***inUSP1091 (04-17-20) BES Unique Specification (This Section requires SPP1050, SPP280 and SPP290.)***

***(Follow all instructions. If there are no instructions above a subsection, paragraph, sentence or bullet, then include them in the project but make necessary modifications to only include project specific specifications. Delete specifications that do not apply to the project. Remove all instructions before preparing the final document.***

***(Use this Section on projects that require in water work, work in fish or wildlife habitat near waterways.)***

### Section 01091 –Stream Restoration And Enhancement

Section 01091 is not a Standard Construction Specification and is included in this project by Unique Special Provision.

**01091.00 Scope** - This Work consists of constructing stream channels, wetlands, floodplains and other riparian enhancements to the lines and grades shown in the Contract Documents. The Work includes furnishing and placing Constructed Streambed, Large Woody Debris, Streambank Stabilization Treatments, Stream Diversion and Site Dewatering materials.

**01091.02 Definitions** **:**

**Constructed Streambed** – A streambed constructed with native or imported streambed materials that simulates a natural watercourse providing flow conveyance, habitat, and spawning beds.

**Constructed Streambank** – A streambank constructed with materials such as matting, native or imported soil, a prescribed seed mix, and wooden stakes.

**Framework Gradation -** The essential supporting structure of the streambed

**Large Woody Debris** – Logs, rootwads, and/or slash placed to enhance in-stream and riparian habitat.

**Log –** A length of tree that has fallen naturally or cut by mechanical means.

**Matting –** All natural, 100% biodegradable erosion control matting per Section 00280 Matting and the CPL.

**Rootwad –** A felled tree (log) with roots still attached and soil removed so that the roots are left exposed.

**Slash –** Woody material that results from timber harvest; may include treetops and branches with needles intact.

**Spawning Gravel –** Sorted, clean [gravel](http://www.mondofacto.com/facts/dictionary?gravel) of [size](http://www.mondofacto.com/facts/dictionary?size) and gradation appropriate for [resident](http://www.mondofacto.com/facts/dictionary?resident) or [anadromous fish](http://www.mondofacto.com/facts/dictionary?anadromous+fish) spawning.

**Stream Diversion and Dewatering** –Diversion of stream flow and groundwater discharge required to provide and maintain dry access to regulated work areas per or in conjunction with the work area isolation plan for the project as described in Section 00290.

**Thalweg** – A longitudinal profile along the deepest flow path of a channel.

**01091.03 Submittals**  - Submit four weeks prior to start of the Work and in accordance with Section 00150.35 and applicable permits, the following for Owner’s review and approval:

1. **Stream Diversion and Dewatering Plan (SDDP)**
2. Site plan showing the proposed layout and location of all SDDP elements of the Work. Include staging of materials and equipment.
3. Specification of materials and equipment used to implement, maintain and monitor the SDDP.
4. Monitoring, operation, and maintenance plan to ensure Work area(s) remain dewatered during the duration of the Work.
5. Account for flow rates shown in the Contract Documents, plus undetermined rates of seepage into work areas. Refer to Section 00290 and permits for additional requirements.
6. Identify and include 24-hour contact information for the competent person responsible for installation, operation and maintenance of the SDDP.
7. **Constructed Streambed and Spawning Gravel -** The Contractor shall submit the following for the Owner’s review and approval prior to purchase and at least 4 weeks prior to placement:
8. List of material suppliers and location of material source.
9. Data sheets and compliance test results confirming grain size gradations and specific gravity.
10. Schedule addressing coordination meeting between the Owner’s Representative and the material supplier(s) at the material quarry and stockpile. Material will be inspected and evaluated for acceptability prior to purchase.
11. **Large Wood** -The Contractor shall submit the following for Owner’s review and approval prior to purchase and at least 4 weeks prior to installation:
12. List of material suppliers and location of material source data sheets indicating the length, diameter, and species of large wood to be delivered onsite.
13. Imported materials will be inspected upon arrival at project site and evaluated for suitability by the Owner’s Representative.
14. **Streambank and Floodplain Stabilization Treatments** -The Contractor shall submit the following for Owner’s review and approval prior to purchase and at least 4 weeks prior to installation:
15. Stabilization material samples and manufacturer’s data per Section 00280.

**Materials**

**01091.10 Materials** - Provide materials meeting the following requirements:

1. **Constructed Streambed and Spawning Gravel**
2. All reference to stone will refer to rock materials placed in the streambed including boulders and Imported Streambed Stone.
3. Provide durable stone with a Mohs hardness of 5 or more and resistant to weathering, free of organic material and structural defects, shale, and limestone, and conforms to gradation requirements specified below. Material density shall be a minimum of 168 pounds per cubic foot; specific gravity shall be a minimum of 2.7. Stone shall be smooth and round unless otherwise specified or approved by Owner’s Representative, preferably from a river or stream source and not broken or crushed.
4. Contractor may elect to mix imported stone with native to achieve the specified gradation by submitting a cost reduction proposal to the Owner’s Representative for approval.

***(Designer’s Note: Provide volume and weight per Project requirements, insert into the gradation table. The items in yellow below are meant to be examples and need to be developed by the Designer or Engineer.)***

1. **Streambed Boulders**

Boulders shall be 24” minimum average, gray basalt (matching native rock color), blocky or subangular in shape.  Boulder length shall not be greater than twice the width or height. Boulders to be approved by Owner’s Representative prior to placement.

***(Designer’s Note: Specify % fines per Project requirements.)***

1. **Imported Streambed Stone**
2. Imported Streambed Stone shall be a mixture of 80% by volume Framework Gradation and 20% by volume Fines Gradation, Imported Streambed Stone shall not be pre-mixed prior to placement. Instead, Imported Streambed Stone shall be placed in alternating lifts of Framework Gradation followed by Fines Gradation, as described below.

***(Designer’s Note: Insert Framework Gradation tables per Project requirements.)***

**Framework Gradation - Type I Stone (24-inch Constructed Streambed):**

|  |  |  |
| --- | --- | --- |
| Percent Finer | Size of Stone (in) | |
| (% by Weight) | Minimum | Maximum |
| 100 | 11 | 13 |
| 50 | 5 | 7 |
| 15 | 0.25 | 0.75 |

**Framework Gradation - Type II Stone (18-inch Constructed Streambed):**

|  |  |  |
| --- | --- | --- |
| Percent Finer | Size of Stone (in) | |
| (% by Weight) | Minimum | Maximum |
| 100 | 8 | 10 |
| 50 | 4 | 6 |
| 15 | 0.25 | 0.75 |

**Fines Gradation:**

|  |  |  |
| --- | --- | --- |
| Percent Finer | Size of Stone (in) | |
| (% by Weight) | Minimum | Maximum |
| 100 | 0.131 (#7 sieve) | 0.25 |
| 50 | 0.033 (#20 sieve) | 0.079 (#10 sieve) |
| 15 | 0.003 (#200 sieve) | 0.007 (#80 sieve) |

**Spawning Gravels Gradation**

***(Designer Note: Specify which spawning gravel is appropriate for the project.)***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Chinook | Coho | Steelhead | Resident Trout | Pacific Lamprey |
| Substrate Mix Size Range (inch) | 0.8 – 4.2 | 0.5 – 4.0 | 0.25 – 0.4 | 0.25 – 2.0 | 0.25 – 2.0 |
| Percent (Fines) | 5 | 8 | 5 | 5 | 5 |
| Percent (0.1 – 0.5 inch) | 19 | 23 | 15 | 30 | 20 |
| Percent (0.6 – 2.0 inch) | 58 | 43 | 52 | 60 | 60 |
| Percent (2.1 – 4.0 inch) | 10 | 23 | 20 | 5 | 15 |
| Percent (4.1 – 6.0 inch) | 8 | 3 | 8 | - | - |
|  |  |  |  |  |  |
| Minimum Area/Spawning Pair (sf ft) | 26.1 | 11.7 | 18.8 | - | 3.1 |
| Substrate Depth (in) | 12-28 | 12-28 | 12-28 | 12 | 12 |

1. **Logs and Rootwads** - Materials shall meet the following requirements:
2. **General:** Tree species shall be native conifer that are disease free, have limited rot or decay and are clean of dirt and debris.
3. **Sourcing:** Shall originate from one or more of the following sources:
   1. Forest Stewardship Council (FSC) certified timber,
   2. Healthy Forest, Healthy Communities (HFHC) timber,
   3. Northwest urban salvage timber or other approved Northwest salvage timber,
   4. Utility grade and 12”+3 SAW Logs and Rootwads originating from approved Oregon Department of Forestry Timber Sales,
   5. Owner Supplied Logs and Rootwads.
4. **Logs and Rootwads Supplier List:** The following supplier list is provided to assist with sourcing and procurement:

|  |  |  |
| --- | --- | --- |
| **Supplier** | **Contact Person/e-mail** | **Telephone No.** |
| Trout Mountain Forestry | Portland Office | 503-222-9772 |
| Hyla Woods | Portland Office  peter@hylawoods.com | 971-678-9466 |
| NW Natural Resource Group | Olympia Office  kirk@nnrg.org | 360-316-9317 |
| Integrated Resource Management | Philomath Office  marc@irmforestry.com | 541-929-3408 |

***(Designer’s Note: Provide length and diameters specific to project. The range of length and diameter should allow some flexibility, but not so much that the contractor will provide the smallest size.)***

1. **Diameter:** The minimum diameter of logs (with or without attached root wads) shall be 12-14 inches, measured at the approximate midpoint of the log, with no part of the log below the minimum diameter.
2. **Length**: Logs lengths shall be specified in the Contract Documents.
3. **Rootwads:** Rootwads shall be attached to the trunk and have a minimum fan diameter of 3 times the trunk diameter measured at breast height. Rootwads shall have a stout root structure with roots that are at least 2 inches in diameter. All roots shall remain intact and untrimmed within the specified rootwad fan.
4. **Slash** –Materials shall meet the following requirements:
5. Green leftover material from the harvest of the logs, or land clearing activities.
6. Tree material shall be disease free.
7. Can be composed of tops of trees and/or branches. Small diameter material (twigs, branches, and needles) must remain intact. There shall be no trimming of branches or treetops.
8. **Flexible Channel Liner** - Materials shall meet the following requirements:
   1. **Matting Fabrics**
9. Coir fabrics shall consist of 100% biodegradable matting material. Only those coir fabrics specified will be accepted unless otherwise approved by the Owner’s Representative.
10. Each roll of coir fabric shall be packaged individually in a suitable sheet, wrapper, or container to protect the fabric from damage to ultraviolet light, moisture, and mud during normal storage and handling.
11. Identify each roll of coir fabric with a tag or label securely affixed to the outside of the roll on one end. The label shall include the manufacturer or supplier, the style number, and the roll and lot numbers.
12. Store all coir fabrics elevated off the ground and ensure that they are adequately covered to protect the material from damage. Protect coir fabrics from sharp objects which may damage the fabric.
13. Coir fabrics damaged during transport, storage or placement shall be replaced at no additional cost.
14. The Owner’s Representative will randomly select and obtain samples from rolls of coir fabric after arrival on the site and prior to installation to compare with previously submitted samples.
    1. **Matting Streambank Fabric --** Use appropriate products per section 00280 and the CPL, unless otherwise specified or approved.
15. **Seed**
16. Provide the Owner with seven days’ notice for seed delivery. The Owner will provide seed to the contractor for Streambank and Floodplain Stabilization Treatments. Owner-supplied seed shall be stored to prevent damage prior to application.
17. Prepare erosion control seeding areas no later than two days following the completion of ground disturbing activities for any given area of work.
18. **Wood Stakes**

Wood Stakes shall be used to anchor all matting. Stakes shall be solid and free of knots or defects. Stakes shall be 18” in length. Stakes should be constructed by cutting a standard grade fir 2” X 4” lumber lengthwise along the diagonal to create wedge shaped stakes, or by some other method resulting in a stake of dimensions approved by the Owner’s Representative. Stakes should not be constructed from pressure or chemically treated wood.

1. **Soil**
2. Use selected general backfill in accordance with 00330 of the Standard Construction Specifications from site excavations for construction of fabric wrapped soil lifts. Selected general backfill will be approved by the Owner’s Representative.
3. Contractor supplied borrow in accordance with section 00330 of the Standard Construction Specifications will be utilized to supplement soil from site excavations and may be mixed with selected general backfill to produce soil classified as GC, GM in the Unified Soil Classification system.

**Construction**

**01091.40 Construct per Contract Documents-**  Streambed, Streambank and Floodplain Stabilization Treatments.

***(Designer’s Note: Designer to specify flow rates. Consult with Hydraulic Modeler for seasonal flow rates. Include SPP00290)***

**01091.42 Constructed Streambed and Spawning Gravels**

1. Perform all shaping of the sub-grade to the elevations, lines and grades, as shown. Shape, trim, and finish slopes of channels to conform to the sub-grade lines, grades, and cross sections as shown. The finished sub-grade will be reviewed and approved by the Owner prior to placement of any new material.
2. Transport and deliver streambed materials to the construction site in a separate and unmixed state for each specified gradation. Handling shall be limited to assure the integrity of the specified gradations and that segregation does not occur. Gradations are described in section 01091.10.
3. Where possible place boulders as described with approximately 1/3 of their volume projecting above the finished grades.
4. Place stone within the constructed streambed and banks to form a consolidated layer that conveys discharge across its surfaces without immediate subterranean flow when flow is restored to the constructed streambed and thereafter. Spawning Gravels are allowed subterranean flow, as approved by Owner’s Representative.
5. **Imported Streambed Stone Installation** – Place Imported streambed stone on top of the channel finished sub-grade to the lines, grades, and cross sections shown in the Contract Documents. Transport and deliver Streambed Stone materials to the project site in a separate and unmixed state for each specified gradation. Handling shall be limited to assure the integrity of the specified gradations and the segregation does not occur.
6. Place Framework Gradation stone in a lift with thickness equal to the largest stone in the gradation (i.e., 9 inches for 18-inch Constructed Streambed and 12 inches for 24-inch Constructed Streambed). Do not drop stones from a height greater than 2 feet above the finished subgrade.
7. Place Fines Gradation on top of each lift of the Framework Gradation and use water to wash the fines into the voids in the stone layer. Apply water sufficiently to assure that all void spaces are filled with fines. Do not place Fines Gradation within culverts.
8. Dewater as required during washing so water does not pool in the placement area and wash water does not discharge into receiving water.
9. Remove any excess fines prior to placing the next lift of Framework Gradation to assure stone to stone contact and that the subsequent lift does not rest on fines.
10. Place the next lift of the Framework Gradation as described above until the finish grade has been reached.
11. Finish grade tolerance = +/- 2 inches to allow for larger cobbles to protrude above the stated finish grade. Average profile grade will be as stated or indicated. The finish grade tolerance will not apply to boulders placed within the constructed streambed.

**01091.43 Large Woody Debris (LWD) Installation**

1. Obtain the necessary quantity and size of LWD elements for this project, including all labor, and equipment necessary for the transportation and installation of woody debris. Confirm locations for installation of LWD. Final location will be approved by the Owner’s Representative and will depend upon the size, shape and volume of LWD.
2. Place LWD as shown or directed to create aquatic habitat and to result in a stable placement. In some locations, LWD retention is accomplished through burial or partial burial. Excavate as necessary to place large woody debris. Shape and finish subgrade to allow for placement of LWD as indicated and directed.
3. Use select general backfill and imported streambed stone for log and rootwad backfill material as shown. Place backfill material around log or rootwad and compact. Compact backfill material using a “jumping jack” or other similar hand operated compaction equipment around log or rootwads to 90% maximum density per AASHTO T-99(Note: check moisture content).

***(Designer note: Consult Reveg. for seed application rates and adjust yellow highlighted below.)***

**01091.45 Streambank and Floodplain Stabilization Treatments** :

1. **Floodplain Stabilization Treatment** – Stabilize graded slopes adjacent to the stream by staking biodegradable matting fabrics on top of the finished grades.
2. **Streambank Stabilization Treatment** –Stabilize streambanks using fabric wrapped soil lifts constructed with soil, owner-supplied seed, streambank matting fabrics, and wooden stakes. Construct fabric wrapped soil lifts to lines and grades as shown or directed. Stake matting tightly, with no loose fabric. Stake areas with tapered wooden stakes to hold matting firmly to underlying soil. When fabric folds are required around channel bends, the fold shall be in the direction of flow and the fabric will be staked at the folds.
3. **Coir Streambank Fabric**
4. Perform all shaping of the sub-grade to the elevations, lines, and grades as shown or as indicated. Owner’s Representative will approve the finished sub-grade.
5. Grade the area to be covered by coir fabric to a smooth condition free from depressions and protruding rocks, sticks, and other debris which may prevent a smooth application or that may damage the fabric. Remove all objects that could interfere with application or damage the coir fabrics.
6. Place woven coir fabrics, as shown, overlaying nonwoven coir fabric. The coir fabrics shall be placed, stretched tightly, and anchored as shown using wood stakes. Where both layers of coir fabrics are present, wood stakes shall be installed through both layers. It is not required to anchor the nonwoven and woven fabrics individually. Wood stakes shall be placed between the fibers of the woven coir fabric. Cutting of the coir fabrics to facilitate wooden stake placement will not be allowed.
7. Complete all seeding using owner-supplied seed.
8. Apply seeding to soil with mechanical spreaders that uniformly. Apply seed to soil prior to folding back and staking coir fabrics as shown.
9. Overlap coir fabric such that upstream pieces of fabric overlap the downstream piece of fabric a minimum of 1 foot. Stake coir fabric with wooden stakes placed 1 foot on-center.
10. Install coir termination trenches along the edges of the coir fabric sheet as shown or indicated. Install coir transition trenches along the edge of the proposed streambed as indicated.
11. Coordinate the installation of the coir streambank fabrics with the placement of the LWD. Fit coir fabric around Logs and Rootwad structures with a minimal amount of cutting. Tuck coir fabric underneath Logs and Rootwad elements. Stake around all cut edges of coir fabric with the wooden stakes at 12-inches on center spacing. All exposed soil between top of bank and toe of bank must be covered by coir fabric.
12. Damaged coir fabric shall be repaired or replaced. If damaged coir fabric has a tear of 6 inches or less, scrap fabric may be placed beneath damaged woven coir fabric such that it extends 24 inches beyond the damaged area in all directions. Stake around the tear with 4 wooden stakes on 12-inch centers. Coir fabric with tears greater than 6 inches shall be replaced at no additional expense to Owner.
13. Install coir streambank fabrics stretched taught and staked to have firm contact with underlying soil. Install additional wooden stakes, as directed, to tighten up loosely staked coir fabrics.
14. **Coir Erosion Control Fabric**
15. Perform grading to the elevations, lines, and grades as shown in the Contract Documents or as indicated. Owner’s Representative will approve the finished grade.
16. After finish grading, rip all disturbed soil areas within the limits of construction. Soil shall be ripped to a depth of at least 12 inches, including all areas around floodplain wood, as directed. Soil shall be ripped with a Ripco© D3C Multi Shank Ripper Unit or equivalent rear-mounted unit. Ripping with a toothed bucket will not be accepted. After ripping, no further machine traffic over ripped areas shall occur.
17. After ripping, grade the area to be covered by coir fabric to a smooth condition free from depressions and protruding rocks, sticks, and other debris which may prevent a smooth application or that may damage the fabric. Remove all objects that could interfere with application or damage the coir erosion control fabric.
18. Seeding shall be applied following finish grading and ripping and prior to erosion control fabric placement with mechanical spreader that uniformly apply dry seed.
19. Overlap coir erosion control fabric such that upstream pieces of fabric overlap the downstream piece of fabric a minimum of 1 foot. Stake coir erosion control fabric with wooden stakes placed 1 foot on-center spacing.
20. Install coir termination trenches along the edges of the coir fabric sheet as shown or indicated. Install coir transition trenches along the edge of the proposed streambed as indicated.
21. Coordinate the installation of the coir fabric with the placement of the LWD. Fit coir fabric around Logs and Rootwad structures with a minimal amount of cutting. Tuck coir fabric underneath Logs and Rootwad elements. Stake around all cut edges of coir fabric with the wooden stakes at 1 foot on center spacing. All exposed soil between top of bank and toe of bank must be covered with coir.
22. Repair or replace damaged coir fabric. If damaged coir fabric has a tear of 6 inches or less, scrap fabric may be placed beneath damaged woven coir fabric such that it extends 24 inches beyond the damaged area in all directions. Stake around the tear with 4 wooden stakes on 1 foot on-center spacing. Coir fabric with tears greater than 6 inches shall be replaced at no additional expense to Owner.

**Restoration and Clean up**

**01091.60 General**  **-** At the end of the Work, stabilize all disturbed soils, including temporary access roads, level all unlevel and uneven areas at the staging-access area and impacted areas near the Work area at no additional cost to the Owner.

1. **Damaged streambanks** – Restore streambanks to a natural slope, pattern, and profile suitable for establishment of permanent woody vegetation and seeding or as directed by the Owner’s Representative.
2. Stockpile all large wood, native vegetation, weed-free topsoil, and native channel material displaced by construction. Cut large wood into pieces of no less than 20 feet in length, or as approved by the Owner’s Representative. Stockpiled native wood and vegetation remain the property of the Owner or as directed.
3. At the end of the Work, stabilize all disturbed soils, including temporary access roads per Section 00280.
4. **Pavement** - Restore pavement per Contract Documents.

**Measurement**

**01091.80 Measurement** – Measurement for stream restoration and enhancement is made in accordance with the specified unit of measure.

**(a) Stream Diversion and Dewatering Plan (SDDP)**– No measurement will be made for the Stream Diversion and Dewatering Plan.

**(b) Streambed Boulders** – Streambed Boulders will be measured on a weight basis, by the ton, in the hauling vehicle.

**(c) Constructed Streambed** – Stone placed for constructed streambed will be measured on a weight basis, by the ton, in the hauling vehicle for each gradation specified.

**(d) Large Wood (LW)** - Measurement for LW is made on a unit basis, per each for the items Logs and Rootwads. Slash will be measured on a volume basis by cubic yard.

**(e) Constructed Streambank** - Measurement for Constructed Streambank will be made on an area basis per square foot of vertical wall face for the item “Constructed Streambank.”

***(Designer’s Note: Coordinate payment of Constructed Streambed and Constructed Streambank with payment for Earthwork; i.e., Embankment and Excavation SPP00330.)***

**Payment**

**01091.90 Payment** - The accepted quantities will be paid for at the Contract unit price per unit of measurement for one or more of the following unique pay items:

**Pay Item Unit of Measurement**

(a) Stream Diversion and Dewatering Lump Sum

(b) Streambed Boulders Ton

(c) Constructed Streambed Ton

(d) Log Each

(e) Rootwads Each

(f) Slash Lump Sum

(h) Constructed Streambank Square Foot of Vertical Wall Face

Item (a) includes all costs incurred for providing, installing operating and maintaining Stream Diversion and Dewatering, Turbidity monitoring, and Work Isolation during the duration of the Work, per Section 00290. No additional payments will be made for outfall energy dissipation system.

Items (b) and (c) include all costs for providing and placing stone materials used for streambed construction.

Items (d), (e), and (f) include all costs for providing and placing the materials as shown in the Contract Documents and directed by Owner’s Representative. This includes excavation for placement, pinning, anchoring, backfill, and disposal.

Item (h) includes providing all materials, labor, and equipment necessary for construction of fabric-wrapped soil lifts. No additional payments will be made for coir fabrics and wooden stakes.

No additional payments will be made for installation of Owner supplied seed per 01030.

Payment will be payment in full for furnishing and placing all materials, and for furnishing equipment, labor and incidentals necessary to complete the Work in this Section.