## SPSRW-XX: DOUBLE DROP ROCK CROSS VANE

Version Date: 05/22/2015 Revision Date: XX/XX/XXXX by XXX

### Description

The work covered by this section consists of furnishing, stockpiling, placing, and maintaining approved stone, boulders, and filter fabric to be utilized to construct the double drop rock cross vane, as specified in the Contract Document or as directed by the Engineer. Double drop rock cross vanes are in-stream flow structures primarily used for grade control, reducing near bank shear stresses, and providing habitat.

The quantity of structures to be constructed will be affected by actual conditions that occur during the construction of the project. The type and quantity of this structure may be increased or decreased at the direction of 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

Boulders shall consist of flat-sided, durable field or quarry stone that is sound, hard, dense, angular, and resistant to the action of air and water, and free of seams, cracks, or other structural defects. The Contractor shall use stone pieces with a “shape factor” greater than two (length and width more than twice the thickness). The Contractor cannot use limestone or concrete waste for stone. Stone shall be approved by the Engineer.

The size (length, width and depth (thickness)) of the boulder material shall as specified by the Engineer. Stone shall be approved by the Engineer.

Boulders for in-stream structures shall conform to the specifications for boulders shall conform to their respective specifications as shown on the plans.

Coarse backfill material shall consist of durable field or quarry stone that is sound, hard, dense, slightly rounded, resistant to the action of air and water, and free of seams, cracks, or other structural defects. The Contractor shall use stone pieces with a “shape factor” less than two (length and width less than twice the thickness). The Contractor cannot use limestone or concrete waste for stone. Stone shall be approved by the Engineer.

The type, size and gradation of the Coarse Backfill Material shall be specified by the Engineer to be mobile or non-mobile as the conditions in the channel warrant, and in accordance with the construction documents.

Coarse backfill material shall meet the material requirements of NCDOT section 1042 Rip Rap Materials.

Filter fabric for sealing structures shall meet the material requirements of NCDOT Section 1056 Geosynthetics.

### Methods

ENGINEER TO UPDATE IF THEY FEEL THAT THIS SPECIFICATION IS INADEQUATE FOR SITE CONDITIONS.

Structure installation and channel grading sequences may vary based on structure function and design. Grade control structures such as double drop rock cross vanes shall be installed as grading operations progress downstream.

Prior to construction of the structure, establish elevations at the upstream end of the proposed structure, upstream end of the structure step, and at the bankfull connection point. The Contractor may install additional survey control, as needed, to complete the work in accordance with the Contract Documents.

Invert (Footer Installation):

* 1. Over-excavate the stream bed to a depth equal to the total thickness of the structure invert header and footer boulders. Over excavation of the footer trench shall be in the upstream direction, from the proposed structure face. Bedding for the placement of the footer boulders shall be approved by the Engineer prior to placement.
	2. Place invert footer boulders in the over-excavated locations. Footer boulders shall have direct surface contact with adjacent boulders and shall smoothly and gradually transition in accordance with the design vane arm slope. Review, survey (measure), and adjust the alignment and/or height of the invert footer boulders, as needed. Selecting boulders with similar thickness for the footers may assist with the ease of construction. The footers shall be reviewed by the Engineer prior to proceeding with the work.
	3. Install filter fabric per the Contract Documents. Typically the fabric is draped over the top of footers, down the back face of the footer boulders and across the area of over-excavation/trenching. Fabric reaching the excavated soil face may be folded and/or trimmed, in accordance with the Contract Documents. The fabric installation shall be reviewed by the Engineer prior to proceeding with the work.
	4. Place Coarse Backfill on top of the filter fabric and between the back of the footer boulders and the excavated stream bed soil face. Coarse Backfill shall be level with the top surface of the footer boulders. The Coarse Backfill shall be reviewed by the Engineer prior to proceeding with the work.

Vane Arms and Floodplain Sills (Footer Installation):

* 1. Beginning on one-side of the channel, over-excavate/trench the stream bed to a depth equal to the total thickness of the header and footer boulders. The excavation slope should be smooth and gradual, typically matching the designed vane arm slope.
	2. Place footer boulders in the trench made for the vane arm. Footer boulders shall have direct surface contact with adjacent boulders and shall smoothly and gradually transition in accordance with the design vane arm slope. Review, survey (measure), and adjust the alignment and/or height of the vane arm footer boulders, as needed. Selecting boulders with similar thickness for the footers may assist with the ease of construction. The footers shall be reviewed by the Engineer prior to proceeding with the work.
	3. Install the footer boulders for the floodplain sill at the downstream end of the structure arm. Review, survey (measure), and adjust the alignment and/or height of the sill footer boulders, as needed. The footers shall be reviewed by the Engineer prior to proceeding with the work.
	4. Install filter fabric per the Contract Documents. Typically the fabric is draped over the top of footers, down the back face of the footer boulders and across the area of over-excavation/trenching. Fabric reaching the excavated soil face may be folded and/or trimmed, in accordance with the Contract Documents. The fabric installation shall be reviewed by the Engineer prior to proceeding with the work.
	5. Place Coarse Backfill on top of the filter fabric and between the back of the footer boulders and the excavated soil face. Coarse Backfill shall be level with the top surface of the footer boulders. The Coarse Backfill shall be reviewed by the Engineer prior to proceeding with the work.
	6. Continuing with the other side of the channel, repeat steps e) through k) until the footers for the structure arm and sill are completed.

Invert (Header Installation):

* 1. Place the header boulders on top of and slightly back from the edge of the footer boulders (such that the header boulders rest partially on top of the Coarse Backfill material). Header boulders shall be placed so that they span the seams of the footer boulders. Header boulders shall have direct surface contact with adjacent boulders, free of gaps, and shall smoothly and gradually tie to the boulder cross vane arms. Review, survey (measure), and adjust the alignment and/or height of the invert header boulders, as needed. Selecting boulders with similar thickness for the headers may assist with the ease of construction.
	2. Place Coarse Backfill between the back of the header boulders (invert) and the limits of the upstream excavated soil face. Coarse Backfill shall be level with the top surface of the header boulders. The Coarse Backfill shall be reviewed by the Engineer prior to proceeding with the work.

Vane Arms and Floodplain Sills (Header Installation):

* 1. Beginning on one-side of the channel, place the header boulders on top of and slightly back from the edge of the footer boulders (such that the header boulders rest partially on top of the Coarse Backfill material). Header boulders shall be placed so that they span the seams of the footer boulders. Header boulders shall have direct surface contact with adjacent boulders, free of gaps, and shall smoothly and gradually transition in accordance with the design vane arm slope. Review, survey (measure), and adjust the alignment and/or height of the vane arm header boulders, as needed. Selecting boulders with similar thickness for the headers may assist with the ease of construction.
	2. Install the header boulders for the boulder sill at the downstream end of the structure arm. Sill header boulders shall be placed so that they span the seams of the sill footer boulders. Header boulders shall have direct surface contact with adjacent boulders, free of gaps. Review, survey (measure), and adjust the alignment and/or height of the sill header boulders, as needed. The sill header boulders shall be reviewed by the Engineer prior to proceeding with the work.
	3. Place Coarse Backfill between the back of the header boulders (vane and sill) and the excavated soil face. Coarse Backfill shall be level with the top surface of the header boulders. The Coarse Backfill shall be reviewed by the Engineer prior to proceeding with the work.
	4. Continuing with the other side of the channel, repeat steps n) through q) until the headers for the structure arm and sill are completed.

Structure Step (Footer & Header Installation):

* 1. Over-excavate the stream bed to a depth equal to the total thickness of the structure step invert header and footer boulders. Over excavation of the footer trench shall be in the upstream direction, from the proposed structure face.
	2. Place structure step footer boulders in the over-excavated locations. Footer boulders shall have direct surface contact with adjacent boulders and shall smoothly and gradually transition in accordance with the design structure step slope. Review, survey (measure), and adjust the alignment and/or height of the structure step footer boulders, as needed. Selecting boulders with similar thickness for the footers may assist with the ease of construction. The footers shall be reviewed by the Engineer prior to proceeding with the work.
	3. Place Coarse Backfill between the back of the structure step footer boulders and the excavated stream bed soil face. Coarse Backfill shall be level with the top surface of the footer boulders. No fabric is used in the construction of the structure step. The Coarse Backfill shall be reviewed by the Engineer prior to proceeding with the work.
	4. Place the header boulders on top of and slightly back from the edge of the footer boulders (such that the header boulders rest partially on top of the Coarse Backfill material). Header boulders shall be placed so that they span the seams of the footer boulders. Header boulders shall have direct surface contact with adjacent boulders, free of gaps, and shall smoothly and gradually tie to the boulder cross vane arms. Review, survey (measure), and adjust the alignment and/or height of the invert header boulders, as needed. Selecting boulders with similar thickness for the headers may assist with the ease of construction.
	5. After installing all of the cross vane header boulders, inspect the structure (arms, floodplain sills, and invert) and trim/cut any loose and/or visible fabric.
	6. Finish grade the adjacent streambed, channel banks, and/or floodplain to provide a smooth even grade transition between project structure components (arms, sills, inverts, floodplain sills, etc.) and the existing and/or proposed ground surface.

In locations where exposed bedrock and/or other existing feature extends to and/or within the limits of the proposed work, the double drop boulder cross vane installation shall be field adjusted to incorporate the bedrock/existing feature, into the finished work. The Engineer shall be contacted as soon as the presence of bedrock and/or other existing feature is field identified, to determine the appropriate method of incorporation. Site conditions may require slight deviation from the plan and shall be approved by the Engineer.

### Measurement

The quantity of double drop boulder cross vane to be paid for shall be the actual number of linear feet of “Double Drop Rock Cross Vane” completed and accepted into the final work, as measured along the centerline surface of the structure (sill, vane, invert, and structure step).

The payment will be considered as full compensation for all work covered in this special provision, including, but not limited to grading, installation, excavating, placing backfill, maintaining the feature through acceptance, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work as specified in the Contract Documents, or as directed by the Engineer.

### Payment

The work covered by this section shall be paid for at the contract per linear foot price for “Double Drop Rock Cross Vane”.

Payment will be full compensation for all work covered in this special provision, including, but not limited to grading, installation, excavating, placing backfill, maintaining the feature through acceptance, and for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work as specified in the Contract Documents, or as directed by the Engineer.

Payment shall be made under:

DOUBLE DROP ROCK CROSS VANE LF