately 60% of the flow, but several other side channels were flowing as well. The stream was well connected with its wide floodplain and evidence of overbank flow was obvious. There were some small (1' tall) overhanging banks with exposed roots, which may be evidence that this channel is still sorting out its preferred path.

USACE/DEC Comments

The NYSDEC was concerned with reconnecting all the side channels and making sure that flow was restored to all parts of this complex braided stream system. They requested that large woody debris be returned to the stream reach after installing the pipeline. Trout were observed at this site and timing restrictions would apply.

April 2014 site pictures

CROSSING

CROSSING: LOOKING UPSTREAM

CROSSING: LOOKING DOWNSTREAM

CROSSING: LOOKING UPSTREAM ON SIDE CHANNEL

SC-1C-S325
Clapper Hollow Creek
Latitude: (S325) 42.521031
Longitude: (S325) -74.681911

KA Site Visit (April 2014) Summary

Since the 2013 visits, the stream crossing was moved upstream at the request of the agencies, to a location near upstream end of the survey from Kleinschmidt's November site visit. At this visit, a slight tweak to the new reroute was made to avoid a side slope issue. Discussion of construction methods occurred, including how we would dewater such a large watershed with multiple stream channels and wetland area. The DEC and USACE asked if directional boring was a possibility. The DEC stated that the timing restrictions could be avoided by boring this site. The site was relatively complex and the restoration efforts will need to reconnect all small channels and tributaries to this stream. Access road construction can use mats to cross wetland hummocks combined with a span to cross the main channel with prefab piers.

KA Site Visit (November 2013) Summary

The survey team investigated the original alignment and an alternate location upstream at the outlet of a low gradient beaver flowage. Both sites were surveyed. The proposed location is located in a steep-sided, deeply-incised (i.e. 50 ft-deep) gorge within a dense old growth hemlock forest. The stream is moderate gradient and within the foot print does not meander, but turns sharply immediately downstream from the crossing. There is dense forest canopy, and slopes are stable due to the forest root system. The stream has a narrow flood plan on river left and a somewhat wider flood plain on river right which is vegetated with trees. Small localized minor toe of bank erosion but no nick points in the channel. Habitat is comprised of riffle and shallow run, dominated by cobble but with patches of unembedded gravel. Generally found to be high quality trout habitat suitable for all life stages.

The alternate crossing sites are about 100ft upstream from the original alignment and cross the creek near the downstream outlet of a beaver flowage exiting a wetland area. This stream slope here is much lower gradient than at the original site. The stream in this area is wide with a poorly defined channel, and many bifurcations through the wetland where multiple water elevations are controlled by beaver dams, thus the surveyed elevations are likely ephemeral. Adjacent riparian slopes are not as steep and dominated by a mix of scrub shrub, small trees and grasses. The banks are not well defined, but there is no evidence of erosion. This stream may provide some seasonal refuge for trout but the quality is not as high as the immediate downstream segment. Its value is primarily water quality and source of insect forage drift for downstream trout populations.

Agency Site Visit (July/August 2013) Notes

Stream left bank is extremely steep (~45%) and covered with mature hemlocks. Stream has minor signs of undercutting of banks and downcutting. The proposed site is fed by a wetland with lower gradient and cold water seeps. Evidence of siltation near the stream banks suggests that the steep banks provide a source of sediment. Site had some pet burials that may reroute pipeline.

USACE/DEC Comments

Extremely concerned about installation of the pipeline on steep bank. Without the hemlock forest, a landslide is probable. Engineering methods would have to be reviewed and approved. Most likely moving the crossing upstream to the wetland is better. There needs to be a compromise between stream impacts and wetland impacts.

April 2014 site pictures

CROSSING

CROSSING LOOKING UPSTREAM

CROSSING LOOKING DOWNSTREAM

November 2013 site pictures

PREVIOUS CROSSING: BEAVER DAM IMPOUNDMENT

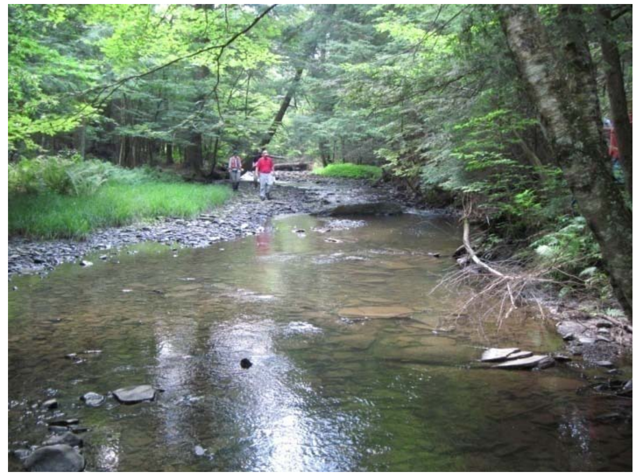
PREVIOUS CROSSING: LOOKING DOWNSTREAM

PREVIOUS CROSSING: SIDE CHANNEL AND STREAM ELEVATION DIFFERENCE

PREVIOUS CROSSING: LOOKING UPSTREAM

July 2013 site pictures

PREVIOUS CROSSING: LOOKING DOWNSTREAM



PREVIOUS CROSSING: LOOKING UPSTREAM

PREVIOUS CROSSING: TOP OF BANK

SC-1F-S002
UNT to Charlotte Creek
Latitude: 42.516548
Longitude: -74.691645

KA Site Visit (November 2013) Summary

This stream is narrow and small, and descends a hillside through a thicket of young trees and scrub growth. The stream crossing has been relocated downstream from the original alignment visited in July. Habitat consists of a series of shallow run/pools interrupted by rubble and cobble. Rooted riparian and wetland vegetation is present right up to the poorly defined banks. No erosion, pronounced down-cutting, or head cuts are evident. Substrate is cobble and gravel with some fines. The stream does not meander significantly through the crossing area. Habitat for trout is poor within the crossing area, but may provide some insect drift and maintain water quality for trout inhabiting downstream sections.

Agency Site Visit (July/August 2013) Notes

High gradient step pool system that transitions from a forested hillside to a wetland/agricultural setting. The gradient lessens downstream.

USACE/DEC Comments

Too much gradient at proposed site. Moving the crossing downstream will decrease the risk of exposing the pipeline and require less tree removal. The wetland impacts would likely remain the same.

November 2013 site picture

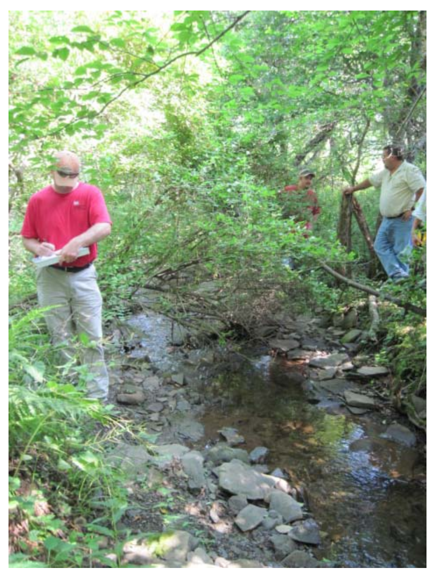
PREVIOUS CROSSING

PREVIOUS CROSSING: LOOKING DOWNSTREAM

UPSTREAM OF PREVIOUS CROSSING: LOOKING UPSTREAM

July 2013 site pictures

PREVIOUS CROSSING: DOWNSTREAM



PREVIOUS CROSSING: UPSTREAM

SC-1Q-S278
UNT to Clapper Hollow Creek
Latitude: 42.525293
Longitude: -74.666644

KA Site Visit (November 2013) Summary

This site has extremely high gradient with evidence of instability, head cutting and bank erosion throughout the entire upstream and downstream length from the crossing alignment. The forest is relatively young and based on evidence of stone fencing was likely pastureland 30 or so years ago. Habitat is comprised of shallow, narrow step pocket pools and drops, with abundant object cover such as boulders, cobbles and rootwads. There is intermediate meandering in this stream. Banks are steep and incised with evidence of slumping and undercutting. This may be a flashy stream during spring runoff and after large rain events. As such it does not provide suitable habitat for trout, and the lack of spawning gravels suggests that natural reproduction would be limited in this immediate reach.

Agency Site Visit (July/August 2013) Notes

Located in a deciduous forest with good cover, the stream is an incised, high gradient stream that may have been recently degraded by hurricanes. Reroute to further downstream was discussed.

USACE/DEC Comments

NYSDEC was concerned about possible head cut from downstream. They recommended grade control features downstream of pipeline crossing to prevent future exposure. It was also mentioned that the downed trees in stream should be left in place as they provide grade control.

November 2013 site pictures

CROSSING

CROSSING: LOOKING DOWNSTREAM

STEEPLY ERODED BANKS UPSTREAM OF CROSSING

CROSSING: LOOKING UPSTREAM

July 2013 site pictures

PREVIOUS CROSSING: DOWNSTREAM

PREVIOUS CROSSING: UPSTREAM

ATTACHMENT C

STREAM STATS DATA FOR PRIORITY 1 STREAMS

Priority 1Streams: StreamStats **Stream Name**	Area (mi^2)	Peak 2-year flow (cfs)	Peak 5-year flow (cfs)	Peak 10-year flow (cfs)	Peak 50-year flow (cfs)	Peak 100-year flow (cfs)	Peak 500-year flow (cfs)	Bankfull Area (ft^2)	Bankfull Depth (ft)	Bankfull Discharge (cfs)	Bankfull Width (ft)
BR1HS178_UT-FlyCk	7.9	254	378	463	659	747	953	59	1.8	265	34
BR1HS179_UT-FlyCk	0.1	4	8	10	17	20	29	1	0.3	4	4
BR1IS001_UT-MarshCk	1.7	88	144	188	297	348	475	17	1.0	72	17
BR1IS057_OquagaCk	30.3	1120	1670	2050	2940	3340	4280	179	2.9	840	62
BR1IS190_UT-OquagaCk	0.5	36	60	79	127	150	207	7	0.7	27	10
BR1JS048_UT-FlyCk	1.7	77	117	145	211	242	314	17	1.0	72	17
BR1KS140_UT-OquagaCk	0.3	21	35	47	75	89	124	4	0.5	16	8
BR1QS209_UT Dry Brook	0.1	9	16	21	34	40	57	2	0.4	8	5
BR1US141_OquagaCk	16.4	709	1060	1310	1880	2150	2760	108	2.3	497	47
CH1AS048_LandersCk	3.2	196	309	392	593	687	916	28	1.3	123	23
DE1GS005_UT Charlotte Ck	0.2	12	21	28	47	56	78	3	0.5	12	7
DE1IS201_KortrightCk	26.6	1010	1480	1800	2550	2880	3660	161	2.8	751	59
DE1PS053_UT-MiddleBk	0.8	49	83	110	178	210	292	9	0.8	39	13
DE1PS129_OuleoutCk	106.2	3500	5080	6170	8680	9800	12400	501	4.7	2450	110
DE-XX-S79.36_ProssorHollowBk	0.1	10	17	22	37	43	61	2	0.4	7	5
SC1AS370_UT Clapper Hollo	0.6	26	38	47	66	75	96	7	0.7	29	11
SC1CS325_ClapperHollowCk	8.0	326	480	586	832	942	1200	60	1.8	269	34
SC1FS002_UT-CharlotteCk	0.4	23	37	47	71	83	110	5	0.6	21	9
SC1LS327_ClapperHollowBk	0.1	9	15	19	31	37	52	2	0.4	7	5
SC1QS278_UT-ClapperHollow	0.2	10	14	17	24	27	34	3	0.5	13	7

Peak discharge and bankfull geometry values were calculated using the USGS StreamStats tool (http://water.usgs.gov/osw/streamstats/), which relies on regional statistical regression equations . These values are estimates only and are subject to uncertainty as described in the reports underlying these calculations (Lumia et al., 2006 & Mulvihill et al., 2009). This uncertainty is especially great for small streams (< 2 mi^2) where little data exist. Kleinschmidt reports these values for planing purposes only. Kleinschmidt has estimated bankfull geometry at the majority of Priority 1 sites and reports these values in Table 1. Where bankfull dimensions were not surveyed in the field regression values from Stream Stats are used.

Lumia, Richard, Freehafer, D.A., and Smith, M.J., 2006, Magnitude and Frequency of Floods in New York: U.S. Geological Survey Scientific Investigations Report 2006–5112, 152 p.

Mulvihill, C.I., Baldigo, B.P., Miller, S.J., and DeKoskie, Douglas, 2009, Bankfull Discharge and Channel Characteristics of