# Ivy-Dillingham Creek Restoration

Buncombe County, North Carolina

# PROJECT MANUAL

**September 4, 2024**

Prepared for:

Buncombe County
49 Mt. Carmel Rd
Asheville, NC 28806

Prepared By:

Jennings Environmental PLLC
7 Samuel Ashe Drive
Asheville, NC 28805

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**Definitions**

**Contract Documents:** The legally binding agreement and associated documentation, including approved construction plans (Plans) and technical specifications (Specifications), collectively agreed upon by the Owner and Contractor.

**Contractor:** The entity selected and approved by the Owner to execute the construction of the Project based on the approved Plans and Specifications.

**Engineer / Designer:** A registered Professional Engineer licensed within the State of North Carolina, responsible for Project implementation and final certification. The Owner may designate a qualified designee in place of a registered Engineer. Field conditions may necessitate modifications to the Plans and Specifications. However, any unauthorized alterations absolve the Engineer and their representatives from liability concerning the performance and functionality of those modified portions.

**Owner:** Refers to Buncombe County (the County) or their authorized representative. The Owner shall designate a representative to manage daily Project activities, including contractual matters, requests for information (RFIs), payment applications, construction administration, and adherence to the approved Plans and Specifications. References to the Owner or the County herein are interchangeable.

**Plans:** Approved construction drawings titled "Ivy-Dillingham Creek Restoration" dated September 2024.

**Project:** The entire scope of work encompassing the "Ivy-Dillingham Creek Restoration" and its associated Plans and Specifications.

**Site:** The designated construction area within the approved Limits of Disturbance (LOD) as outlined in the "Ivy-Dillingham Creek Restoration" within the Plans and Specifications.

**Specifications:** Technical and general requirements for Project completion, detailed within the Plans. These specifications, both technical and otherwise, are solely applicable to this Project and do not constitute design specifications or guidance beyond the Project's scope and limitations.

**Work Zone / Work Area:** Generally, the disturbed and unstabilized area within the Site. Within active watercourses, the work zone must be limited to allow clearing, installation of in-stream structures (if applicable), final grading, and streambank stabilization (using coir matting or other specified measures) to be completed within a single workday. Work zones outside active watercourses may be expanded by the Engineer's discretion, provided proper sediment and erosion control practices are implemented as outlined in the Plans and Specifications. Extensive clearing and grading beyond the immediate work zone are prohibited. The Engineer has the authority to modify work zone lengths

# 1.0 SPECIAL CONDITIONS

## 1.1 CONTRACTOR'S QUALIFICATIONS

The Contractor must document experience and provide project owner references for successful completion of at least three (3) natural stream restoration projects within the past five (5) years with the following project components:

- Accurate grading of stream channels and floodplains to provide sustainable functional natural stream features including thalweg, riffle, step, pool, run, glide, point bar, inner berm, bankfull bench, meanders, and floodplain habitat pools.
- Accurate installation of in-channel boulder and log structures for streamflow direction, bank stabilization, and grade control, including vanes, j-hook vanes, step-pools, constructed riffles, wood and rock toe revetments, and stacked boulder walls.
- Successful installation of biodegradable erosion control matting and native riparian vegetation on streambanks and floodplains, including seeding, mulching, tree seedlings, and live stakes.
- Successful compliance with environmental permit requirements imposed by US Army Corps of Engineers and state and local environmental agencies. Specific environmental requirements include erosion and sedimentation control measures, stormwater management, water quality protection, waste management, and ground cover establishment.

## 1.2 CONTRACTOR'S LIABILITY FOR DAMAGE

The Contractor shall assume full responsibility for the security of the project site throughout the construction period. All necessary safeguards mandated by applicable laws, ordinances, and Engineer or Owner-specified safety protocols must be implemented by the Contractor. The Contractor is responsible for locating and accurately identifying all existing utilities, both above and below ground, prior to construction activities. Measures must be taken to avoid any detrimental impact or disruption to these utilities. Pre-mobilization coordination with the Engineer is highly recommended to establish a clear understanding of existing infrastructure that requires protection during construction.

The Contractor shall be held solely liable for any damage caused to the property of the Owner, Engineer, or other parties on the site, resulting from the actions of the Contractor, their personnel, or subcontractors. This includes the obligation to repair and restore all such damages. The Contractor shall assume full financial responsibility for any legal claims filed against the Engineer arising from such property damage. Upon project completion, all existing rights-of-way and roadways utilized as construction entrances or access routes must be restored to their original condition.

Based on historical data for Black Mountain, NC (NOAA Station ID: 31-6231), the 25-year 24-hour storm event is 6.15 inches of rainfall. The Contractor is obligated to report all rainfall events exceeding 0.5 inches accumulated over a 24-hour period, as measured by on-site rain gauges. The Contractor is responsible for repairing and restoring any damage incurred on the project site due to flooding events associated with storm less severe than a 25-year 24-hour storm event. This liability period commences upon the initiation of clearing and tree removal activities and extends until the Engineer formally accepts the completed and stabilized construction site. The Owner reserves the right to negotiate repair costs associated with flood damage caused by storm events exceeding a 25-year 24-hour storm event on a case-by-case basis.

## 1.3 CONSTRUCTION WARRANTY

The Contractor shall warrant all materials and workmanship associated with the construction of the Site for a period of one (1) year, commencing upon the Engineer and Owner's acceptance of final site stabilization. The Engineer shall conduct visual inspections at six (6) and twelve (12) months to assess: Stability of stream restoration and grading activities, structures and compliance with final finish grades and vegetation installation as documented in the as-built plans. Following each inspection, the Engineer shall provide a written report to the Contractor, detailing any deficiencies identified and requiring remediation. The Engineer will convene an on-site meeting with the Contractor to discuss the corrective actions necessary to address the identified deficiencies. Upon completion of the corrective actions, the Contractor shall notify the Engineer. The Engineer will then conduct a final inspection of the warranty work and provide recommendations for acceptance. The Engineer shall notify the Owner of any outstanding warranty items that remain unresolved after the final inspection.

# 2.0 SITE PREPARATION

## 2.1 MOBILIZATION AND DEMOBILIZATION

### Description

This work consists of the mobilization and demobilization of the Contractor's equipment, materials and personnel necessary to perform the work required in the Plans. Mobilization will not be considered as work in fulfilling the requirement for commencement of work.

### Methods

Mobilization encompasses all activities and associated costs incurred for transportation of all personnel; delivery of all equipment, materials, and operating supplies; establishment of temporary offices and other essential facilities required for the Contractor's operations at the Site; premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements (if applicable); and any additional items explicitly specified within this technical specification. Demobilization encompasses all activities and associated costs incurred for transportation of personnel, equipment, and supplies not included in the contract, away from the Site; disassembly, removal, and comprehensive cleanup of all temporary facilities on the Site; Repair of any offices, buildings, or other facilities built on the Site specifically for this project.

The Contractor shall furnish and finance sanitary facilities for all workers, as mandated by local ordinances, to ensure complete and adequate sanitation for the duration of the Project. These sanitary facilities and their surrounding areas must be kept clean and orderly at all times. The Engineer shall approve their placement within the project Site. The Contractor may utilize storage containers and trailers on the project Site for the project's duration. The Contractor holds full responsibility for ensuring compliance with all relevant codes, ordinances, and requirements established by local authorities for temporary facilities, associated controls and related health and safety regulations.

## 2.2 CONSTRUCTION SURVEY

### Description

The construction survey shall include but not be limited to the layout of the stream channel, erosion control (E&SC) measures, limits of disturbance, temporary and permanent easements and all sensitive ecological areas associated with the implementation of the design as indicated in the Plans. The Contractor shall always maintain a GPS and/or level and rod on-site for use by the Engineer to evaluate stream grades and structure elevation. This condition will not alleviate the Contractor's responsibility to ensure that the stream is constructed in accordance with the project Plans and Specifications.

### Methods

The Engineer shall furnish the following digital project data to the Contractor: CAD surface files, digital linework files, Project Plans in PDF format (for reference). The Contractor shall verify and establish control points as necessary to ensure accurate construction layout.

*Construction Survey Option A: Utilizing GPS Equipment*

Full stakeout of the stream channel and associated structures may be waived if the Contractor employs GPS equipment to guide stream construction activities. However, GPS use is only acceptable if it demonstrably achieves the accuracy and tolerances specified in the Plans and Specifications for finished grades and structures. The Contractor bears sole responsibility for verifying GPS accuracy before conducting the construction survey. The Engineer reserves the right to conduct field verification of the construction survey as deemed necessary. Any resurveying necessitated by discrepancies in GPS accuracy exceeding project tolerances shall be borne by the Contractor.

*Construction Survey Option B: Traditional Stakeout Method*

If the Contractor elects not to utilize GPS equipment, a Professional Land Surveyor will perform a complete stakeout of the stream channel under their supervision. This stakeout must facilitate Engineer verification of the stream channel layout prior to construction commencement. The Contractor shall mark the proposed centerline of the channel at 50-foot intervals, as well as at the head of each riffle, pool, and maximum pool depth location within the proposed channel. Upon completion of the stakeout and prior to initiating construction activities, the Contractor shall provide the Engineer with a 48-hour notice for stream alignment approval. Stakes must be maintained until construction in the work area receives Engineer approval. No additional compensation will be provided for re-staking. The Contractor, under the supervision of a Professional Land Surveyor, shall stake out sensitive areas.

## 2.3 CLEARING AND TREE REMOVAL

### Description

Clearing and Tree Removal shall include the cutting, complete removal and satisfactory disposal of wooded vegetation and trees marked for removal, miscellaneous concrete & brick, signs, and other rubble and/or debris within the limits of construction or as identified on the Contract Documents.

### Methods

All clearing and tree removal activities shall be conducted prior to the commencement of grading operations, with the exception of woody material situated on or within existing stream banks that provides bank stabilization. Tree removal by the Contractor and subcontractors must be minimized and strictly limited to unavoidable conflicts with project access or essential construction activities. Prior to initiating work, the Contractor shall identify and clearly mark all trees slated for removal. Marked trees require review and approval by both the Engineer and Buncombe County. Tree removal for site access shall not be for convenience only. Should unforeseen circumstances necessitate the removal of additional trees during project implementation, the Contractor shall mark these trees for review and approval by both Buncombe County and the Engineer. Grubbing activities shall be restricted to designated areas earmarked for channel and floodplain excavation.

### Damage to Remaining Vegetation

The Contractor's clearing and tree removal activities shall prioritize the preservation of vegetation that is to remain intact. This entails implementing techniques that minimize physical contact and potential damage to retained trees and plant life. Any inadvertent injuries sustained during the process will require corrective actions by the Contractor, at no additional expense to the Project Owner. These actions include:

- Prompt removal of any broken branches.
- Treatment of rough or scarred edges on remaining vegetation, following established arboricultural practices.
- Removal and disposal of any vegetation that suffers severe damage, compromising its aesthetic or functional value within the landscaping design. Replacement of such vegetation will involve seeding and mulching with new plant material (grass, ground cover, etc.).

All cleared materials, encompassing vegetation debris, must be disposed of in strict adherence to all applicable local, state, and federal regulations. This may involve the on-site recycling or repurposing of suitable materials for project use, if feasible. Otherwise, proper disposal at designated facilities will be mandatory.

# 3.0 EROSION AND SEDIMENTATION CONTROL

This section details the requirements for the implementation and upkeep of E&SC measures throughout the Project. The primary objective of these practices is to achieve compliance with the project Plans, permits, local ordinances, state regulations, and federal mandates. The specific number of E&SC devices deployed may be subject to adjustments based on the prevailing site conditions encountered during construction activities. The Engineer holds the authority to modify the E&SC plan by increasing, decreasing, or eliminating the need for specific devices. These adjustments will not be construed as alterations to the core construction plan or a fundamental change in the project's overall character.

For comprehensive guidance and specifications on E&SC practices, refer to the latest edition of the NCDEQ Stormwater Design Manual (2017, including any amendments). The Contractor is must to adhere to the following requirements throughout the project duration:

1. All E&SC practices must comply with the project Plans and Specifications, as well as the stipulations outlined in General Permit No. NCG010000 (National Pollutant Discharge Elimination System - General Permit for Stormwater Discharge).
2. E&SC devices necessitate a minimum inspection frequency of once per week. Additionally, a mandatory inspection must be conducted within 24 hours following any significant rainfall event exceeding 0.25 inches of accumulated precipitation within a 24-hour period. Documented records of these inspections must be meticulously maintained, and any malfunctioning devices must be promptly repaired to restore functionality. The Contractor is responsible for maintaining a functional rain gauge on-site and diligently recording daily rainfall amounts and corresponding dates.
3. Copies of the project Plans, Specifications, Notice of Intent (NOI), On-Site Stormwater Pollution Prevention Plan (OS-SWPPP), rainfall records, and inspection reports must be readily available for inspection at the Project Site at all times.

## 3.1 CONSTRUCTION ENTRANCE

### Description

Construction Entrance shall include the installation, maintenance, and removal of Construction Entrance in the location and to the extents defined in the Plans or as directed by the Engineer. The work covered by this section consists of furnishing, installing, maintaining, and removing any and all Construction Entrances used to facilitate Site access.

### Methods

The Contractor shall install the Construction Entrance in accordance with the detail incorporated into the Plans and the NCDEQ Stormwater Design Manual (2017). Damage to any existing surface roads, gates, or vegetation, adjacent to the designated entrances shall be repaired by the Contractor to a condition equal to the pre- construction condition. The Contractor shall be solely responsible for the cost of such repairs.

### Maintenance and Removal

The Contractor shall be responsible for all maintenance required to keep the Construction Entrance in proper working condition. The Contractor is responsible for removing the Construction Entrance in its entirety at the end of the project and returning the area occupied by the Construction Entrance to pre-project grades, elevations, and conditions. The Contractor shall establish permanent stabilization with temporary and permanent seeding and mulching on the disturbed area resulting from the removal of the Construction Entrance.

### 3.2 TEMPORARY IN-STREAM DIVERSION

#### Description

This section outlines the scope of work associated with the temporary in-stream diversion. The primary objective is to maintain stream flow throughout the Site while simultaneously isolating designated work areas from the flowing water. Dewatering of these isolated work zones will be achieved in strict compliance with the project Plans and Specifications, or as directed by the Engineer. To ensure dry working conditions for in-stream construction activities, the implementation of the temporary in-stream diversion will be employed as necessary.

The scope of work encompassed by this section specifically addresses the furnishing, installation, ongoing maintenance, and removal of all temporary instream diversions utilized on the project.

#### Materials and Methods

All work in or adjacent to the stream shall be conducted such that the flow does not come in contact with the disturbed work area. Construct a temporary in-stream diversion using gravel, cobble and / or boulders from the streambed to form a berm that diverts flow around the work area such that flows do not interact with disturbed earth and construction materials.

Construction shall be timed to occur during times of low flow. Construction scheduling and staging shall be timed to minimize the amount of time spent working in the river channel. The riverbanks, structures and work area must be stabilized at the end of each day before the temporary berms are removed and flow is returned the full channel.

### 3.3 EROSION CONTROL MATTING

#### Description

The work covered by this specification consists of furnishing and installing Erosion Control Matting on finished grade as shown on the Plans and Details. The quantity of Erosion Control Matting to be installed may be affected by the actual conditions that occur during the construction of the project. The quantity of Erosion Control Matting may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

#### Materials

Coir Fiber Matting will be machine-produced mat made of 100% coconut (natural) fiber with properties as follows:

| PROPERTY | REQUIREMENT | TEST METHOD |
|---|---|---|
| matrix | 100% coconut fiber | ECTC* |
| roll size | 6.6 feet x 164 feet | ECTC* |
| thickness | 0.30 inches (minimum) | ASTM D5199 |
| elongation | 34% x 38% (maximum) | ECTC* |
| flexibility | 65030 x 29590 mg cm | ECTC* |
| mass per unit area | 20 ounces per square yard (minimum) | ASTM D5261 |
| stable flow velocity | 11 feet per second (minimum) | ECTC* |
| open area (measured) | 50% (maximum) | ECTC* |
| tensile strength | 1348 x 626 pounds per foot | ASTM D5035 |
| ‘C’ factor | 0.002 | ASTM D5035 |

*Testing methods specified by Erosion Control Technology Council (ECTC) guidelines.

### Methods

The Contractor shall install erosion control matting on designated locations, strictly adhering to the dimensions (width and length) detailed in the Plans or as instructed by the Engineer. Installation of the matting will follow the specifications outlined in the Plans and details, ensuring complete coverage in designated areas. Overlapping seams of adjacent mat sections must maintain a minimum 6-inch width. Upstream matting edges should overlap downstream matting during installation to create a shingle effect. Stakes, spaced at 3-foot intervals, will be driven into the ground in a staggered or offset pattern to secure the overlapping seams and prevent fabric separation. Matting will be keyed into the riffles along the channel toe for improved stability. Installation must occur only when the matting is completely dry.

Prior to matting placement, the subgrade must be finished to the final design grades, eliminating any voids or uneven surfaces. Following subgrade preparation, the area will be treated with fertilizer, soil amendments, seeding, and mulching according to the specifications outlined elsewhere in the Plans and Specifications. Straw mulch will be applied on the finished grade to achieve a minimum 60% soil coverage.

Stakes used for securing the fabric will be wooden, with a square cross-section of 2 inches by 2 inches and a total length of 12 inches. A single notch must be cut approximately 1 inch from the top of each stake. Biodegradable stakes, such as the approved Eco-STAKE™, may be substituted with prior authorization from the Engineer. However, when Eco-STAKES™ are used for the majority of the matting, wooden stakes with an 18-inch length will be required to secure the top and bottom edges for additional stability. The use of metal staples is strictly prohibited on this project.

## 3.4 TEMPORARY FORD CROSSING

### Description

This section outlines the scope of work associated with the temporary ford crossing. The primary objective is to maintain stream flow throughout the Site while simultaneously accessing designated work areas. Accessing these work zones will be achieved in strict compliance with the project Plans and Specifications, or as directed by the Engineer. To ensure dry working conditions for in-stream construction activities, the implementation of the temporary ford crossing will be employed as necessary.

The scope of work encompassed by this section specifically addresses the furnishing, installation, ongoing maintenance, and removal of all temporary ford crossings utilized on the project.

### Materials and Methods

All work in or adjacent to the stream shall be conducted such that the flow does not come in contact with the disturbed work area. Construct a temporary ford crossing using gravel, cobble and / or boulders from the streambed to form a berm that diverts flow around the work area such that flows do not interact with disturbed earth and construction materials.

Construction shall be timed to occur during times of low flow. Construction scheduling and staging shall be timed to minimize the amount of time spent working in the river channel. The riverbanks, structures and work area must be stabilized at the end of each day before the temporary berms are removed and flow is returned the full channel.

# 4.0 GRADING EARTH WORK

## 4.1 STREAM CHANNEL AND FLOODPLAIN GRADING

### Description

This work involves the excavation of floodplains and new channels. The Contractor shall perform excavation and grading as necessary to attain final surface elevations along the stream corridor as shown on the Plans.

### Methods

The Contractor shall perform grading as necessary to attain final design surface elevations as shown on the Plans. Topsoil and excess earth shall be stockpiled for use in backfills and channel plugs. Field modifications shall be approved by the Engineer. Final elevations for channel grade and stream dimensions shall be within a vertical tolerance of +/- 0.1 feet (1.2-inches) and a horizontal tolerance of +/- 0.2 feet (2.4-inches). Final floodplain grades shall be within a vertical tolerance of +/- 0.2 feet (2.4-inches) and a horizontal tolerance of +/- 0.4 feet (4.8-inches). Sensitive areas to be protected, as noted in the Plans, include tree save areas and stream buffer zones. Damage to these areas will be the Contractor's responsibility for re-establishment.

New stream channel banks will be graded evenly and smoothly at the slopes and dimensions indicated on the Plans. The top of slopes and embankments will match surrounding adjacent grade such that after compaction and settlement, grades will be at proper elevation. The Contractor will be required to address any settlement that occurs prior to final project approval by the Engineer. Existing drainage patterns should remain unchanged on the adjacent floodplain, unless otherwise noted in the Plans.

## 4.2 CHANNEL PLUGS AND BACKFILL

### Description

This work involves the placement of fill in the abandoned channel, designated stockpiles and permanent fill locations. The Contractor shall perform excavation and grading as necessary to complete all excavation activities within the Site.

### Methods

Channel plugs shall follow the detail in the Plans. Channel plugs shall be installed at all locations identified in the Plans, and as directed by the Engineer, to prevent flow from returning to the existing channel to be abandoned. Channel plugs shall be constructed with suitable onsite material to be approved the Engineer. Channel plugs and backfill shall be installed in lifts. Lift thickness shall not exceed 12" and compaction shall be achieved by use of mechanical compaction equipment. Along the proposed channel, the channel plug side slope shall conform to the side slopes specified in the Plans. Along the abandoned channel, the channel plug side slope shall not exceed 3:1 (H:V). Topsoil shall be placed over all channel plugs and backfill areas to promote stabilization and re-vegetation.

# 5.0 STREAM RESTORATION

## 5.1 RIFFLES

### Description

The work covered by this section consists of the construction of various riffle types constructed with rock and boulders and any other materials indicated by Plans. Riffles are installed once local channel excavation is complete.

### Materials and Methods

Riffles shall be constructed using a well-graded blend of the stone having properties consistent with those detailed in Section 8.0 of these Specifications. All riffle types shall be constructed according to the Plans, or as directed by the Engineer in the field. All materials shall be placed neatly and uniformly with an even surface in accordance with the Plans and shall meet the approval of the Engineer. All riffles shall have a low flow channel (thalweg) that does not concentrate flow against the toe of the streambank.

Native alluvium available onsite may be used to supplement the quarried stone. All native stone must be approved the Engineer. The Contractor shall refer to the detail in the Plans specific to each in-stream structure for rock sizing requirements. Native rock encountered during channel excavation may be identified and stockpiled to supplement quarried stone used for riffles.

### Tolerances

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans. In locations where exposed bedrock extends to and/or above the proposed finished grade, the bedrock shall be incorporated into the completed work as directed by the engineer.

## 5.2 BOULDER J-HOOK VANES

### Description

The work covered by this section consists of furnishing, stockpiling, placing and maintaining approved stone, boulders, filter fabric, and backfill to be utilized to construct J-Hook Vanes according to locations, lines, elevations and grades of the plans and details.

### Materials and Methods

Materials used to construct J-Hook Vanes shall meet all the requirements described the Plans and Section 8 of the Specifications. Set boulder inverts at elevation shown on the plan and profile sheets. Non-woven geotextile shall be placed on the upstream side of the structure to prevent washout of sediment through boulder gaps. Filter fabric shall extend from the bottom of the footer boulder to the finished grade elevation and shall be placed the entire length of the structure.

### Tolerances

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans. In locations where exposed bedrock extends to and/or above the proposed finished grade, the bedrock shall be incorporated into the completed work as directed by the engineer.

## 5.3 BOULDER CROSS VANE

### Description

The work covered by this section consists of furnishing, stockpiling, placing and maintaining approved stone, boulders, filter fabric, and backfill to be utilized to construct Boulder Cross Vanes according to locations, lines, elevations and grades of the plans and details.

### Materials and Methods

Materials used to construct Boulder Cross Vanes shall meet all the requirements described the Plans and Section 8 of the Specifications. Set boulder inverts at elevation shown on the plan and profile sheets. Non-woven geotextile shall be placed on the upstream side of the structure to prevent washout of sediment through boulder gaps. Filter fabric shall extend from the bottom of the footer boulder to the finished grade elevation and shall be placed the entire length of the structure.

**Tolerances**

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans. In locations where exposed bedrock extends to and/or above the proposed finished grade, the bedrock shall be incorporated into the completed work as directed by the engineer.

## 5.4 STACKED BOULDER WALL WITH SOIL LIFTS

**Description**

The work covered by this section consists of furnishing, stockpiling, placing and maintaining approved stone, boulders, filter fabric, and backfill to be utilized to construct Stacked Boulder Walls with Soil Lifts according to locations, lines, elevations and grades of the plans and details.

**Materials and Methods**

Materials used to construct Stacked Boulder Walls with Soil Lifts shall meet all the requirements described the Plans and Section 8 of the Specifications. Set boulder inverts at elevation shown on the plan and profile sheets. Non-woven geotextile shall be placed on the upstream side of the structure to prevent washout of sediment through boulder gaps. Filter fabric shall extend from the bottom of the footer boulder to the finished grade elevation and shall be placed the entire length of the structure.

**Tolerances**

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans. In locations where exposed bedrock extends to and/or above the proposed finished grade, the bedrock shall be incorporated into the completed work as directed by the engineer.

## 5.5 ROCK TOE PROTECTION (LG) WITH SOIL LIFTS

**Description**

The work covered by this section consists of furnishing, stockpiling, placing and maintaining approved stone, boulders, filter fabric, and backfill to be utilized to construct Rock Toe Protection (LG) with Soil Lifts according to locations, lines, elevations and grades of the plans and details.

**Materials and Methods**

Materials used to construct Rock Toe Protection (LG) with Soil Lifts shall meet all the requirements described the Plans and Section 8 of the Specifications. Set boulder inverts at elevation shown on the plan and profile sheets. Non-woven geotextile shall be placed on the upstream side of the structure to prevent washout of sediment through boulder gaps. Filter fabric shall extend from the bottom of the footer boulder to the finished grade elevation and shall be placed the entire length of the structure.

**Tolerances**

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans. In locations where exposed bedrock extends to and/or above the proposed finished grade, the bedrock shall be incorporated into the completed work as directed by the engineer.

## 5.6 FLOODPLAIN SILLS

### Description

The work covered by this section consists of furnishing, stockpiling, placing and maintaining approved stone, boulders, filter fabric, and backfill to be utilized to construct Floodplain Sills according to locations, lines, elevations and grades of the plans and details.

### Materials and Methods

Materials used to construct Floodplain Sills shall meet all the requirements described the Plans and Section 8 of the Specifications. Set boulder inverts at elevation shown on the plan and profile sheets. Non-woven geotextile shall be placed on the upstream side of the structure to prevent washout of sediment through boulder gaps. Filter fabric shall extend from the bottom of the footer boulder to the finished grade elevation and shall be placed the entire length of the structure.

### Tolerances

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans. In locations where exposed bedrock extends to and/or above the proposed finished grade, the bedrock shall be incorporated into the completed work as directed by the engineer.

## 5.7 ROCK-LINED SWALES

### Description

The work covered by this section consists of furnishing, stockpiling, placing and maintaining approved stone, filter fabric, and backfill to be utilized to construct Rock-lined Swales according to locations, lines, elevations and grades of the plans and details.

### Materials and Methods

Materials used to construct Floodplain Sills shall meet all the requirements described the Plans and Section 8 of the Specifications. Set rock at elevation shown on the plan and profile sheets. Non-woven geotextile shall be placed on the upstream side of the structure to prevent washout of sediment through rock gaps. Filter fabric shall extend bottom section of rock placement to the finished grade elevation and shall be placed the entire length of the structure.

### Tolerances

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans. In locations where exposed bedrock extends to and/or above the proposed finished grade, the bedrock shall be incorporated into the completed work as directed by the engineer.

## 5.8 WATER INTAKE

### Description

The work covered by this section consists of furnishing, stockpiling, placing and maintaining approved stone, filter fabric, and backfill to be utilized to construct Water Intake according to locations, lines, elevations and grades of the plans and details.

### Materials and Methods

Materials used to construct Water Intake shall meet all the requirements described the Plans and Section 8 of the Specifications. Set pipe and other infrastructure at elevation shown on the plan and profile sheets.

### Tolerances

The finished structure shall be within plus or minus 0.1 foot of the design elevation shown on the Plans.

# 6.0 SITE STABILIZATION AND RE-VEGETATION

## 6.1 TEMPORARY SEEDING

### Description

The work covered by this specification consists of furnishing and installing Temporary Seeding in areas specified in the plans. The quantity of temporary Seeding may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work. This work consists of Site preparation, soil amendments, seedbed preparation, seeding and mulching.

### Materials and Methods

Temporary seeding shall follow the planting schedule presented in the Plans.

All seed and seed varieties must be free of state and federal noxious weed seed. In addition, none of the following seed will occur in the mix:

- beach vitex
- Canada thistle
- Crested floating heart
- Eurasian watermilfoil
- loosestrife
- bushkiller
- musk thistle
- oxygen-weed
- puncturevine
- round leaf bittersweet
- spiny plumless thistle
- swamp stonecrop
- water chestnut
- water primrose
- water snowflake
- watermoss
- yellow fieldcress
- yellow floating heart

Soil Preparation

The Contractor shall loosen the sub-grade to a minimum depth of 4-inches and grade to a smooth, even surface with a loose, uniformly fine texture. The areas to be seeded are then to be rolled and raked to remove ridges and fill depressions to meet finish grades. The Contractor is to limit sub grade and finish grade preparation to areas that will be planted immediately. Prepared areas are to be restored if eroded or otherwise disturbed after fine grading and before planting.

Fertilizer

Fertilizer will be organic fertilizer and not petroleum-based fertilizer. Fertilizer will be applied at the rates indicated in the Plans. The Contractor may recommend alternative application rates based on a soil test from a certified lab. All soil amendment applications shall occur prior to seeding.

Limestone

Limestone will be applied at the rates indicated in the Plans. The Contractor may recommend alternative application rates based on a soil test from a certified lab.

Mulch

Mulch will consist of wheat straw mulch.

Water

The Contractor may provide supplemental irrigation as needed to promote successful seed germination, early root development, and achieve a uniform vegetative cover. The Contractor is solely responsible for the application of soil amendments according to the specifications outlined in this document.

Seeding

All soil amendments must be applied prior to the seeding process. Seeding operations will be restricted by the following environmental conditions:

1. Temperature: Seeding shall not be conducted when ambient temperatures fall below 32°F (0°C).
2. Ground Conditions: Seeding is prohibited on frozen ground.

The primary seeding method shall be via broadcast spreader. However, alternative methods may be employed with prior written approval from the Engineer. The applied seed must be incorporated within the top ¼ inch of the soil profile. Following seed application, a cultipacker or similar equipment (e.g., drag mat, chain-link fence) will be utilized to firm the soil and maximize seed-to-soil contact.

The Contractor is responsible for initiating maintenance activities immediately upon completion of seeding operations and continuing this maintenance regimen until final project acceptance. Maintenance of seeded areas may include the following:

- Irrigation
- Weed and pest control
- Fertilization
- Erosion repair
- Reseeding

Any other incidental operations needed to establish a healthy, vigorous, weed-free, and disease-free uniform stand of grass. Any areas that fail to exhibit uniform grass cover for any reason must be subject to maintenance treatments until a minimum of 90% coverage is achieved with no bare areas exceeding five square feet.

**6.2 PERMANENT SEEDING**

**Description**

The work covered by this specification consists of furnishing and installing Permanent Seeding in areas specified in the plans. This work includes riparian seeding on the streambanks and floodplain and upland seeding on the access path. Permanent Seeding shall occur in conjunction with Temporary Seeding. Soil amendments and preparation for Temporary Seeding shall be sufficiently fertilized for Permanent Seeding; additional fertilizer is not required for Permanent Seeding.

**Materials and Methods**

Permanent Seeding shall follow the planting schedule presented in the Plans.

All seed and seed varieties must be free of state and federal noxious weed seed. In addition, none of the following seed will occur in the mix:

- beach vitex
- Canada thistle
- Crested floating heart
- Eurasian watermilfoil
- loosestrife
- bushkiller
- musk thistle
- oxygen-weed
- puncturevine
- round leaf bittersweet
- spiny plumless thistle
- swamp stonecrop
- water chestnut
- water primrose
- water snowflake
- watermoss
- yellow fieldcress
- yellow floating heart

Seed may be mixed by the supplier and is not required to be mixed on site. Contractor shall provide

detailed information including but not limited to germination rates, noxious weed seeds and date and location of harvest on seed mix. Seed will have a Pure Live Seed (PLS) certification equal to or greater than that rate specified on the plant schedules. If the PLS is less than specified, the Contractor will increase the seeding rate to compensate for the PLS difference.

## 6.3 LIVE STAKES AND HERBACEOUS PLUGS

### Description

The work covered by this specification consists of furnishing and installing Live Stakes and Herbaceous Plugs on streambanks and other areas as applicable to the Plans and details. Live Staking is a standard bioengineering technique which involves planting of dormant plant cuttings using species known to produce roots from cuttings. The work will also cover the furnishing and installation of Herbaceous Plugs along the toe of the proposed streambanks as shown on the Plans.

### Materials and Methods

This section outlines the technical specifications for the installation of live stakes and herbaceous plugs within the project. Strict adherence to the planting schedule outlined in the project Plans is mandatory for live stake and herbaceous plug installations.

Plant Material Requirements

Live Stakes' diameter must range between 0.5 inches and 1.5 inches, with a minimum acceptable diameter of 0.25 inches and a maximum allowable diameter of 2 inches. Live stakes and bare root material should be between 2 and 3 feet long and exhibit a relatively straight profile. Specific preparation techniques are required for live stakes:

- Execute a 45-degree angle cut on the Basal End (Planting End)
- Implement a clean, flat cut on the top end

While the Plans specify plant species, substitutions may be permissible based on availability. However, any proposed substitutions require prior written approval from the Engineer. Plant materials exhibiting excessive damage (including significant bark damage), oblique cuts, or splitting will be rejected.

Storage and Protection

The Contractor is responsible for implementing appropriate storage measures to ensure the viability of all live materials. This includes safeguarding them from drying out or overheating during transportation and installation. Continuous protection from direct sunlight and wind exposure is mandatory for live plant material. Acceptable methods for achieving this protection include:

- Shade fabric deployment
- Heeling-in practices
- Application of mulch
- Utilization of plastic coverings
- Regular watering

Planting Season

Live stake harvesting and installation activities must be conducted outside the designated growing season as established by local NRCS WETS data. This data defines the growing season as the period exceeding a 50% probability of average daily temperatures surpassing 28 degrees Fahrenheit, based on historical weather information obtained from a local WETS station.

Installation Procedures

Specific installation instructions and details are provided within the project Plans. A dead blow hammer will be used to drive live stakes into the ground. The top end of the installed stake should protrude approximately 3 inches above the final ground elevation. On sloped surfaces, ensure live stakes are installed perpendicular to the finished grade. Achieve 80% subsurface placement by burying this percentage of the live stake's length within the soil. In situations involving exceptionally hard ground, a pilot hole may be created using a 0.5-inch metal rod. This rod must be carefully removed without rotating to prevent enlarging the hole. Live stakes and herbaceous plugs on streambanks will be installed in a diamond pattern using offset rows spaced 3.0 feet apart on center (O.C.) with one along the top of the stream bank, one along the middle of the stream bank, and one along the toe of the stream bank. Live stakes should ideally remain unsplit during installation. However, if splitting occurs stakes with splits exceeding 1/6 of their total length must be removed and replaced with undamaged specimens. Stakes with splits measuring less than 1/6 of their total length can be salvaged by re-trimming the top portion after installation to eliminate the damaged area.

## 6.4 BARE ROOTS

### Description

The work in this section consists of furnishing and installing riparian and upland plants in the form of bare root plants. The quantity of plants may be increased, decreased, or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

### Materials and Methods

Bare root plant installation activities will strictly adhere to the planting schedule outlined within the project Plans. All plant sources and materials must be submitted for prior Engineer approval. The supplier shall provide certification demonstrating that the seed origin for the supplied plants comes from Hardiness Zone 8, east of the Mississippi River. Plant material collected from non-nursery sources is strictly prohibited unless the Engineer grants explicit approval for both the specific materials and their source. Any substitutions proposed for the specified plant species require written approval from the Engineer and must be native to the project site's state and physiographic region.

Species Selection and Installation Timing

While the Plans specify plant species, substitutions may be permissible based on availability. However, any substitutions require prior written approval from the Engineer. Plant harvesting and installation activities must be confined to the dormant season.

Planting Locations, Types, Sizes, and Spacing

Refer to the Contract Documents for detailed information regarding designated planting areas, plant types, plant sizes for installation, and required plant spacing. Installation may necessitate the creation of holes within the installed coir matting.

Plant Material Requirements

Bare roots must possess a minimum root length of 3 inches to facilitate secure planting. Source materials for bare root plants may include transplants from existing streambanks or disturbed areas within the project site. Bare root plants designated for floodplain areas should exhibit a diameter ranging between 0.5 inches and 1.5 inches. The maximum allowable diameter is 2 inches, with a minimum acceptable diameter of 0.25 inches. Plant lengths should fall within a range of 2 to 3 feet and exhibit a relatively

straight profile. Species substitutions may be considered based on availability, but require prior Engineer approval. The Engineer will make final determinations regarding plant locations and configurations in the field.

Plant Handling and Storage

Plant root systems must be maintained in a moist condition during transport and storage until planting occurs. Additionally, root stock will be soaked in a tree gel containing a mixture of endomycorrhizal and ectomycorrhizal fungi.

Planting Procedures

Any undisturbed areas designated for planting will be mowed to a maximum height of six inches prior to the commencement of planting activities. Planting holes will be excavated using a mattock or dribble bar. The required depth of the planting holes must ensure that the first lateral root of the root mass is level with the surrounding grade. Non-organic debris should be removed from the excavated holes, and loose soil must be hand-tamped within the hole's bottom.

Spread plant roots within the planting hole and backfill the hole with soil. Standard landscape staples measuring six inches in length may be used, with Engineer approval, to secure tublings within the streambank. All planting holes must be backfilled and closed by the end of each workday. Any tags, labels, strings, or wires on the plants must be removed unless the Engineer provides specific instructions to the contrary. Trees will be planted in a staggered configuration, with rows spaced according to the specifications outlined in the Plans and Details. These rows will run perpendicular to the valley contour.

The Contractor may provide supplemental irrigation as deemed necessary for plant installation, ongoing maintenance, and overall plant survival. The furnishing of water, as well as the equipment and labor required for its application, is considered incidental to the bare root planting process.

# 7.0 SITE CLEANUP

## 7.1 EXCESS EARTH AND WOODY DEBRIS REMOVAL

### Description

This specification covers the removal and disposal of excess earth and woody debris from the Site at an offsite location identified by the Contractor. The work shall be performed in accordance with all applicable laws, regulations, and permits.

The quantity of Excess Earth and Woody Debris Removal to be performed by the Contractor will be affected by the actual conditions that occur during the construction of the project. The quantity of Excess Earth and Woody Debris Removal may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

### Materials and Methods

Excess earth and woody debris may be generated during the grading and excavation of the new stream channel. Disposal areas may not be available within the Site. Excess earth that is not used to backfill the old channel and woody debris that is not incorporated into structures must be hauled away and removed from the Site. The disposal location must have an approved Land Disturbance Permit through NCDEQ or otherwise be approved and permitted (local, state and / or federal) to accept the materials (e.g. landfills).

# 8.0 MATERIALS

## 8.1 STONE

### Description

This work consists of furnishing and stockpiling approved stone used to construct erosion and sedimentation control BMPs, in-stream structures and for use in other locations as directed by the Engineer. All rock used for in-stream structures shall be clean and free of trash and debris. Native rock encountered during channel excavation shall be identified and stockpiled for use as rock for in-stream structures. The Contractor shall refer to the detail in the Plans specific to each in-stream structure for rock sizing requirements. The Engineer shall approve all rock prior to use in in-stream structures to ensure conformity. The Contractor shall discard Engineer rejected rock from the work zone and replace with suitable material at no additional cost to the Owner.

The quantity of stone to be installed will be influenced by actual field conditions that occur during the construction of the project. The quantity of stone may be increased, decreased, or eliminated entirely as directed by the Engineer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

### Materials

Riprap

Stone shall consist of blasted granite quarry stone or other stone stockpiled onsite and approved by the Engineer. The stone shall be sound, tough, dense, resistant to the action of air and water, and suitable in all other respects for the purpose intended. All stone shall meet the approval of the Engineer. If stone doesn't meet approval, the Contractor shall absorb the cost of hauling the rejected stone away from the Site. The various classes of the riprap shall be distributed within the required size range according to the Table below:

| Riprap Stone Sizes | | | |
|---|---|---|---|
| **Class** | **Minimum (in)** | **Median (in)** | **Maximum (in)** |
| Surge | 2 | 2.5 | 3 |
| Class A | 4 | 6 | 8 |
| Class B | 9 | 12 | 15 |

Boulders

Boulders shall be sized to have minimum dimensions as indicated on the Plans. All boulders used for in-stream structures shall be structural stone, cubical or rectangular in shape, and shall be relatively flat on either side in the same dimension, preferably the long dimension. All boulders shall be placed to form an in-stream structure in accordance with the plans, neatly and uniformly, and shall meet the approval of the Engineer. Boulders may be available onsite. The Engineer must approve the use of boulders that may be available onsite.

### Methods

The Contractor shall install stone in locations and to the widths and lengths as shown on the Plans, or as directed by the Engineer.

## 8.2 WOODY DEBRIS

### Description

Woody Debris used for in-stream structures shall be harvested onsite or supplied by the Contractor. Limbs, tops and small logs from native hardwood trees encountered during clearing and tree removal shall be identified, processed and stockpiled for use as Woody Debris in Woody Riffles and Brush Toe Protection.

### Materials

Woody debris shall consist woody branches, limbs and tree tops generated on site, which are free of decay and disease. Woody debris shall be hardwood and free from invasive species. Split branches or damaged logs are not acceptable for reuse, unless otherwise approved by the Engineer. Woody debris shall be free of soil and debris prior to installation. The required thickness and lengths for woody debris by Type are detailed in the Table below:

| Woody Debris Size Classifications | | | |
|---|---|---|---|
| **Type** | **Minimum (in)** | **Maximum (in)** | **Length (ft)** |
| Fine Woody Debris | 1 | 4 | </= 4 |
| Coarse Woody Debris | 4 | 12 | </= 8 |

### Methods

The Contractor shall install Woody Debris in locations and to the widths and lengths as shown on the Plans, or as directed by the Engineer.

## 8.3 FILTER FABRIC

### Description

This work consists of furnishing and installing filter fabric as shown on the Plans. Filter fabric is used for stabilization and reinforcement for in-stream structures. The quantity of filter fabric to be installed will be influenced by the actual conditions that occur during the construction of the project. The quantity of filter fabric may be increased, decreased, or eliminated entirely as directed. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

### Materials

All filter fabric used shall be non-woven. Filter fabric shall meet the requirements listed in the table below. The Engineer shall visually inspect and verify the filter fabric to be used prior to its installation. The product name or label shall be attached to the filter fabric while stockpiled on site to allow for efficient verification of filter fabric properties by the Engineer. Filter fabric with defects, flaws, deterioration, or damage will be rejected.

| Filter Fabric Requirements | |
|---|---|
| **Property** | **Requirement (MARV)** |
| Elongation (MD & CD) >50% | >50% |
| Grab Strength (MD & CD) AASHTO M 288 | AASHTO M 288 Table 1 Class 1 |
| Tear Strength (MD & CD) | |
| Puncture Strength | |
| Permittivity | AASHTO M 288 Table 6 |
| Apparent Opening Size | |

| | |
|---|---|
| UV Stability (Retained Strength) | 15% to 50% in Situ Soil Passing 0.075 mm |

**Methods**

The Contractor shall install filter fabric in locations and to the widths and lengths as shown on the Plans, or as directed by the Engineer.

| BARNARDSVILLE IVY-DILLINGHAM CREEK RESTORATION CONSTRUCTION QUANTITIES | | | | | |
|---|---|---|---|---|---|
| **ITEM #** | **DESCRIPTION** | **QTY** | **UNIT** | **UNIT PRICE** | **TOTAL PRICE** |
| **SITE PREPARATION** | | | | | |
| 1 | MOBILIZATION | 1 | LS | | $ - |
| 2 | CONSTRUCTION SURVEY / GPS MODEL PREPARATION | 1 | LS | | $ - |
| **EROSION AND SEDIMENTATION CONTROL** | | | | | |
| 3 | CONSTRUCTION ENTRANCE | 2 | EA | | $ - |
| 4 | SILT FENCE | 680 | LF | | $ - |
| 5 | TEMPORARY IN-STREAM DIVERSIONS (WHEN WORKING IN ACTIVE CHANNEL) | 1 | LS | | $ - |
| 6 | EROSION CONTROL MATTING | 10,400 | SY | | $ - |
| 7 | TEMPORARY FORD CROSSING | 2 | EA | | $ - |
| **STREAM RESTORATION** | | | | | |
| 8 | EXCAVATION AND GRADING | 10,200 | CY | | $ - |
| 9 | DISPOSAL OF EXCESS EARTH ON-SITE | 3,100 | CY | | $ - |
| 10 | DISPOSAL OF EXCESS EARTH OFF-SITE | 7,100 | CY | | $ - |
| 11 | BOULDER J-HOOK | 2 | EA | | $ - |
| 12 | BOULDER CROSS VANE | 1 | EA | | $ - |
| 13 | BOULDER RIFFLE | 5 | EA | | $ - |
| 14 | BOULDER TOE PROTECTION | 235 | LF | | $ - |
| 15 | ROCK TOE PROTECTION | 105 | LF | | $ - |
| 16 | FLOODPLAIN SILL | 506 | LF | | $ - |
| 17 | ROCK-LINED SWALES - CLASS 2 | 280 | TN | | $ - |
| **WATER INTAKE SYSTEM** | | | | | |
| 18 | INSTALL 80 LF 8" SCHEDULE 40 PVC PIPE | 1 | LS | | $ - |
| 19 | PRECAST WET WELL WITH MANHOLE ACCESS | 1 | LS | | $ - |
| 20 | PUMP SCREEN | 2 | EA | | $ - |
| **VEGETATION** | | | | | |
| 21 | TEMPORARY SEED, MULCH AND SOIL PREP | 3.4 | AC | | $ - |
| 22 | PERMANENT SEEDING: ZONE 1 AND 2 - STREAMBANK AND FLOODPLAIN | 3.4 | AC | | $ - |
| 23 | WOODY PLANTINGS: ZONE 1 - STREAMBANK | 4,840 | EA | | $ - |
| 24 | WOODY PLANTINGS: ZONE 2 - FLOODPLAIN | 563 | EA | | $ - |
| **TOTAL** | | | | | |
| **25** | **CONSTRUCTION TOTAL** | **-** | **-** | **-** | **$ -** |