

SECTION 01551 – INVASIVE SPECIES CONTROL

PART 1 - GENERAL

1.1 Description of Work

- A. This work shall consist of activities to control or eradicate invasive vegetation within the project area prior to, during and following construction (pre- and post-construction maintenance) through the application of approved herbicides. Activities may include hand extraction or grubbing in combination with the herbicide application.
- B. All work shall be performed in accordance with this specification, the Contract Documents, and as directed by the Project Officer.
- C. Invasive vegetation control shall include plants on the Virginia Department of Conservation & Recreation (DCR) Division of Natural Heritage *Virginia Invasive Plant Species List* and any plants identified as invasive by the County's Invasive Plant Program (<https://www.arlingtonva.us/Government/Programs/Sustainability-and-Environment/Trees/Invasive-Plants>) or listed on the current *Non-Native Invasive Plants of Arlington County, Virginia Plant List* (<https://www.arlingtonva.us/files/sharedassets/public/Environment/Documents/Invasive-Plant-List-2-19-15.pdf>).
- D. Mapping
 - 1. Contractor performing the invasive plant removal should survey and map invasive species locations and provide treatment records so Arlington County can include this information in a GIS geo-data base. Surveys and maps shall be fully compatible with Arlington County's GIS System.
- E. Permits
 - 1. For control of invasive species, it is solely the Contractor's responsibility to obtain all necessary permits to use pesticides (the application must be performed by a Virginia certified pesticide applicator).
- F. All work must be approved by Arlington County Project officer.

PART 2 - PRODUCTS

2.1 Herbicides

- A. If treatment area is in or adjacent to water ways, all herbicides shall be EPA registered chemicals that are approved for use in or adjacent to waterways to control and prevent re-growth of

undesirable vegetation. The contractor shall receive Project Officer's approval of the herbicides proposed for use.

- B. The Contractor shall use triclopyr, glyphosphate, or imazapyr, using the concentrations, application methods and rates specified in the product labels appropriate to the size and quantity of invasive plants. The Project officer shall approve additional locations when needs are identified at the project site.
- C. The Contractor shall select herbicide appropriate to the species being managed and shall submit selection to the Project Officer for approval.
- D. The Contractor shall submit a written request for use of herbicides whose active ingredient is other than those listed above and receive written approval prior to use of such chemicals on the project.
- E. Manufacturer's specification sheets (labels and SDS) for herbicide, wetting agent, basal oil, and dyes shall be submitted to the Project Officer.
- F. A colorant shall be added to the herbicide in order to easily identify plants that have been treated.

PART 3 - EXECUTION

3.1 Herbicide Application

- A. Herbicide application is strictly regulated, and the Contractor must ensure that all regulations are followed. Application equipment, personal protective equipment and application rates of the herbicide shall be in conformance with manufacturer's recommendations as shown on the product label and in accordance with state pesticide application laws.

3.2 Control Guidelines

- A. Pre-Project Meeting: A pre-project meeting shall be scheduled prior to commencement of invasive plant control operations. Meeting shall include Arlington County Department of Parks Natural Resources Division staff.
- B. Qualifications: The Contractor shall employ at least one Botanist, Practical Botanist, Species Surveyor, Certified Arborist or Landscape Architect that is qualified to distinguish between beneficial native plant species and harmful invasive plants. Additional qualifications are as follows:
 - 1. One such Contractor professional shall directly supervise all work being performed.
 - 2. Any person working on this scope of work shall receive training that will minimize non-target damage.
 - 3. All field staff shall receive training that will minimize non-target damage.

4. All laborers shall receive basic safety instructions before beginning work at each site.
 5. The County reserves the right to conduct random tests of project staff and shall have the authority to direct the Contractor to remove certain staff from the project if, in the County's opinion, such staff is not qualified to do the work.
 6. The Contractor shall ensure that the herbicide applicator is certified by the Virginia Department of Agriculture and Consumer Services for Category 3 (Trees, shrubs, flowers outdoor, turf) and Category 5 (Aquatic) herbicide application.
 7. The Contractor shall submit qualifications of key personnel who will be performing and/or supervising work on site, including a copy of the herbicide applicators and the supervising commercial applicators license.
- C. Notification: The Contractor shall notify the Project Officer at least 48 hours prior to all herbicide applications.
- D. Flagging: The areas planned for treatment shall be clearly flagged in the field and reviewed by the Project Officer & Office of Sustainability and Environmental Protection prior to commencement of treatment activities. The Contractor shall be prepared to discuss invasive species control and native plant preservation methodologies during this field review.
- E. Timing of Herbicide Application: Herbicide application shall only be conducted during appropriate weather conditions as indicated on the product label. The herbicide shall not be applied when it is raining or if rain is forecasted within 24 hours of the planned application. The wind speed cannot be greater than 10 mph at the time of application.
- F. Application Method: Herbicide application shall be selective low volume treatments with a backpack sprayer, truck mounted spray rig with low volume pump and spray gun, squirt bottle, injection gun, paint brush or other methods, as approved by the Project Officer. Broadcast high volume applications will not be permitted. The herbicide shall be applied with approved spraying apparatus directly to the target plant. Extreme caution shall be used when spraying adjacent to off-target, non-invasive vegetation or directly adjacent to any waterways/wetlands. Overspray of herbicide onto non-target plants shall be avoided to the greatest extent possible. The Project Officer may require pruning prior to treatment or grubbing and treating of re-sprouts to minimize herbicide overspray and non-target damage. The Contractor shall be responsible for any act of negligence in applying and handling of the herbicide on the project.
- G. Pre-Construction Invasive Plant Eradication: Pre-construction invasive plant control shall occur outside the project's Limits of Disturbance (LOD) and shall extend 25 feet to all sides from the project's LOD unless otherwise identified in the contract documents or as directed by the Project Officer. The Contractor shall conduct a field walk of the project area to identify the location and density of the invasive plant species to be managed during pre-construction. Once the Contractor has identified these areas and approved the locations and methods to be used, they will manage the invasive plants as described below or as determined by the Project Officer.
1. Dense stands of invasive plants: Thoroughly wet all leaves with approved herbicides. Cut large stems and apply approved herbicides to cut surfaces immediately using spray bottle or paint brush.

2. Individual plants or small patches of invasive plants: Utilize spot treatment methods being sure to minimize overspray onto surrounding desirable plants. Cut large stems and apply these herbicides to cut surfaces immediately using spray bottle or paint brush.
 3. Targeted invasive tree removal in tree protection zones: Cut trees near ground and swab the stump surface using a spray bottle of paint brush with 3 to 5% solutions of glyphosphate in water using a surfactant. Cutting and treatment of trees within tree protection zones shall be done by hand only. There shall be no mechanical clearing of targeted trees within tree protection zones.
- H. Maintenance During Construction (prior to Substantial Completion): Inspect all areas within the Limits of Work (LOW) monthly from March to October. Undertake manual or chemical invasive species control as necessary to maintain the project areas prior to substantial project completion as determined by the Project Officer. Inspection and treatment within the control perimeter (defined as 25 feet to the outside of the LOD) shall also occur on an as needed basis to protect planted areas. Treatment of some species (e.g. English ivy) may be required by the Project Officer outside of the growing season.
- I. Post-Construction Invasive Plant Eradication: Post-construction management of invasive plants shall begin at the date of Substantial Completion or as designated in the provided task order. Post-construction treatment and control may include post-construction invasive plant management for projects constructed by others.
- J. Inspect all areas within the LOW (including the LOD and the control perimeter) monthly during the growing season (March to October). Identify and flag individual plants and areas dominated by invasive plants. Manually pull plants and treat the remnants left in the ground at the appropriate time of year to best control the target plant, between July 1st and October 1st for most species. Spot treat individual invasive plants being sure to minimize overspray onto surrounding desirable plants. Cut large stems and apply these herbicides to cut surfaces immediately using spray bottle or paint brush. Treatment of some species (e.g. English ivy) may be required by the Project Officer outside of the growing season.
- K. Herbicide Handling: The Contractor shall store, transport and handle the herbicide in accordance with the manufacturer's recommendations. Materials shall be stored in the original container at a secured location. Any spills or leaks must be cleaned up immediately.
- L. Mapping: Contractor shall provide survey and/or GPS services for locating and/or establishing property lines, RPA boundaries, specific areas to be treated, etc. All completed work shall be submitted to the Arlington County Project Officer in digital format.
1. Maps/data shall be fully compatible with Arlington County's GIS (Arc) System.
 2. Maps/data shall contain at a minimum: Delineations of treatment areas in polygon format with attribute data that includes the names of invasive plants treated, their density, chemicals used, percent of chemical used, treatment method, type of equipment used, weather conditions, and date of treatment.
- M. Site Cleanup: During the execution of invasive vegetation control measures, all areas shall be kept neat and clean and free of trash and debris. Final cleanup shall be the responsibility of the

Contractor and shall consist of the removal of flagging and the removal of all trash and materials incidental to the project to an approved off-site disposal location.

- N. Replacement of Native Plants Damaged: The Contractor shall be responsible for replacing and/or pruning of any native plant material that is killed or damaged through any act of negligence by the Contractor in applying and handling of the herbicide on the project.
- O. Final Inspection: The Contractor shall be responsible for correcting all deficiencies within seven (7) calendar days of inspection. The County's representative and the Contractor shall perform a final inspection and any corrective actions at the closeout of the contract.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Pre- and Post-construction Invasive Species Control

- A. Pre-construction invasive species control and post- construction invasive species control shall be measured and paid for per acre treated for Invasive Plant Control. Hand extraction prior to or following herbicide application will be considered part of the contract unit price. Payment includes labor, materials, including chemicals, transport and disposal as needed to perform the intended work.
- B. Invasive species control during construction shall not be paid separately in accordance with Section 329300 Exterior Plants, except that cut stump treatments or similar chemical applications following select tree removal shall be included in the unit price for Cut Stump Herbicide Treatment.

4.2 Selective Tree Removal

- A. Selective tree removal shall be measured and paid for at the unit price for tree removal according to the size of the tree removed. The unit price includes tree removal by machine as well as select tree removal by hand. All work may include hand extraction which will be considered incidental to the unit price. This work will only be undertaken as approved or directed by the Project Officer, and price and payment will constitute full compensation for furnishing all materials, labor, tools, equipment, and incidentals necessary to complete the work, dispose offsite and clean up the area except that if cut stump herbicide treatment is provided this unit price shall also be paid.

- 4.3 Selective Cut Stump or Girdle Herbicide Treatment A. Cut stump or Girdle herbicide treatment may be required in conjunction with selective tree removal. This work will only be undertaken as approved or directed by the County and shall be paid at each unit price. Price and payment will constitute full compensation for furnishing all chemicals, materials, labor, tools, equipment, and incidentals necessary to complete the work.

END OF SECTION 02550

SECTION 02211 - GABIONS

PART 1 - GENERAL

1.1 1.1 Description of Work

- A. Provide all labor, material and equipment to perform all work pertaining to the fabrication, construction, and installation of gabions in accordance with these specifications and the lines, grades and dimensions shown on the approved plans.

1.2 Related Work Specified Elsewhere

- A. Section 02200 - Earthwork

1.3 Applicable Specifications

- A. Virginia Department of Transportation, Road and Bridge Specifications (VDOT)

PART 2 - PRODUCTS

2.1 Gabion Units

- A. Wire mesh used to form gabion baskets shall conform to Section 228 of the VDOT Specifications. Mesh edge wire and selvedge reinforcing wire shall be not less than 0.150 inch (9 gauge) and lacing/tie wire for binding gabion units together, not less than 0.087 inch for galvanized gabion units. When PVC coated gabions are specified on the plans, minimum edge wire and selvedge wire shall be 0.132 inch and lace wire 0.087 inch.

2.2 Stone

- A. Stone shall conform to Section 204.02 of the VDOT Specifications.

2.3 Filter Material

- A. Filter material shall conform to Section 245 of the VDOT Specifications.

PART 3 - EXECUTION

- 3.1 Excavation for gabions shall be performed in accordance with Section 02200. Gabions shall be placed on a smooth foundation. Final line and grade shall be approved by the Project Officer.
- 3.2 The assembly, placement and filling of the gabion units shall be as specified in Section 610.03 of VDOT Specifications.

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Gabion structures shall be measured in cubic yards based on the nominal dimensions of the baskets (Gabion units) placed. Payment shall be at the unit price stated in the Bid Proposal and shall include demolition, slope preparation, excavation, erosion and sediment control, filter material, backfill and restoration where required, and all other work necessary for a complete installation in place.

END OF SECTION 02211

SECTION 02215 - IMPORTED STREAM BED MATERIAL

PART 1 - GENERAL

1.1 Description of the Work

This item consists of cobble-gravel-sand material for pool and riffle stream bed from an approved off-site source and installing it as bedding along the proposed stream bed. Salvage material from the existing stream bed may be used to supplement imported material provided its gradation is consistent with this specific section and it is approved by the Project Officer.

The work consists of installing the imported pool and riffle and stream bed material with the imported / salvaged stone in the channel as indicated on the Contract Drawings.

1.2 Related Work Specified Elsewhere

- A. Section 01500- Temporary Sediment and Erosion Control
- B. Section 02100- Clearing and Grubbing
- C. Section 02200- Earthwork
- D. Section 02520 – Update title of 2520

1.3 Applicable Standards and Specifications

- A. Erosion and Sediment Control (Chapter 57 of the Arlington County Code)
- B. Virginia Erosion and Sediment Control Handbook
- C. Arlington County Planning and Field Guide for Erosion and Sediment Control
- D. Arlington County Planning & Field Guide for Pollution Prevention (P2)
- E. Arlington County Department of Parks and Recreation Design Standards

1.4 Submittals

- A. The Contractor shall obtain a written statement from the supplier certifying that the imported stream bed material to be furnished and delivered to the construction site meets the requirements for gradation and source as stipulated in this specification.

- B. The source or sources of proposed imported material shall be submitted to the Project Officer a minimum of 10 working days prior to delivery to the construction site. The Contractor and Project Officer will visit the source(s) concurrently to ensure that the proposed bedding materials meets the specification requirement. A site visit may be waived by the Project Officer when the material will come from a source that has been approved in the past.

PART 2 - PRODUCTS

- 2.1 Nature and Gradation of Bedding Material may vary based on site specific conditions but shall generally meet the following:

- A. Imported pool material shall meet the following size distribution.

	Min	Max	Min	Max
	(mm)	(mm)	(inches)	(inches)
D16	13	25	0.512	0.984
D35	38	76	1.5	3.0
D50	89	140	3.5	5.5
D84	203	305	8.0	12.0
D95	381	508	15.0	20.0

- B. Imported riffle material shall meet the following size distribution.

	Min	Max	Min	Max
	(mm)	(mm)	(inches)	(inches)
D16	0.04	0.08	0.002	0.003
D35	30	60	1.2	2.4
D50	130	190	5.1	7.5
D65	240	310	9.4	12.2
D84	380	440	15.0	17.3
D95	460	520	18.1	20.5

2.2 Salvaged existing stream bed material may be used for the proposed pool stream bed reaches as long as the salvage material is within the gradation envelop.

2.3 Material Composition

A. Imported material composition may vary based on site specific conditions but shall generally meet the following size distribution:

Material Composition

Material	Size	Quantity (Volume)	Percent
Topsoil	Loam or silt load with 3-5% organic content	0.5 bucket	12 - 17%
Course Sand	0.04 - 0.08" (1 - 2 mm)	0.5 bucket	12 - 17%
Bank Run Gravel	0.08 - 2.5" (2 - 64 mm)	1 bucket	20 - 30%
Rock/Cobble	Class I Riprap (8-12" Dia)	2 buckets	45 - 50%

The above material table is for general information only and may vary in product name and size depending on availability and supplier. Contractor should provide the supplier with the material size distribution matrix so the supplier may evaluate what combination of currently available products will meet the specified distribution.

PART 3 - EXECUTION

3.1 Placement of Bedding Material

A. Pools shall be constructed according to the Contract Drawings, or as directed by the Project Officer in the field.

1. Stream bed material shall be excavated from the existing stream bed and stockpiled for placement within the proposed excavated stream channel if requirements are met per paragraph 2.2.
2. Excavate the stream bed in the pool / riffle sections.
3. No stream bed material shall be placed until foundation preparation for instream structures is completed and the foundation and excavations have been inspected and approved by the Project Officer.
4. The stream bed material shall be placed and spread uniformly and neatly in one horizontal layer on the prepared sub-grade surfaces to a depth of 18 inches as indicated in the Contract Drawings.

5. The stream bed material layer shall be compacted by at least 4 passes, over the entire surface, of the track of a crawler-type tractor weighing not less than 8 tons or an equivalent method approved by the Project Officer

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Imported Stream Bed material shall be paid per ton of material imported / transported to the site and installed as accepted by the Project Officer. Such price and payment shall be full compensation for the items of work, including the cost for furnishing all materials, labor, equipment, tools, and incidentals required by Parts 2 and 3 above and complete in place. There shall be no payment for stream bed material salvaged and used on site.

END OF SECTION 02215

SECTION 02216 - ON-SITE LARGE WOODY DEBRIS AND LOG STRUCTURES**PART 1 - GENERAL**

1.1 This work shall consist of using woody material such as log structures and branches along stream toes, bed and banks for the purpose of stabilizing stream and provide habitat for aquatic species by reducing width-depth ratio, reducing erosion, deflecting flows and trapping sediment. This work shall include:

- A. Instream Buried Log sill
- B. Floodplain Log Sill
- C. Root Wads
- D. Log Vanes
- E. Cedar Tree Revetments
- F. Live Crib Wall
- G. Brush Mattress
- H. Log Drops
- I. Natural Fiber rolls
- J. Live Fascines

The Large woody debris and log structures shall be furnished and installed on stream banks and other areas as applicable to the Contract Drawings.

PART 2 - PRODUCTS**2.1 Logs**

- A. Single logs designated for removal in the approved Contract Drawings and/or harvested from within the approved limits of disturbance with the authorization of the Urban Forester, if possible. Other sources must be approved by the Project Officer prior to use. Typically, species are native to the area, free from disease and preferably hard wood. Logs should be 12+ inches in diameter and shall be rot resistant.
- B. Logs shall be harvested as close to time of installation as possible before they become desiccated and prone to breaking.
- C.

2.2 Soil Stabilization Matting

- A. Shall be bristle coir fiber matting consisting of machine twisted twines and be 100 percent biodegradable. Soil Stabilization Matting shall be resistant to the tractive forces of the stream channel during high flow events. Soil Stabilization Matting which uses plastics, metals or other man-made materials in the construction of the material will not be permitted. Apparent opening size shall be sufficient to foster the sprouting of stabilization/restoration seed.

2.3 Stakes

- A. Stakes shall be 100% biodegradable material and shall be designed to safely and effectively secure erosion control blankets, coir logs, fascines and other bioengineered structures for temporary or permanent applications.

2.4 Foundation Logs, Cantilevered Logs and Brushes

- A. Shall be harvested from the project site within the approved limits of disturbance if possible. Other sources must be approved prior to use. Tree varieties with higher specific gravities will be most favorable for use. Diameters and lengths of the logs will be based on site conditions and availability.

2.5 Root Wad or Root Ball

- A. Lower portion of a preferably rot-resistant tree species consisting of a root fan and a trunk. The root fan shall have a diameter roughly equal to the vertical distance from the design scour depth to the Channel Forming Discharge (Qcf) elevation. Root fans shall have relatively few broken branches and be securely attached to the trunk. Trunks shall be relatively straight and free of breaks, and splits. Trunks shall be long enough so that 3/4 of their length is securely embedded in the bank at maximum scour. A minimum length of 10 feet and a maximum length of 20 feet are recommended. Trunks should have a minimum diameter of 12 inches.

2.6 Anchors

- A. 1/4 inch minimum rebar or drift pin for anchoring and connecting logs. Length should be 18" at a minimum.

2.7 Support Piling

3 inches to 6-inch diameter logs with one angled and one flat end. Long enough to extend from the normal baseflow elevation to a minimum of one foot below the design scour depth.

2.8 Natural Fiber roll

- A. Natural fiber logs composed of biodegradable materials such as coir fiber are commercially available in 16 or 18-inch diameter rolls.
- 2.9 Live Fascines
- A. Commercially supplied or field harvested Live Branches with diameters varying between ½ to 2 inches and 5 to 10 feet length, with relatively straight branches with no visible signs of disease, damage, or deformity.
- 2.10 Cedar Tree Revetment
- A. Revetment Tree: Tree should have numerous limbs and fine branches. Tree species other than cedar can be used if they are resistant to decay and have a similar growth form.
 - B. Anchors, clamps and Cable: Anchors should be Duckbill, arrowhead, disc, or fencepost anchors per manufacturers' specifications made of a rust resistant metal material. Anchors should be sized to resist 1200 pound pullout force at a minimum. Clamps should be rust resistant saddle clamps and cables should be 3/16 inch aircraft cable or equivalent

PART 3 - EXECUTION

- 3.1 Construction Recommendation
- A. The construction details in the Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004) shall be used as a general guide. When modified versions of the construction details for the On-Site Large Woody Debris and Log Structures are shown on construction plans, they shall supersede the ones in the general guide. The Project Officer can require field modifications as needed.
 - B. Flow from the stream should be diverted away from the work area in accordance with the approved Erosion and Sediment Control Plan and the site should be dewatered.
 - C. Log Vanes should be angled 20 to 30 degrees from the upstream bank. Log Vane arms should be installed with a vertical angle along the vane arm ranging from two to seven percent. Log Vanes should span approximately one-half to two-thirds of the bank full channel width.
 - D. Excavate the trench and prepare area along streambank and in streambed for placement of footer rocks. Footer rocks should be installed at both the streambank and thalweg locations to insure proper footing of the Log Vane structure and to eliminate scour at key tie-in locations.
 - E. Place log onto footer rocks such that the Log Vane arm that ties into the streambank will be installed at the bank full elevation and the other end of the Log Vane arm will be embedded into the streambed at the thalweg elevation and will be located within the middle third of the bank full channel width.
 - F. Anchor rocks / stabilizing boulder should be installed on top of both ends of the Log Vane. Anchor stones in the streambed will be offset to the upstream side of the Log Vane and

placed to minimize rolling of anchor stone and will not protrude from the streambed elevation more than one-third the thickness of the anchor rock. Anchor rocks will be placed along the streambank position of the Log Vane arm in similar fashion and will not extend more than one-third the thickness of the anchor rock.

- G. The Log Vane arm that ties into the streambank should extend a minimum of 5 to 6 feet into the streambank. Additionally, the thalweg end of the structure should be embedded a minimum of 2 to 3 feet. When two or more smaller logs are used to accomplish the design specifications of the Log Vane, the logs should be secured together with cables or rebar material based upon manufacturing specifications. Log Vanes should be anchored into the streambed with support pilings and/or duckbill anchors with lengths exceeding the potential of long-term bed degradation and/or scour depths.
- H. Each log in the structure should be anchored at both ends at a point on the trunk near the toe of the streambank. A post-driver (manual or electric) is required to set the anchors.
- I. Placement of salvaged streambed material obtained during trench excavation will be placed along the upstream side of the Log Vane arm and between the streambank to create a uniform slope between the Log Vane arm and the streambank. At a minimum, streambed gravel will be placed to the elevation of the sloping Log Vane arm on the upstream side of Log Vane.
- J. Soil Stabilization Matting will be installed along the streambanks in the area of disturbance and should be seeded, mulched, and planted with approved landscaping.
- K. Remove approved VESCHB devices upon stabilization of the channel.
- L. Ensure no leakage/flow under or around the structure by properly grading, sealing, and compacting under and around the structure.
- M. After installation, the Project Officer shall check proper function/flow path by observing flow over structure. Repair as needed to ensure proper function
- N. Project Officer shall inspect logs and anchors before they are placed. It is important that properly sized logs and anchors be installed to protect against structural failure.

3.2 Installation Guidelines

- A. Using a tractor or similar equipment, stage logs and all other woody debris structures listed in part 1 above on top of the streambank.
- B. Starting at a stable area of the streambank downstream from the eroded areas, place the tree along the toe of the eroded streambank, with the top end pointed downstream.
- C. Attach cable to the anchor and drive anchor into the streambank a minimum of 5 feet using a post driver. Drive an anchor and cable at the trunk end and the top end of the tree.
- D. Secure the top end firmly against the toe of the bank and pull cable tight using tractor or equivalent. Tighten clamp.

- E. Move next tree into place so it overlaps the butt end with the first tree. Overlap the second tree on top of the first tree so that there are no gaps between them. Use the cable placed into the bank at the butt of the first tree to secure the top end of the second tree, thereby securing both trees. Tighten and clamp as described above.
- E. Drive an anchor and cable into the streambank for securing the butt of the second tree and the top end of the third tree.
- F. Repeat the above steps for all additional trees until a stable area of streambank upstream of the eroding bank is reached.
- G. Root wad: Either drive the root wad into the bank with track hoe or trench it into the bank. If driving the root wad into the bank, sharpen the trunk end to a point.
- H. Large boulders are placed on the top and sides of the footer log and root wad to hold them in place. Boulders can be placed as an even course across the whole bench or in strategic locations on the front and back ends of the footer log. Boulders placed in between root wads limits lateral movement.
- I. Header or cut-off logs meeting the same specifications as footer logs can be placed on top of the root wads from the front of one root wad to the front of the adjacent root wad or from front to back for added stability.

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Log Structures (Instream buried log sill, floodplain log sill, Log vanes, Cedar Tree Revetment) shall be measured in linear feet / diameter of wood log or bundle / source (onsite or offsite). Payment shall include the complete in-place installation of the item of work, including the cost for furnishing all materials, binding, and bundling cables, anchors and rebar, labor, equipment, incidentals, transportation to site, storage, and preparation.
- 4.2 Root wads and log drops shall be measured as each. Payment shall include the complete in-place installation of the item of work, including the cost for furnishing all materials, binding, and bundling cables, anchors and rebar, labor, equipment, incidentals, transportation to site, storage, and preparation.
- 4.3 Natural Fiber Rolls and Live Fascines shall be measured in lineal feet. Payment shall include the complete in-place installation of the item of work, including the cost for furnishing all materials, binding, and bundling cables, anchors and rebar, labor, equipment, incidentals, transportation to site, storage, preparation.
- 4.4 Brush mattress, Live Soil Lifts and Live Crib walls shall be measured in square feet of the front face of the structures. Payment shall include all work and materials necessary for the complete in-place installation as described in the Construction Documents and Details.
- 4.5 Such payment as indicated in 4.1 through 4.4 shall be considered full compensation for the item of work, including the cost for furnishing all materials, binding, and bundling cables, stone, anchors and rebar, labor, equipment, incidentals, transportation to site, storage, preparation.

END OF SECTION 02216

SECTION 02217 – ROCK VANE STRUCTURES

PART 1 - GENERAL

1.1 Description of Work

- A. This work consists of constructing in-stream structures constructed for the purpose of reducing shear stress on streambanks, flow deflection, grade control for the streambed as well as to promote pool development. Vanes shall be constructed at the location and in accordance with the details provided in the Contract Drawings and following specification. The work shall include Cross Vanes, J-Hooks, A-Hooks, and W-Hooks and shall consist of both Footer Rocks, placed below the invert of the proposed channel, as well as Vane Rocks.

1.2 Related Work Specified Elsewhere

- A. Section 01500 - Temporary Sediment and Erosion Control
- B. Section 02100 - Clearing and Grubbing
- C. Section 02200 – Earthwork
- D. Section 02211 - Gabions
- E. Section 02215 – Imported Stream Bed Material
- F. Section 02218 – Rock Step Pool Structures
- G. Section 02219 – Imbricated Stone wall and revetment
- H. Section 02520 – Temporary Maintenance of Stream Flow

1.3 Applicable Standards and Specification

- A. Erosion and Sediment Control (Chapter 57 of the Arlington County Code)
- B. Virginia Erosion and Sediment Control Handbook
- C. Arlington County Planning and Field Guide for Erosion and Sediment Control
- D. Arlington County Planning & Field Guide for Pollution Prevention (P2)
- E. Arlington County Department of Parks and Recreation Design Standards
- F. Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004)

PART 2 - PRODUCTS

2.1 Stones

- A. Stones should be angular, rectangular, and blocky in shape such that they are stackable and should be of sufficient size to resist displacement by the site-specific design storm event. The length of the longest axis of each stone should be the greater of 1/3 the height of the proposed wall and the size necessary to resist the
- B. shear stresses of the design storm event. Boulder stones shall be properly sized to resist the tractive forces utilizing empirical relationships for shear stress for the anticipated design storm event.
1. Individual Rock Boulder shall be block-like in shape and meet the minimum/maximum size requirements specified in the Construction Drawings. Rock Boulder color shall blend with the existing streambed material. Green/Gray, brown/gray, dark gray, and/or deep brown shall be acceptable. White Rock is not acceptable. All Rock shall be free from laminations, weak cleavages and will not disintegrate from the action of air, water and in handling and placing. Granular sedimentary stone will be unacceptable.
 2. Rock Boulders shall have a minimum Bulk Specific Gravity of 2.65 and an Absorption of not more than two (2) percent in accordance with ASTM Method C 127. The test for soundness shall be performed in accordance with ASTM Method C 88 for coarse aggregate and shall yield the following results: weight loss in five (5) cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.
 3. Stone/Rock and Gravel shall conform to the following requirements:
 - i. Boulders for vanes shall be imported boulders / imbricated riprap.
 - j. Top Vane Rocks that form the finished grade consist of rocks placed upon footer rocks and shall not be larger than footer rocks.
 - k. Top rocks consist of rocks placed upon Footer Rocks. Dimensions of Top Rocks shall have the following dimensions: 3 – 5’ length, 2.5’ – 3.5’ width, and 1.5’ – 2’ depth. Top Rocks shall not be larger than Footer Rocks.
 - l. Rock dimensions shall fall within the dimensions shown in the Construction Details as follows: 3-6’ length, 2.5-4’ width, and 1.5’-2.5’ depth. Of the rock supply, the larger rocks shall be used for Footer Rocks with the following dimensions: 4-6’ length, 3-4’ width, and 1.5-2.5’ depth.
 - m. Poorly Graded Gravel – Gravel for backfilling and “choking” shall be a poorly graded gravel mix consisting of river run sand, and gravel-cobble material that meets the gradation requirements indicated in the Imported Riffle Streambed Material Gradation Table. The source of gravel material and samples shall be provided to the Engineer for review and approval prior to commencing construction operations. Installation shall be in accordance with these specifications and as directed by the Engineer.
 - n. All filter fabric installed as part of the Rock vane Structure shall be a non-woven fabric (MIRAFI 180N 8 oz. or approved equal).
 - o. Sill rocks are the bottom stones that also extend into the banks. Sills extend into the bank where the highest rock meets the streambank. The purpose of the sill is to prevent water from cutting around the boulders next to the bank during high flow. Sill rock shall be placed in close rock to rock contact with no space between

adjoining rocks. The elevation of the sill shall be as determined on the plan drawings, specifications, construction notes or as determined on-site by the Project Officer.

2.2 Footer Rocks

- A. Footer rocks shall be large enough to achieve the desired height when installed in the stream and shall be sized to resist movement from velocities and shear stresses for the design storm event. Footer rock shall also be blocky, flat, and typically 1.5 times longer than the intermediate axis.
- B. Footer rocks consist of rocks placed below the invert of the proposed channel to provide support for the Vane Rocks and prevent excessive downstream scour. The footer rock size shall meet the following dimensions: 2-3' length, 1.5-2.5' width, and 1.0-2.0' depth.

2.3 Rock Vane

- A. The rock vane shall be constructed of angular, flat, or cubed rock. Individual rock fragments shall be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. The dry weight density of each rock shall be 160 pounds per cubic foot or greater. No concrete, man-made rocks, or soft rocks shall be used for the construction of the in-stream structures.

2.4 Source of Materials

- A. Prior to execution of the contract, the Contractor will locate potential sources of rock. The Contractor and the project officer will jointly visit the site(s) to determine whether the rock meets the requirements as set forth in these specifications. A site visit may be waived by the Project Officer when rock will come from a source that has been approved in the past.

PART 3 - EXECUTION

3.1 Construction Method

- A. The construction details in the Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004) shall be used as a general guide. The Project Officer can require modifications as needed
- B. All vane structures shall be constructed according to the Cross, J-Hook, A-Hook, W-Hook Detail shown on the Contract Drawings or as directed by the Project Officer. The elevation tolerance for the vane structures will be +/-0.1ft of design elevations. Footer rocks used in in-stream structures shall extend inward toward the center of the channel, past the header rocks.

- C. A trench shall be excavated for the structure. The excavation width shall be at least one foot wider than the structure. After the footer rocks are placed in the trench, the trench shall be backfilled to the proposed invert with the specified gravel mix.
- D. A minimum of 6-inches of topsoil as specified under Item 2.3 – 2.5 of section 329100, shall be placed along the top of the bank behind the top header rock.
- E. Flow of the stream should be diverted away from the work area in accordance with the approved VESCH and the site should be dewatered.
- F. Vanes shall be constructed so that adjoining rocks taper in an upstream direction, from the bank full elevation to the stream invert. The upstream (lower) end of the vanes is set at an angle of 20°-30° tangent to the curve.
- G. The downstream end of the vane shall be keyed into the streambank at the bank full elevation. The vane shall be keyed a minimum of eight feet (8') into the streambank. The upstream end of vane shall be keyed into the streambed at the invert elevation. The vane shall be installed with a slope of 4% to 7% from the streambed invert to the bank full elevation.
- H. The Vanes shall be completed by the placement of a cross channel sill at the design invert of the streambed. Cross channel rocks shall be properly secured behind Footer Rocks and shall be placed so that the sill rocks are i level across the channel. Vane Rocks shall be placed in a linear fashion so as to produce the sloping Cross vane, and shall be placed with tight, continuous surface contact between adjoining rock. Rock shall be placed so as to have no significant gap between adjoining rock.
- I. Vane Rock shall be placed so as to have a final smooth surface along the top plane of the Cross vane. No vane rock shall protrude higher than the other rock in the rock vane. A completed Cross vane has a smooth, continuous finish grade from the bank full elevation to the streambed.
- J. As the Cross vane is constructed, the Contractor shall chink all voids between the footer rocks, and between the footer rocks and vane rocks. Voids shall be chinked with small boulders, cobble, or rock fragments. Chinking will be conducted such that no voids greater than four inches (4") in size will be present.
- K. No significant voids shall exist between adjoining footer and top rock of other instream structures. In order to prevent piping of water through structure rocks, the contractor shall chink by hand or equipment all undesirable voids with smaller rocks such as any existing streambed material or specified substrate.
- L. Upon completion of the vane, the Contractor shall place stabilizing vegetation as shown in the Vegetation Plan and Specifications.
- M. Placement of Footer Rocks is critical to the success of vanes. To ensure proper placement, the Contractor shall provide a portable pump to dewater excessive ground water from the excavation. All footer rock placement shall be conducted in a dry excavation.

- N. Excavate the trench for footer rocks to the elevation and grades necessary for placement of both footer and wall rock so that the desired elevation of the structure meets the lines and grades of the structure schedule and in accordance with the rock vane detail.
- O. Excavate vane feature and place salvaged streambed material from pool area for placement along vane structures in approved area for use in future construction sequence.
- P. Place footer rocks in excavated trench with adjacent rocks abutting each other. Footer rocks should be placed neatly so that the top rocks can rest securely on two-footer stones. Smaller stones should be used to fill void spaces so that each rock rests solidly on the previous rock with minimal opportunity for movement.

3.2 General Construction Notes

- A. Flow of the stream should be diverted away from the work area in accordance with the approved VESCH and the site should be dewatered.
- B. Footer rocks shall be placed individually and keyed into the channel, bed, stream bank as shown in the detail.
- C. Vane rocks shall be placed on footer rocks in an upstream offset direction such that less than one-half the footer rock is exposed. Vane structures rocks should be placed such that the center of the top rock is set atop the seam of the two lower footer rocks. All rock vane footer rocks should touch adjacent rocks to form a tight fit. No gaps or voids shall exist between footer and top rocks.
- D.
- E. Remove approved Erosion and Sediment Control devices upon stabilization of the channel in accordance with the approved plan and stabilize disturbed area with seed, mulch, and stabilization fabric.

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Rock vane Structures (Cross Vanes, J-Hooks, A-Hooks, and W-Hooks and shall consist of both Footer Rocks, placed below the invert of the proposed channel, as well as Vane Rocks) shall be paid per ton of material installed and accepted by the Project Officer. Such price and payment shall be full compensation for the items of work, including the cost for furnishing all materials, labor, equipment, tools, transportation to project site and incidentals such as filter fabric, poorly graded gravel and VDOT stones as specified in the construction documents and all other products associated with the installation of rock vanes as required by Part 2 and 3 above.

END OF SECTION 02217

SECTION 02218 - ROCK STEP POOL STRUCTURES

PART 1 - GENERAL

1.1 Description of Work

This work consists of constructing Rock Step Pool Structures. Rock Step Pool Structures are in-stream flow structures primarily used for grade control, reducing near bank shear stresses, and providing habitat at locations designated on the Contract Drawings to diversify the low flow path. The rock structures extend across the entire streambed and tie into both banks. Pools are excavated below the rock structures, and the streambed upstream and downstream of the rocks are lined with imported riffle bed material.

1.2 Related work specified elsewhere

- A. Section 01500 - Temporary Sediment and Erosion Control
- B. Section 02100 - Clearing and Grubbing
- C. Section 02200 - Earthwork
- D. Section 02215 – Imported Stream Bed Material
- E. Section 02217 - Rock Vane Structures
- F. Section 02520 – Temporary Maintenance of Stream Flow

1.2 Applicable Standards and Specifications

- A. Erosion and Sediment Control (Chapter 57 of the Arlington County Code)
- B. Virginia Erosion and Sediment Control Handbook
- C. Arlington County Planning and Field Guide for Erosion and Sediment Control
- D. Arlington County Planning & Field Guide for Pollution Prevention (P2)
- E. Arlington County Department of Parks and Recreation Design Standards
- F. Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004)

PART 2 - PRODUCTS

2.1 Rock Quality

- A. Rock shall be natural looking, rectangular, and blocky in shape such that they are easily stackable and shall be of sufficient size to resist displacement by the site-specific design storm event. Step structures can be constructed of boulders, natural bed rock outcrops that can be incorporated in to the profile and aligned across the channel to create the “step feature.
- B. Rock Boulder color shall blend with the existing streambed material. Green/Gray, brown/gray, dark gray, and/or dark brown shall be acceptable. White Rock is not acceptable. All Rock shall be free from laminations, weak cleavages and will not disintegrate from the action of air, water and in handling and placing. Granular sedimentary stone will generally be unacceptable.
- C. Rock Boulders shall have a minimum Bulk Specific Gravity of 2.65 and an Absorption of not more than two (2) percent in accordance with ASTM Method C 127. The test for soundness shall be performed in accordance with ASTM Method C 88 for coarse aggregate and shall yield the following results: weight loss in five (5) cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.
- D. Stone/Rock and Gravel shall conform to the following requirements:
 - 1. Boulders for rock step pools shall be imported imbricated stone.
 - 2. Footer rocks consist of rocks placed below the invert of the proposed channel to provide support for the wall Rocks and prevent excessive downstream scour. The footer rock size shall meet the following dimensions: 2-3’ length, 1.5-2.5’ width, and 1.0-2.0’ depth.
 - 3. Top step pool Rocks that form the finished grade consist of rocks placed upon footer rocks and shall not be larger than footer rocks.
 - 4. Top rocks consist of rocks placed upon Footer Rocks. Dimensions of Top Rocks shall have the following dimensions: 2 – 3 ’ length, 1.5’ – 2.5’ width, and 1.0’ – 2’ depth. Top Rocks shall not be larger than Footer Rocks.
 - 5. Rock dimensions shall fall within the dimensions shown in the Construction Details and at a minimum follows: 2-3’ length, 1.5-2.5’ width, and 1.0’-2.0’ depth. Of the rock supply, the larger rocks shall be used for Footer Rocks Poorly Graded Gravel – Gravel for backfilling and “choking” shall be a poorly graded gravel mix consisting of river run sand, and gravel-cobble material that meets the gradation requirements indicated in the Imported Riffle Streambed Material Gradation Table. The source of gravel material and samples shall be provided to the Engineer for review and approval prior

to commencing construction operations. Installation shall be in accordance with these specifications and as directed by the Engineer.

- E. Footer Rocks
 - 1. Footer rocks consist of rocks placed below the invert of the proposed channel to provide support for the step pool Rocks and prevent excessive downstream scour. The footer rock size shall meet the following dimensions: 2-3' length, 1.5-2.5' width, and 1.0-2.0' depth.
 - 2. Footer rocks shall be large enough to achieve the desired height when installed in the stream and shall be sized to resist movement from velocities and shear stresses for the design storm event. Footer rocks shall also be blocky, flat, and typically 1.5 times longer than the intermediate axis.
- F. Filter Fabric and Erosion control matting
 - 1. All filter fabric installed as part of the Rock Step Pool Structure shall be a non-woven fabric (MIRAFI 180N 8 oz. or approved equal). Geotextile filter fabric shall be in accordance with Section 245 of the VDOT Specifications.
 - 2. Erosion control matting shall follow Virginia Erosion and Sediment Control Handbook (VESCH) Standard and specs 3.36 – Soil Stabilization Blanket and matting.

PART 3 - EXECUTION

- 3.1 Construction method
 - A. The construction details in the Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004) shall be used as a general guide. The Project Officer can require modifications as needed.
 - B. Rock Step Pool Structures shall be constructed according to the Rock Step Pool Structure Detail shown on the Contract Drawings or as directed by the Project Officer. The elevation tolerance for in-stream structures will be +/-0.1ft of design elevations. Footer rocks used in in-stream structures shall extend inward toward the center of the channel, past the header rocks so that the footers act as a splash rock.
 - C. The Step-Pool structures shall be constructed as detailed in the construction plans and are usually installed perpendicular to the stream flow and following an arch shape when stream geometry allows. A trench shall be excavated for the structure. The width of excavation in the direction of flow shall be a minimum of one foot wider than the structure. After the footer rocks are placed in the downstream edge of the trench, the trench shall be backfilled to the proposed invert with the specified gravel mix in accordance with section 02215 – Imported Stream Bed Material.
 - D. Top rocks shall be placed so that they lean on the footer rocks and fit snugly together in a puzzle-like fashion. Care should be taken when placing top rocks that the seams between top rocks do not line up with the seams between the footer rocks. The top elevation of the rocks placed at the thalweg (deepest portion of the stream) shall be

equal to the elevation of the thalweg plus 0.1 to 0.2 tenths of a foot. Starting at the thalweg, adjacent rocks shall taper up (approximately 5 to 10 percent slope) to the end top rock, which shall be placed at the "bank full" elevation.

- E. The outermost top rock of the Step-Pool structure shall be installed with one half (1/2) the diameter of the end top rock buried into the stream bank.
- F. Place footer rocks in excavated trench with adjacent rocks abutting each other. Footer rocks should be placed neatly so that the top rocks can rest securely on two-footer stones. Smaller stones should be used to fill void spaces so that each rock rests solidly on the previous rock with minimal opportunity for movement.
- G. Footer rocks shall be placed individually and keyed into the channel, bed, stream bank as shown in the detail. The top surface of the step pool rocks, and throat shall be placed to create a relatively uniform surface along the top plane of the rock step pool structure from the tie-in elevation along the stream bank to the tie-in elevation at the streambed invert elevations. The top rocks of these structures shall be placed linearly, with tight and contiguous surface contact with adjacent rock.
- H. Excavate the trench for footer rocks to the elevation and grades necessary for placement of both footer and step pool arm and "step" or cascade rock so that the desired elevation of the structure meets the lines and grades of the structure schedule and in accordance with the Rock Step Pool Detail.
- I. Excavate pool feature and place salvaged streambed material from pool area for placement along step pool structures in approved area for use in future construction sequence.
- J. Step Pool rocks shall be placed on footer rocks in an upstream offset direction such that less than one-half the footer rock is exposed. Step Pool rocks should be placed such that the center of the top rock is set atop the seam of the two lower footer rocks. All Step Pool and Footer rocks should be touching adjacent rocks to form a tight fit. No gaps or voids shall exist between footer and top rocks.
- K. Stabilize disturbed area with seed, mulch, and soil stabilization matting and plant in accordance with the approved landscape planting plan.
- L. Geotechnical Filter Fabric shall be keyed in between the top rock on the bank and the rock immediately below it, then folded behind and overtop the top step pool rock. Reshape the slopes to specified elevations and fold the filter fabric over the face of the slope. Key the filter fabric back into the bank a minimum of one foot deep at the top of bank.

3.2. General Construction Notes

- A. Flow of the stream should be diverted away from the work area in accordance with the approved VESCH and the site should be dewatered.

- B. Step Pool features will tie into the bank full elevation at the streambank. Upon completion of the Step Pool feature, vane arms will be keyed into the streambank a minimum of 5.0 ft, unless otherwise directed.
- C. Remove approved VESCH devices upon stabilization of the channel in accordance with the approved plan and stabilize disturbed area with seed, mulch, and stabilization fabric.
- D. The step pools shall be constructed of angular, flat, or cubed rock. Individual rock fragments shall be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. The dry weight density of each rock shall be 160 pounds per cubic foot or greater. No concrete, man-made rocks, or soft rocks shall be used for the construction of the in-stream structures.
- E. No significant voids shall exist between adjoining footer and top rock in vane arms and/or throat section of structure. In order to prevent piping of water through structure rocks, the contractor shall chink by hand or equipment all undesirable voids with smaller rocks such as any existing streambed material or specified substrate.

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Rock Step Pool Structures shall be paid per ton of material installed and accepted by the Project Officer. Such price and payment shall be full compensation for the items of work, including the cost for furnishing all materials, including filter fabric, poorly graded gravel, and VDOT stone sizes called out in the plan, labor, equipment, tools, transportation to project site and incidentals required by Part 2 and 3 above.

END OF SECTION 02218

SECTION 02219 – IMBRICATED STONE WALL AND REVETMENT

PART 1 - GENERAL

1.1 Description of Work

Provide all labor, materials, and equipment for the construction of the Imbricated Stone Stream BMP (best management practices) Wall and Revetment as detailed in the Contract Documents and as specified herein. The Imbricated Stone Stream BMP Wall and Revetment will serve as protection, armoring and stabilization of the stream bank.

1.2 Related Work Specified Elsewhere

- A. Section 01500 - Temporary Sediment and Erosion Control
- B. Section 02100 - Clearing and Grubbing
- C. Section 02200 - Earthwork
- D. Section 02215 – Imported Stream Bed Material
- E. Section 02217 - Rock Vane Structures
- F. Section 02218 – Rock Step Pool Structures
- G. Section 02520 – Temporary Maintenance of Stream Flow

1.3 Applicable Standards and Specification

- H. Erosion and Sediment Control (Chapter 57 of the Arlington County Code)
- I. Virginia Erosion and Sediment Control Handbook
- J. Arlington County Planning and Field Guide for Erosion and Sediment Control
- K. Arlington County Planning & Field Guide for Pollution Prevention (P2)
- L. Arlington County Department of Parks and Recreation Design Standards
- M. Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004)

PART 2 - PRODUCTS

2.1 Stone

- A. Stones should be angular, rectangular, and blocky in shape such that they are stackable and should be of sufficient size to resist displacement by the site-specific design storm event. The length of the longest axis of each stone should be the greater of 1/3 the height of the proposed wall and the size necessary to resist the shear stresses of the design storm event. Boulder stones shall be properly sized to resist the tractive forces utilizing empirical relationships for shear stress for the anticipated design storm event.
- B. Rock Boulder color shall blend with the existing streambed material. Green/Gray, brown/gray, dark gray, and/or dark brown shall be acceptable. White Rock is not acceptable. All Rock shall be free from laminations, weak cleavages and will not disintegrate from the action of air, water and in handling and placing. Granular sedimentary stone will be unacceptable.
- C. Rock Boulders shall have a minimum Bulk Specific Gravity of 2.65 and an Absorption of not more than two (2) percent in accordance with ASTM Method C 127. The test for soundness shall be performed in accordance with ASTM Method C 88 for coarse aggregate and shall yield the following results: weight loss in five (5) cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.
- D. Stone/Rock and Gravel shall conform to the following requirements:
 - 1. Boulders for walls shall be imported imbricated riprap.
 - 2. Footer rocks consist of rocks placed below the invert of the proposed channel to provide support for the wall Rocks and prevent excessive downstream scour. The footer rock size shall meet the following dimensions: 4-6' length, 3-4' width, and 1.5-2.5' depth.
 - 3. Top wall Rocks that form the finished grade consist of rocks placed upon Footer Rocks and shall not be larger than Footer Rocks.
 - 4. Top Rocks consists of rocks placed upon Footer Rocks. Top Rocks shall have the following dimensions: 3 – 5' length, 2.5' – 3.5' width, and 1.5' – 2.5' depth.
 - 5. Footer rocks shall be large enough to achieve the desired height when installed in the stream and shall be sized to resist movement from velocities and shear stresses for the design storm event. Footer rocks shall also be blocky, flat, and typically 1.5 times longer than the intermediate axis.
 - 6. Rock dimensions shall fall within the dimensions shown in the Construction Details as follows: 3-6' length, 2.5-4' width, and 1.5'-2.5' depth. Of the rock supply, the larger rocks shall be used for Footer Rocks with the following dimensions: 4-6' length, 3-4' width, and 1.5-2.5' depth.
 - 7. Poorly Graded Gravel – Gravel for backfilling and “choking” shall be a poorly graded gravel mix consisting of river run sand, and gravel-cobble material that meets the gradation requirements indicated in the Imported Riffle Streambed Material Gradation Table as indicated in Section 02215 Imported Stream Bed Material, part 2 – 2.1. A. The source of gravel material and samples shall be provided to the Project Officer for review and approval prior to commencing construction operations. Installation shall be in accordance with these specifications and as directed by the Project Officer.

E. Source of Material

1. Prior to commencement of construction, the Contractor will locate potential sources of rock. The Contractor and the Project Officer will jointly visit the site(s) to determine whether the rock meets the requirements as set forth in these specifications. A site visit may be waived by the Project Officer when rock will come from a source that has been approved in the past.
2. The Imbricated stone wall shall be constructed of angular, flat, or cubed rock. Individual rock fragments shall be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. The dry weight density of each rock shall be 160 pounds per cubic foot or greater. No concrete, man-made rocks, or soft rocks shall be used for the construction of the in-stream structures.

2.2 Soil Stabilization Matting

Shall be bristle coir fiber matting consisting of machine twisted twines and be 100 percent biodegradable. Soil Stabilization Matting shall be resistant to the tractive forces of the stream channel during high flow events. Soil Stabilization Matting which uses plastics, metals, or other man-made materials in the construction of the material will not be permitted. Apparent opening size shall be sufficient to foster the sprouting of stabilization/restoration seed mixes. Soil stabilization matting shall also meet the requirements of Arlington County Construction Standards and Specs Section 329100-2.8.

2.3 Stakes

Stakes shall be 100% biodegradable material and shall be designed to safely and effectively secure erosion control blankets, coir logs, fascines, and other biodegradable structures for temporary and permanent application.

2.4 Toe Trench Rock

Toe Trench Rock shall be of sufficient size to resist the tractive forces utilizing empirical relationships for shear stress and velocities in accordance with the sizing below.

Stone Size	Allowable Velocity	<u>Class</u>
<u>(in)</u>	<u>(ft/Sec)</u>	
4	5	I
6	6	I
8	7	I
14.5	10	II
18	11	II
22	12	II

26	13	III
34	15	III

2.5 Geotextile Fabric

Geotextile Filter Fabric shall be in accordance shall meet requirements of Section 245 of the VDOT Specifications. Geotextile shall be nonwoven geotextile composed of polypropylene fibers that meet the following specifications:

<u>Mechanical Properties</u>	<u>ASTM Standard</u>
Grab Tensile Strength	D4632
Grab Tensile Elongation	D4632
Trapezoid Tear Strength	D4533
CBR Puncture Strength	D6241
Apparent Opening Size	D4751
Permittivity	D4491
Flow Rate	D4491
UV Resistance (at 500 hours)	D4355

B. All filter fabric installed as part of imbricated wall structure shall be a non-woven fabric (MIRAFI 180N 8 oz. or approved equal).

2.6 Granular Filter

Granular Filter shall have the following gradation

<u>Percent Less Than</u>	<u>U.S. Standard sieve size</u>
100	2.5 in (64mm)
85-100	1.0 in (25mm)
60-100	0.5 in (13mm)
35-70	No. 10
20-50	No. 40
03-20	No.200

2.7 Topsoil

Topsoil shall meet the requirement of Section 244.02b and Section 6.0 of the VDOT Road and Bridge Specifications. Topsoil shall consist of friable surface soil free of grass, roots, weeds, sticks, stones, or other foreign materials. The topsoil shall be removed from the designated areas and shall be stockpiled at locations approved by the Project Officer inside the LOD (LIMITS OF DISTURBANCE). Objectionable materials encountered during excavation shall be removed and buried at locations shown on the Contract Drawings or approved by the Project Officer or otherwise removed from the construction site.

2.8 VDOT # 57 Stone

VDOT #57 stone shall be an open-graded, self-compacting aggregate blend of size 5, 6, & 7 stone. #57 coarse aggregate stone has 100% passing 1 1/2" screen, 95-100% passing 1" screen, 25-60% passing 1/2" screen, 0-10% passing #4 screen, and 0-5% passing #8 screen. Before the stone is placed, a Geotextile fabric is often used as a soil separator between the stone and subgrade to reduce the potential for future stone loss into subgrade. Soil to be used as topsoil must meet the following criteria:

Topsoil must be a loam, sandy loam, clay loam, silt loam, sandy clay loam, or loamy sand.

Other soils may be used if recommended by an agronomist or soil scientist and approved by the appropriate approval authority.

Topsoil must not be a mixture of contrasting textured subsoils and must contain less than 5 percent by volume of cinders, stones, slag, coarse fragments, gravel, sticks, roots, trash, or other materials larger than 1½ inches in diameter.

Topsoil must be free of noxious plants or plant parts such as Bermuda grass, quack grass, Johnson grass, nut sedge, poison ivy, thistle, or others as specified.

PART 3 - EXECUTION

3.1 Construction Method

- A. The construction details in the Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004) shall be used as a general guide. The Project Officer can require modifications as needed.
- B. Imbricated Stone Stream BMP Wall shall be constructed according to the Stacked Stone Stream BMP Wall Detail shown on the Contract Drawings or as directed by the Project Officer. The elevation tolerance for the wall will be +/-0.1ft of design elevations. Footer rocks used in in-stream structures shall extend inward toward the center of the channel, past the Top Rocks.
- C. Excavate the trench for footer rocks to the elevation and grades necessary for placement of both footer and wall rock so that the desired elevation of the structure meets the lines and grades of the structure schedule and in accordance with the Stacked stone wall detail.

- D. Soil Stabilization Matting shall be keyed into the top of the bank and placed along the stable cut/backfill face. Shape the slope to specified elevations and fold the matting over its face. Key the matting back into the bank a minimum of one foot deep at the top of bank.
- E. Place header rocks such that the upstream and downstream end stones are flush with the stream bank. Backfill (VDOT #57 stone or otherwise specified in the contract documents) shall be placed and tamped behind the header stone and along the fabric draped on the cut/backfill slope. Repeat the header stone and backfill installation procedure until design height as shown on the Cross Sections in the contract drawings.
- F. A minimum of 6-inches of topsoil as specified under Item 2.7 –Topsoil above, shall be placed along the top of the bank behind the top header rock.

3.2 General Construction Notes

- A. Flow of the stream should be diverted away from the work area in accordance with the approved Erosion and Sediment Control Plan and the site should be dewatered.
- B. Place footer rocks in excavated trench with adjacent rocks abutting each other. Footer rocks should be placed neatly so that the top rocks can rest securely on two-footer stones. Smaller stones should be used to fill void spaces so that each rock rests solidly on the previous rock with minimal opportunity for movement.
- C. Footer rocks shall be placed individually and keyed into the channel, bed, stream bank as shown in the detail.
- D. Imbricated stone wall rocks shall be placed on footer rocks in an upstream offset direction such that less than one-half the footer rock is exposed. All imbricated stone wall footer rocks should be touching adjacent rocks to form a tight fit. No gaps or voids shall exist between footer and top rocks.
- E. Excavate for wall feature and place salvaged streambed material for future placement in approved area.
- F. Stabilize disturbed area with seed, mulch, and soil stabilization matting and plant in accordance with the approved Contract Drawings.
- G. Remove approved VESCH devices upon stabilization of the channel in accordance with the Contract Drawings and stabilize disturbed area with seed, mulch, and stabilization matting.
- H. No significant voids shall exist between adjoining footer and top rock of other instream structures. To prevent piping of water through structure rocks, the contractor shall chink by hand or equipment all undesirable voids with smaller rocks such as any existing streambed material or specified substrate.

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Imbricated Stone Wall Structures shall be paid per ton of material installed complete in place and accepted by the Project Officer. Such price and payment shall be full compensation for the items of work, including the cost of excavation, preparation of subgrade, furnishing all materials, labor, equipment, tools, backfill); filter fabric; transportation to project site and incidentals listed in part 2 above and complete in place.

END OF SECTION 02219

SECTION 02520– TEMPORARY MAINTENANCE OF STREAM FLOW

PART 1 - GENERAL

1.1 This work consists of furnishing and installing temporary maintenance of stream flow for instream construction activities and all materials, labor, and equipment required for the installation, maintenance, and removal of the temporary maintenance of stream flow.

- A. The work shall include the use of all temporary flow diversions such as:
 - 1. Pump around diversion
 - 2. Sandbag stone diversion
 - 3. Diversion pipe
 - 4. Potable dam / barriers
 - 5. Temporary diversion channels
- B. The temporary maintenance of stream flow shall:
 - 1. Control surface water runoff to prevent flooding of excavations, trenches, and adjacent properties, and the saturation and loosening of soils.
 - 2. Remove subsurface water from excavations and trenches.
 - 3. Provide equipment and facilities to remove sediment and control the rates and volumes of disposal of surface and subsurface waters removed from the work areas.
 - 4. Provide for the protection of adjacent and down gradient properties and environmental resources.

PART 2 - PRODUCTS

2.1 In-Stream Barrier

- A. Riprap for flow diversion and temporary stream crossing per Standard and Specification 3.19: Riprap of the Virginia Erosion and Sediment Control Handbook.
- B. Sandbags may be filled on site or pre-filled and made of burlap or polypropylene materials which are resistant to ultra-violet radiation, tearing, and puncture and should be woven tightly enough to prevent leakage of the fill material (i.e., sand, fine gravel, etc.).
- C. Sandy material may be used to fill sandbags. If permitted, material from the channel may be used to fill the bags.

2.2 Sheeting

- A. Seamless polyethylene plastic sheeting with a minimum 4-mil thickness impervious and resistant to puncture, tearing and ultraviolet degradation or equivalent.

2.3 Pumping Equipment

- A. (As needed) Electric, diesel or gasoline venturi, vacuum, or centrifugal primed pump. Appropriately sized rigid intake and discharge pipe/hose with positive restrained joints. Necessary connectors and properly stored fuel.

2.4 Dewatering Structures

- A. (As needed) Per Standard and Specification 3.26 in the Virginia Erosion and Sediment Control Handbook or sediment/dirt bag per manufacturers specifications.

2.5 Filter Fabric

- A. If used for sealing the structure, filter fabric shall consist of a material meeting the requirement for filter fabric used with riprap as detailed in Table 3.19 D in section 3.19 of the Virginia Erosion and Sediment Control Handbook Third Edition, 1992, page III-171. A granular filter may be substituted for or used with filter fabric. See Standard and Specification 3.19: Riprap for granular filter material specifications.

2.6 Pipes

- A. High Density Polyethylene Pipe (HDPE) or equivalent of appropriate thickness and diameter to accomplish diversion of stream flow. The pipe shall extend a minimum of one foot beyond the upstream and downstream toes of the barriers.

2.7 Modular Dams

- A. Shall consist of self-contained impermeable containers per manufacturers specifications filled with sand.

2.8 Jersey Wall Barrier

- A. Shall consist of concrete jersey wall barriers per manufacturers specifications covered with polyethylene sheeting.

2.9 Inflatable Dams

- A. Shall consist of self-contained impermeable dams per manufacturers specifications filled with water.

2.10 Velocity Dissipator

- A. Riprap or sandbag lined “plunge pool” sized to be non-erosive at the end of discharge pipe / hose.

PART 3 - EXECUTION

3.1 General

- A. Maintenance of stream flow shall be carried out in accordance with The Virginia Erosion and Sediment Control Handbook. The construction details in the Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004) shall be used as a general guide. The Project Officer can require modifications as needed
- B. The length of stream dewatered should be determined by the amount of work that can be completed in one workday. Where possible, utilize existing pools within the stream in place of an excavated sump-hole.
- C. Strategic placement of the in-stream barrier can eliminate multiple installation during construction. In-stream barrier should extend upstream and downstream of the area to be disturbed so its placement does not interfere with in-stream construction.
- D. Remove all large debris located within the foundation of the barrier to ensure proper sealing and reduce leakage through the barrier.
- E. Sandbag/stone barrier shall be monitored daily for leakage and repaired as necessary.
- F. Due to stability issues, equipment cannot be driven over pipes. If there is a possibility of the pipes being driven over by construction equipment, at least 12 inches of stone needs to be placed around the pipe.

3.2 Installation guidelines

- A. Excavate sump hole or identify existing pool upstream of the work area.
- B. Install velocity dissipater downstream of the work area
- C. Set up pump and hose / pipe
- D. Install upstream and downstream barriers and start pump

- E. Use de-watering pump and dewatering device to remove water left between the instream barriers after primary pump installation and as needed during construction.
- F. Complete in-stream construction activities and remove in-stream barriers. Restore / repair impacted stream areas.
- G. The invert elevation of the pipe should be installed on the natural streambed grade per Standard and Specification 3.24: Temporary Vehicular Stream Crossing in the Virginia Erosion and Sediment Control Handbook.
- H. Filter fabric or stone shall be placed under the pipe and should extend one-foot beyond the pipe. Width of filter fabric or stone used under the pipe should be sized according to Standard and Specification 3.24: Temporary Vehicular Stream Crossing in the Virginia Erosion and Sediment Control Handbook.

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Maintenance of stream flow shall apply to all types and uses mentioned in Part 1 above and will be measured and paid for as lump sum. Such payment shall be considered full compensation for the item of work, including the cost for furnishing all materials, labor, equipment, incidentals, transportation to site, storage, preparation, and maintenance of stream flow.

END OF SECTION 2520

SECTION 02802 - LIVE STAKES**PART 1 - GENERAL****1.1 Description of Work**

This work shall consist of inserting live, woody, rootable plant cuttings into Streambanks. Live staking is a standard bioengineering technique which involves planting dormant plant cuttings using species known to produce roots from cuttings. The purpose is to encourage their growth to bind root mass of the mature shrubs and/or trees ultimately stabilizing and reinforcing the soil. The live stakes shall be furnished and installed on stream banks and other areas as applicable to the construction drawings .

1.2 Related Work Specified Elsewhere

- A. Section 02100 - Clearing and Grubbing
- B. Section 02228 – Erosion and Control Matting
- C. Section 329100 – Planting Preparation
- D. Section 329200 – Seeding and Sodding
- E. Section 329300 – Exterior Plants
- F. Section 329500 – Vegetation and Tree Shelter Maintenance

PART 2 - PRODUCTS**2.1 Live stake**

Live stake cuttings shall be approximately one-half inch to one- and one-half inches (0.5" to 1.5") in diameter. Cuttings will not exceed two inches (2") in diameter and shall not be less than 0.25" in diameter. Cuttings shall be three feet (3') in length minimum and reasonably straight.

Live stakes should be cut from fresh, green, healthy, dormant parent plants which are adapted to the site conditions whenever possible.

Live stakes shall be cut at a 45° angle at the basal end and cut flat on the top end. The basal end is the end that will take root and will be the end installed in the ground.

Plant material with excessive damage or oblique cuts, or with excessive damage to the bark, will not be acceptable.

2.2 Species

The species used for live stakes shall be as specified in the Contract Drawings and may include:

Comus amomum/Silky dogwood

Salix nigra/black willow

Sambucus Canadensis/elderberry

Commonly used woody plants for this measure include willow, poplar, and alder since they are versatile and have high growth rates with shrubby habits, fibrous root systems, and high transpiration rates, especially when in leaf.

2.3 Handling and care

Live stakes shall be always kept covered and moist and shall be placed in cold storage if more than a few hours elapse between the cutting and replanting times.

All living materials shall be properly stored to ensure viability.

PART 3 - EXECUTION

3.1 Installation

- A. The construction details in the Virginia Stream Restoration & Stabilization Best Management Practice Guide (2004) shall be used as a general guide. The Project Officer can require modifications as needed.
- B. Installation locations shall be determined in the field and approved by the Project Officer and Urban Forester.
- C. Live stake harvesting and installation shall occur during very early spring, before the last frost-free date for the region (February 15 – March 31)
- D. Live stake rooting areas should be soaked in barrels of water for 24 to 48 hours just prior to installation.
- E. Live stakes shall be installed according to the Planting Summary Notes and Details as shown in the contract documents. Live stakes will be installed in the ground using a dead blow hammer.

The top end of the stake will protrude approximately 3” above the finished ground elevation. On sloped ground surfaces, stakes will be installed perpendicular to the finished grade slope.

- F. The Live Stakes/Posts shall be placed so that 80% of their length is buried. All live stakes shall be planted such that the stake is tamped and has full contact between the soil and cutting. In the event of hard ground, a 0.5” metal bar may be used to initiate a pilot hole for live stakes. The rod must be carefully removed without rotating to enlarge the hole.
- G. Live Stake/Posts shall be installed at the spacing and density as shown in the Contract Drawings or as directed by the Project Officer. Typical spacing for Live Stakes will be 2'-3' apart using a diamond-pattern spacing.
- H. While keeping the bark of the live stakes intact, the side branches should be clearly removed, the basal ends angled for easy insertion, and tops cut square.
- I. The cuttings should be implanted with the angled basal end down and buds oriented up at a minimum angle of 10 degrees to the horizontal so that rooting will not be restricted. All stakes should be positioned above the normal baseflow level. In soft soils, the stakes can be inserted perpendicularly into the slope using a dead blow hammer.
- J. Unstable slope toes should be reinforced against scouring and undercutting using live fascines or rock fill to give the live stakes the best opportunity to root and grow.
- K. The quantity of live stakes to be installed will be affected by the actual conditions that occur during the construction of the project. The quantity of live stakes may be increased, decreased, or eliminated entirely as directed by the Project Officer. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

3.2 Warranty

Guarantee that plants will be alive and in satisfactory growth for a period of two (2) years beginning the date of substantial completion as determined by the Project Officer. The target survival rate for live stakes is 80 percent based on the installed quantity identified on the approved plan.

Contractor shall maintain, inspect, and replace plants in accordance with this Section and Section 329500 Vegetation and Tree Shelter Maintenance

PART 4 - MEASUREMENT AND PAYMENT

- 4.1 Live stakes will be measured and paid for at the unit price per stem. Such payment shall be considered full compensation for the item of work, including the cost for furnishing all materials, labor, equipment, incidentals, transportation to site, storage, preparation, and planting of the live stakes.

END OF SECTION 02802

SECTION 0329500 - VEGETATION AND TREE SHELTER MAINTENANCE

PART 1 - GENERAL

1.1 Description of Work

Provide all materials and labor required to maintain installed vegetation including watering, tree shelter maintenance, and plant maintenance and replacement. Maintenance shall begin on the date of substantial completion as determined by the Project Officer and extend for the duration of the plant warranty period, or for the duration specified in the vegetation maintenance task order.

1.2 Related Work Specified Elsewhere

- A. Section 01551 – Invasive Species Control
- B. Section 02802 – Live Stakes
- C. Section 329100 – Planting Preparation
- D. Section 329200 – Seeding and Sodding
- E. Section 329300 – Exterior Plants

1.3 Warranty

Guarantee that plants will be alive and in satisfactory growth for the warranty period as specified on the approved plan, beginning with the date of substantial completion as determined by the Project Officer. If no warranty period is specified on the approved plan, guarantee that plants will be alive and in satisfactory growth for two (2) years following installation.

PART 2 - PRODUCTS

2.1 Submittals

The contractor shall develop a maintenance schedule identifying the tasks, frequency and approximate dates maintenance work shall be performed and the dates reports shall be submitted. The maintenance schedule shall be approved by the Project Officer prior to the start of maintenance work.

2.2 Reports

Reports shall be submitted electronically to the Project Officer in accordance with this specification and the approved maintenance schedule. Each report shall include maintenance dates, a summary of activities and observations for each maintenance visit, and date-stamped photographs.

PART 3 - EXECUTION

3.1 Woody Plant Maintenance

A. Establishment Watering

Woody vegetation installed under this contract shall be watered for two (2) years following installation.

Watering shall occur year-round, excepting when the soil is frozen. Watering is required when rainfall is less than 1 inch during a seven (7) day period. Water must be applied in sufficient quantities to saturate the soil to a depth of at least 4 inches, however, the Contractor shall avoid applying too much water. The soil shall be saturated, but without runoff.

The Contractor shall submit reports quarterly. Reports shall identify the dates watering occurred and any issues observed.

B. Plant Maintenance

Planting areas shall be inspected twice annually in May and July. Maintenance shall be undertaken as needed and at the appropriate time of year for the task. Maintenance shall include but not be limited to observation of animal or pest damage, reseeding and application of erosion control matting to repair excessive soil rutting/erosion, pruning, as-needed watering, removal of tree stakes, hand pulling of invasive vegetation growing in the root zone of woody plants, and spot mulching.

The Contractor shall submit a report for each visit summarizing the maintenance undertaken or scheduled and any observations or recommendations for planting success.

3.2 Annual Tree Shelter Maintenance

Tree shelters shall be inspected bi-monthly in March through September to ensure trees are adequately protected from deer damage and that woody vegetation is not constrained by the shelter. Inspection may result in a need for minor shelter repairs, removal of vines, hand pulling invasive plants within shelters, and straightening, re-attachment, or removal and replacement of damaged shelters. Where tree/shrubs have outgrown their shelter, the contractor shall make a recommendation for replacement with a larger shelter or shelter removal. Replacement shelters shall be provided at no cost to the County.

The Contractor shall submit a report for each visit summarizing the maintenance undertaken and any recommendations.

3.3 Warranty Plant Replacement

- A. Contractor shall inventory for dead plantings annually during the period of the warranty starting after one full growing season (but no more than one year) from the planting and replace dead plants at no charge to the County.
- B. Any plant that is 25 percent dead or more shall be considered dead and shall be replaced. For live stakes, a target survival rate of 80 percent shall apply, based on the installed quantity from the approved plan or task order plant list in accordance with Specification 02802.
- C. Contractor shall replace vegetation with exact replacement according to the approved planting plan unless otherwise directed by the Project Officer. Substitutions will not be permitted unless a written proposal has been approved. The County may elect to replace vegetation with a different species. For live stakes, the Contractor shall replace dead live stakes with bare root plants to account for lost growth.
- D. The Contractor shall submit an inspection report summarizing the inspection findings and proposed replacement species, sizes and quantities and intended re-planting timeframe to the Project Officer each year by June 1 if inspected in spring or November 1 if inspected in fall. Plants shall be installed during the next growing season. The Contractor shall notify the County of any substitutions and coordinate an exact date/time for the replacement planting with the Project Officer at least 30 business days prior to the planting. All woody plants shall be inspected by the County Urban Forester and accepted prior to planting.
- E. Replacement planting shall occur within the optimum timeframe for the species to be planted. Herbaceous Plants shall be planted between April 1 and May 15 or September 15 and October 30. Woody plants shall be planted between March 1 and May 15 or between September 15 and December 15. Plantings will only occur when weather and soil conditions will permit the successful establishment of plants and only at the County's discretion.
- F. All replacement plants shall be furnished and installed in accordance with the relevant technical specifications. The Contractor shall re-use existing or provide new tree shelters as necessary to protect the replacement plants without cost to the County.

PART 4 - MEASUREMENT AND PAYMENT

The following pay items will be paid in accordance with this section.

4.1 Annual Woody Plant Maintenance

Payment for Annual Woody Plant Maintenance shall be paid per acre and shall include all materials, equipment and labor necessary to coordinate, schedule, provide and report on one year of maintenance to include establishment watering and general plant maintenance.

4.2 Annual Woody Tree Maintenance

Payment for Annual Woody Tree Maintenance shall be paid per each and shall include all materials, equipment and labor necessary to coordinate, schedule, provide and report on one year of maintenance to include establishment watering and general plant maintenance for each tree. This category will be used for individual trees where the total number is less than twenty.

4.3 Annual Tree Shelter Maintenance

Payment for tree shelter maintenance shall be paid per each and shall include all materials, equipment and labor necessary to coordinate, schedule, provide and report on one year of maintenance for each tree shelter installed.

END OF SECTION 0329500