Construction Specification SR -08	**Rock Riprap**

1. Description

Rock Riprap is often used to protect critical streambanks or other slopes from the erosive forces. Riprap may be equipment Placed, Equipment Placed or Stacked & Pinned depending on design requirements, Rock riprap includes the use of filter and bedding aggregates, geotextile and foundations where applicable.

2. Materials:

2.1 Riprap shall be constructed of rock obtained from a source that is approved by the Contracting Officer prior to execution of a contract for the project. When possible, consideration should be given to obtaining rock that is similar in color and texture to the native stone in the project area. The Contractor and Contracting 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 Contracting Officer when the rock source has been approved under past projects.

2.1 Rock shall be of sufficient hardness to resist weathering and shall be free of cracks and other blemishes. Porous rock, such as some limestones, and soft rock, such as shales ,shall not be allowed for use as riprap.

2.3 The shape and size of the rock to be used is set forth in Section 7: Special Conditions and is shown on the project drawings. Rock shape and size is dependent on the method of riprap placement and, the velocities in the stream channel. In some cases, native rock present on the site may be authorized for use by the Contracting Officer. In no instance will concrete or other “debris” rock be allowed.

2.4 All rock under this specification shall meet the conditions of material specification **MS-01 Rock**.

3. Filter or Bedding

3.1 In instances where soil fines in the streambed (streambank) present a potential for soil piping, the Contractor shall install a filter aggregate and/or geotextile as shown on the project drawings.

3.2 As required, and as shown on the project drawings and/or set forth in Section 7: Special Conditions, the Contractor shall install bedding materials to prepare the subgrade and/or protect the geotextile, prior to placement of the rock.

3.3 When applicable, filter and bedding aggregates shall conform to Material Specification **MS-02** unless otherwise specified. When the project design calls for the use of geotextiles, the Contractor shall conform with Materials Specification **MS-03**

4. Subgrade Preparation

4.1 Prior to the placement of rock riprap, filter aggregate, bedding or geotextiles, the subgrade surfaces shall be cut, filled, compacted and graded to the lines and grades as shown on the project drawings. All subgrade surfaces shall be prepared so as to be reasonably smooth, and free of mounds, dips, or windrows.

4.2 The placement of fill to meet design grades and elevations, shall be of an approved material, and placement shall include adequate compaction of the materials as set forth in Construction Specification **SR-07: Stream Channel Excavation.**

4.3 No riprap, filter/ bedding aggregate or geotextile shall be placed until the subgrade is inspected and approved by the Contracting Officer and/or the Project Engineer.

4.4 As shown on the project drawings and/or as set forth in Section 7: Special Conditions, the Contractor shall provide for an adequate foundation under the rock riprap. In instances where unstable soils (i.e. clays/silts) are present, a geotextile and gravel foundation may be required to prevent settling of the riprap.

5. Construction Methods:

5.1 Dumped & Placed Rock Riprap

The rock riprap shall be placed by equipment on the surfaces and to the depths specified. The rock rip rap shall be installed to the full course thickness in one operation and in such a manner as to avoid displacement of the underlaying subgrade, filter/bedding aggregate or geotextile.

The rock for riprap shall be delivered and placed in such a manner that will insure that the riprap in-place, will be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact with the smaller rocks and spalls filling the voids between the larger rock. Hand placement of chinking stone shall be completed to insure a final surface which is smooth and with no voids greater than six inches (6") present between rocks.

At both the upper and lower limits of the riprap section, the rock riprap shall be keyed into the stable bank as shown on the project drawings. Keying of the riprap provides protection from erosion getting behind the riprap blanket. In addition, as shown on the project drawings, the rock riprap shall be placed to an elevation which is below the design streambed elevation. Rock riprap will be placed starting at the lowest elevation of a toe trench as shown on the drawings and/or in Section 8: Special Conditions to this

specification.

5.2 Equipment Placed Rock Riprap

This application shall involve the placement of large, flat rock riprap against the slope in such a manner that the rock riprap “paves” the slope and riprap pieces resemble a puzzle. All rock shall have maximum contact between the individual rock, with out bridging or otherwise creating a void under the rock layer, The rock shall be firmly bedded, and may be placed by hand or by machinery.

Space between the larger rock shall be chinked with smaller rock and spall with no voids greater than one foot (1') existing in the finished riprap face. Small rocks shall not be grouped as a substitute for larger rock. Rock shall only be placed in a single layer in depth, with each rock meeting or exceeding the minimum rock thickness as set forth in Section 8: Special Conditions.

At both the upper and lower limits of the riprap section, the rock riprap shall be keyed into the stable bank as shown on the project drawings. Keying of the riprap provides protection from erosion getting behind the riprap blanket.

5.3 Stacked & Pinned Rock Riprap

Riprap shall be placed in a stacked manner so as to construct a vertical face of protective rock. Rock used in Stacked and Pinned Rock Riprap applications shall be reasonably flat and placed such that there is solid contact between each course of rock. Steel pins shall be placed to secure each rock to the course below, to prevent dislodging of the rock by stream flows, debris or frost heaving.

Stacked Rock riprap shall be started at an elevation below the streambed elevation as shown in the project drawings, to protect from scour under the riprap. In instances where unstable soils (i.e clays, silts, saturated layers) have been determined to be present, the riprap shall be placed on a suitable foundation to prevent settling of the riprap. When a foundation in specified, the foundation shall be installed as shown in the project drawings and in Section 7: Special Conditions. The rock shall be stacked with a banter towards the streambank as shown on the project drawings.

When specified on the project drawings, the contractor shall install steel pins to tie one course of rock to the course below it. Unless otherwise specified, steel pins shall be one inch (1") diameter bars conforming to ASTM Specification A615, A616 or A617. The length of the pins will be a minimum of 4 feet. Holes drilled in the rock for placement of the steel pins may be up to, but not exceed 1.5 inches in diameter. All pins shall be driven flush to the top of the riprap, or within +/- ½ inch of the surface.

At both the upper and lower limits of the Stacked Rock Riprap section, the rock riprap shall be keyed into the stable bank as shown on the project drawings. Keying of the riprap provides protection from erosion getting behind the riprap blanket.

6. Measurement and Method of Payment

Method 1: When specific unit prices are established in the contract, the quantity of each type of material, placed within the specified limits, shall be computed to the nearest unit by weight or volume, as set forth in the Bid Unit Cost. Riprap, bedding, filters, steel pins and other items shall be computed to the nearest unit, with payment made at the Bid Unit Cost.

Method 2: When specified in the bidding documents, the Contractor shall be paid a Lump Sum price for installation of the riprap. Lump sum costs shall include all site preparation, materials, labor and equipment as required to construct the riprap to the specified design limits.

Under all payment methods, payment shall be considered full compensation for completion of the work. Compensation for any items of work described in the contract but not specifically listed in the bid schedule will be included in the payment for the item of the work to which it is subsidiary. Such items are set forth ion Section 7: Special Conditions. No separate payment shall be made for any testing of rock gradation.

7. Special Conditions

7.1 Rock Materials

Rock for this project shall consist of large, flat pieces with one or more relatively straight edges, which can be stacked and pinned to achieve a stable vertical wall. Rock size shall be as follows;

	A-axis	B-axis	C-axis
Minimum Size	3'	3'	1'
Maximum Size	8'	4'	4'

Rock density shall be between 1.4 and 1.6 tons/cuyd

7.2 Rock Placement

Rock shall be placed so as to provide maximum rock to rock contact between successive courses, minimal bridging between rocks and minimal voids between the stacked rock. The Contractor shall hand chink all voids between rocks prior to back filling of the wall, Chinking will be placed so as to be “locked” into the wall.

Rock shall be stacked such that horizontal joints between rocks are staggered, with no joint running vertically through 2 or more courses. Thin rocks shall not be used as shims to adjust the elevation of any stacked rock. All rock placed in the wall shall be done under the direction of the Contracting Officer, and the Contractor shall remove, replace, adjust or otherwise alter the placement of any rock(s) deemed insufficient by the Contracting Officer.

The stacked rock riprap shall be placed as shown on the project drawings, and shall have a minimum banter of 6 on 1 towards the streambank

The Contractor shall install steel pins as shown on the Project Drawings. A minimum of two (2) pins will be used for each rock placed in the wall. The Contractor shall place the steel pins such that they are in the approximate center of the rock to be pinned (top rock), and pins shall be placed so as they are not closer than twelve inches (12") from any edge of the rock to which they are being pinned (bottom rock) The Contracting Officer and/or Project Engineer will observe the Contractors placement of the Rock Pins and shall direct the Contractor to relocate and/or add additional pins as necessary.

7.3 Filter Materials

Under this contract, filter materials are not required between the vertical rock riprap and the native soil of the streambank. Geotextile will be used in the foundation area as shown

on the project drawings and in item 7.6 below.

7.4 Drainfill Materials

Under this contract, backfill behind the stacked rock riprap shall be free draining and porous, and shall be free of organic matter and excessive fines. The backfill for the stacked wall will be a washed, well graded gravel material and must be approved by the Contracting Officer and/or Project Engineer prior to the start of the project. The project will not require geotextile on the vertical face between the native materials (soils) and the rock riprap.

Backfill will be placed behind the wall as each vertical course of the stacked riprap is placed to allow for compaction. The Contractor shall use the bucket of an excavator, and/or a tamper to provide adequate compaction. No backfill will be placed in lifts which exceed twelve inches (12"). No separate payment shall not be made for drainfill, this item is subsidiary to Stacked & Pinned Rock Riprap.

7.5 Subgrade Preparation

Geo-technical investigations have determined that the foundation area under the proposed Stacked Rock Riprap is unsuitable for bearing the vertical loading presented by the wall. The Contractor shall establish a footing foundation prior to placement of the stacked wall by over excavation of the clay/silt materials, and placement of a geotextile barrier and a compacted gravel foundation. All foundation components shall be installed as shown on the design drawings.

Excavation — The Contractor shall excavate a foundation trench at the locations and elevations as shown on the Project Drawings. The Foundation trench shall be constructed six foot (6') wide, and to a depth to allow placement of the foundation bedding materials and to provide for placement of the stacked rock a minimum of two foot (2') below the finished streambed.

Geotextile — As shown on the project drawings, the Contractor shall place a woven geotextile on the side and bottom of the foundation excavation. The geotextile shall meet the conditions set forth in Specification MS-03: Geotextile, Table I, Class II. The apparent opening size shall be number 30 U.S. Standard Sieve size. No separate payment shall be made for geotextile. Payment for this item is included in Unit Bid Cost for Stacked Rock Riprap.

Bedding — After placement of the geotextile, the Contractor shall construct a tamped gravel foundation to support the stacked rock riprap. The gravel material used in the foundation will be placed in lifts not to exceed nine inches (9") in depth, with through compaction of each lift using a plate tamper or vibratory sheep foot roller. Compaction can also be achieved by a minimum of four (4) passes over the entire surface with the track of a

machine weighing not less than twenty (20) tons. The Stacked rock wall will be constructed on top of the foundation materials to the dimensions and limits as shown on the design drawings.

Gravel materials shall free draining and porous, and shall be free of organic matter and excessive fines. The backfill for the stacked wall will be a washed, well graded gravel material and must be approved by the Contracting Officer and/or Project Engineer prior to the start of the project.

7.6 Method of Payment

The method of payment under this contract shall be as follows;

Stacked & Pinned Rock Riprap

Method #1 - Unit Bid Price (linear foot), Unit bid price shall hold for +/- fifty percent (50%) of the estimated units.

Steel Pins

Method #1 - Unit Bid Price (each), Unit bid price shall hold for all quantities of pins installed.

All other work associated with this specification is subsidiary to the bid item for Stacked Rock Riprap.