# REDWOOD NATIONAL PARK

## DESIGN PLANS FOR CONSTRUCTION OF

### STRAWBERRY CREEK

#### RESTORATION PROJECT

**REDWOOD NATIONAL PARK (RNP)**
- March, 2012
- **FINAL PLANS**

**Prepared For:**
- Redwood National Park (RNP)
- Pacific Coast Fish, Wildlife and Wetlands Restoration Association (PCFWRA)

**DESIGNED:** Michael A. Love
- Michael Love & Associates

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**LOCATION MAP**

Redwood National Park Boundary

PROJECT AREA
- Strawberry Creek at Old SOC

Atlantic Ocean

**31/02/2012**
Notes:
1. All trees shown shall remain and be protected, except where indicated.
2. Refer to P1 through P2 (Sheets 10–11) and P4 (Sheet 13) for (N) Channel Thalweg alignment.
3. Refer to Typical Cross Sections Sheets 14 and 19 for channel dimensions and limit of application.
4. Where Carex and wetland plants are present within limits of new channels or planting mounds, plants shall be excavated, including root system, temporarily heeled in and replanted as specified or at the direction of the owner.
5. Temporary Access Road shall have a minimum top width of 10 ft, minimum elevation of 23 ft and shall be constructed of min 2 ft depth imported Borrow consisting of sand and gravel underlain by geotextile. Stream flow shall be conveyed with a minimum 18 inch CMP or HDPE pipe.
6. After completion of culvert installation, Temporary Roadway Borrow material shall be incorporated into Planting Mounds.
Note:
1. All trees shown shall remain and be protected, except where indicated.
2. Refer to P2 through P3 (Sheets 11-12) for (N) Channel Thalweg alignment.
3. Refer to Typical Cross Sections Sheet 14 for channel dimensions and limit of application.
Notes:
1. All trees shown shall remain and be protected, except where indicated.
2. Refer to P4 (Sheet 13) and P5 (Sheet 22) for (N) Channel Thalweg alignment.
3. Refer to Typical Cross Sections Sheet 19 for channel dimensions and limit of application.
4. Where Carex and other native wetland plants are located within the limit of grading, plants shall be excavated, including root system, temporarily healed-in and replanted as specified or at the direction of the Owner.
### TABLE OF TYPICAL CROSS SECTION APPLICATION ALONG STRAWBERRY CREEK ALIGNMENT

<table>
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<tr>
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<tr>
<td>0+0 to</td>
<td>9+85</td>
<td>Slough Channel</td>
</tr>
<tr>
<td>9+85 to</td>
<td>--</td>
<td>Log Step</td>
</tr>
<tr>
<td>9+85 to</td>
<td>10+10</td>
<td>Riffle</td>
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<tr>
<td>10+15 to</td>
<td>10+30</td>
<td>Pool</td>
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<td>10+30 to</td>
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<td>Log Step</td>
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<td>10+75 to</td>
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<tr>
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<td>11+20</td>
<td>Pool</td>
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<tr>
<td>11+20 to</td>
<td>--</td>
<td>Log Step</td>
</tr>
<tr>
<td>11+20 to</td>
<td>11+45</td>
<td>Riffle</td>
</tr>
<tr>
<td>11+50 to</td>
<td>11+65</td>
<td>Pool</td>
</tr>
<tr>
<td>11+65 to</td>
<td>11+96</td>
<td>Culvert Outlet Channel</td>
</tr>
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### Notes:
1. All cross sections are oriented looking up-station.
2. At stations where Typical Sections are not defined, transition gradually between defined sections upstream and downstream.
3. See Sheets 15 to 18 for detailed Grading Cross Sections.
West Fork Tributary Culvert Replacement Specifications

Material Specifications
1. Structural Backfill (Culvert) shall conform to Section 19-3.06 of Caltrans, 2006. Shall have no less than 20% sand, and shall conform to the following gradation:

<table>
<thead>
<tr>
<th>Size</th>
<th>Percent Passing</th>
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<tbody>
<tr>
<td>3&quot;</td>
<td>100%</td>
</tr>
<tr>
<td>No. 4</td>
<td>36-100%</td>
</tr>
<tr>
<td>No. 30</td>
<td>20-100%</td>
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2. Structural Backfill (Embankment) shall conform to Section 19-3.06 for backfill material to be compacted to a relative compaction of no less than 95%.

3. Suitable salvaged materials for Structural Backfill (Embankment) shall be separated and stockpiled for reuse.

Installation Specifications
1. Installation of the West Fork Tributary Culvert replacement shall be installed as specified in the contract documents and in accordance with Section 19 of Caltrans 2006.

2. During Structural Excavation, suitable materials shall be separated and stockpiled for reuse as structural backfill (Embankment).

3. Structural Backfill (Culvert) shall be compacted to a relative compaction of no less than 95%.

4. Structural Backfill (Embankment) shall be compacted to a relative compaction of no less than 90%.

Temporary and Permanent Re-Routing of Existing Water Line

Material Specifications
1. Materials and work shall conform to ASTM American Water Works, Chapter 16 Article 4 of the Title 23 of the California Code of Regulations (2010), and other relevant standards. All materials and methods shall be approved by the Orix Community Services district prior to installation.

2. All temporary pipe material shall be Schedule 80 PVC, HDPE, or steel pipe.

3. Bedding and backfill material for pipelines shall consist of Class 3 inch max Class 2 Aggregate Base as specified in Section 25 of Caltrans, 2006.

Installation Specifications
1. Contractor shall maintain an in-service water supply line to SOC buildings during the project. If continuous water service to the work area will be interrupted during portions of the work, the Contractor shall notify the Owner a minimum of one week in advance of anticipated water shutdowns. The maximum duration for a water shutdown is eight (8) hours.

2. Contractor shall be responsible for verifying pipe sizes, particularly the Outside Diameter (O.D.) of all pipes at connection points, to ensure that commonly available coupling hardware and gaskets will accommodate the existing pipes PRIOR to cutting into any pipe.

3. Water main and service pipe shall be installed in conformance with AWWA C600, and pipe manufacturer’s recommendation.

4. All pipe shall be centered in the trench and laid on compacted bedding.

5. Water main and service pipe ends and service hardware shall be thoroughly cleaned before the pipe is joined. Whenever work ceases for any reason, all exposed pipe ends and hardware shall be closed with a watertight filler, plug, or cover. The interior of the pipe shall be kept free from dirt and debris as the work progresses.

6. Pressure and bacteria testing and disinfection of new water mains and services shall be successfully performed in accordance with AWWA C600 and C651 and accepted by the Owner prior to placing the new pipeline and services into service.

7. Bedding and backfill shall be installed minimum thickness of 1-foot completely surrounding the pipe and compacted to 95%.

Specification for Culvert Streambed Material

Material Specifications
1. Culvert Streambed Material shall meet the following gradations and shall be approved by Owner prior to installation:
   a. 2/3 by weight Rattle Gravel, as specified in the Contract Documents
   b. 1/3 by weight 4 to 6 inch diameter angular rock

Installation Specifications
1. Culvert Streambed Material shall be installed as specified on the Contract Documents and where directed by the Owner.

2. Culvert Streambed Material shall be uniformly mixed and installed such that it does not segregate during installation.

3. Fill voids with smaller material and compact using construction equipment and flooding to obtain a compact, low-permeability mass.

4. After installation, material shall be flooded and further compacted. Continue flooding and compacting until voids are filled and water remains flowing on the surface across the entire length of the installed material.

5. No water used during the flooding process shall be allowed to discharge into the live stream, but may be reused.

6. Fine material washed downstream resulting from flooding shall be fully removed prior to releasing streamflow into project area.

Specification for Rock Steps in Culvert

Material Specifications
1. Rock Step rock shall meet gradations as follows:
   a. ½ Ton RSP
   b. All rock diameters (D) are measured along the intermediate axis. The least dimension (minor axis) of an individual rock fragment shall not be less than one-third the greatest dimension of the fragment.

Installation Specifications
1. Rock Steps shall be installed as specified on the Contract Documents, and where directed by the Owner.

2. Rock shall be placed in accordance with Caltrans, 2006 Section 72 and using “Method A” placement as specified in Caltrans, 2006 Section 72-2.03. No filter cloth shall be installed.

3. All large rock shall be placed individually and secured by machine tamping. Rocks shall have a minimum of four contact points and be securely supported. Rocks shall not be called together.

4. Invert elevation of Rock Steps shall be measured at contact point between two lowest slap rocks.

5. Crests of rocks shall not protrude more than 0.75 feet beyond finished grade.

6. Footer rocks shall be installed downstream of each Step rock.

7. Where bed retention sill is specified, the footer rock shall be installed downstream of the bed retention sill.

Culvert Stream Simulation Channel

Typical Cross Section (NTS)
Planting Mound Specification

Material Specifications
1. Salvaged Soil shall be soil salvaged from project-related excavation activities. Manmade materials excavated will be considered unsuitable and will become the property of the contractor for off-site disposal. Grubbed Material is considered unsuitable. Other organic material will be considered suitable for use. Excavated material may require de-watering before use.

2. Imported Borrow shall conform to Section 19-7-7 of Caltrans, 2006 and consist of a natural sand or gravel, with no individual fragments larger than 3 inches in diameter, no manmade materials, and a minimum of organic materials. After installation, the material shall remain permeable. Imported Borrow shall be approved by the Owner at the point of origin.

Installation Specifications
1. Planting Mounds shall be installed as specified on the Contract Documents, and where directed by the Owner.

2. Invasive grasses within the footprint of the Planting Mounds shall be grubbed to fully remove grass roosts, as directed by Owner.

3. Contractor shall place imported Borrow within the footprint of Planting Mounds for construction access. Placement of temporary Imported Borrow or salvaged soil outside the limit of the Planting Mounds is acceptable if the material is fully underlain by a material that protects wetland vegetation and if all materials are fully removed at the completion of work.

4. Before placement of salvaged soil, the top surface of the Imported Borrow shall be constructed to the elevation specified.

5. Place and tightly compact Salvaged Soil to meet finished grade on the Planting Mounds. Reworking of the soil after de-watering may be necessary to meet finished grade. Once soil is placed, area of placement shall not be used for construction equipment access.

6. Mound top width and elevation may vary ±0.5 ft or as directed by Owner.
Specification for Rock Slope Protection (RSP)

Material Specifications:
2. Rock shall be placed in accordance with Caltrans, 2006 Section 72 and using "Method A" placement as specified in Caltrans, 2006. No RSP Fabric shall be installed.

Installation Specifications:
1. RSP shall be installed where specified.
2. Install RSP as specified to the line and grade specified on the construction documents.
3. All large rock shall be placed individually and secured by machine tamping. Rocks shall have a minimum of four contact points and be securely supported.
4. Rocks shall be placed in one-foot lifts and soil placed to fill the voids between rocks. Soil shall be placed to not hinder rock-to-rock contacts.
5. Place smaller rocks and salvaged streamed material to fill voids between larger rocks.

Specification for Rock Weirs

Material Specifications:
1. Rock Weir rock shall meet gradations as follows:
   a. 1/4 Ton RSP
   b. Riffle Gravel Shall be as specified in the Contract documents
2. All rock diameters (D) are measured along the Intermediate axis. The least dimension (minor axis) of an individual rock fragment shall not be less than one-third the greatest dimension of the fragment.

Installation Specifications:
1. Rock weirs shall be installed as specified on the Contract Documents, and where directed by the Owner.
2. Excavate trench to the specified minimum depth for the entire Rock Weir length.
3. Rock shall be placed in accordance with Caltrans, 2006 Section 72 and using "Method A" placement as specified in Caltrans, 2006 Section 72-2.03. No filter cloth shall be installed.
4. All large rock shall be placed individually and secured by machine tamping. Rocks shall have a minimum of four contact points and be securely supported.
5. Invert elevation of Rock Weirs shall be measured at contact point between two lowest Weir Rocks.
6. Crests of rocks shall not protrude more than 0.75 feet beyond finished grade. Rocks shall not be cabled together.
7. Fill voids with smaller material to obtain a compact, low-permeability mass.
8. Backfill channel bottom with compacted Riffle Gravel.
9. Backfill streambanks with compacted native material.
Specification for Log Steps and Log Weirs

Material Specifications:
1. Contractor shall use logs provided on site. Logs shall not be cut unless at the direction of the Owner.
2. Logs shall meet the dimensions specified in the Contract Documents. Log length shall not be accomplished with joining of multiple logs.
3. Pile Logs shall have bark removed.

Installation Specifications:
1. Log Step and Log Weirs shall be installed as specified on the Contract Documents, and where directed by the Owner.
2. Excavate trench to the specified minimum depth for the entire structure.
3. Install logs such that the top of the Step or Wair Log forms the channel invert at the specified station, elevation, and location on the channel cross section.
4. The stacked log height shall be a minimum of 4 feet, measured vertically.
5. All logs shall be anchored where specified.
6. Cut point on tip of Pile Log and drive Pile Logs the specified length into the undisturbed subgrade at the specified pitch. Cut top of pile below finished grade.
7. Auger pilot hole may be used to facilitate driving of Raked Pile Logs. Pilot hole shall be at least 6 inches smaller than the Raked Pile Log diameter to ensure adequate skin friction is obtained.
8. Backfill channel bottom with compacted Riffle Gravel.
9. Backfill streambanks with compacted native material. Backfill under training Logs shall be hand compacted to the satisfaction of the Owner.

Specification for Riffle Gravel

Material Specifications:
1. Riffle Gravel shall be rounded gravels meeting the following gradations and shall be approved by Owner prior to installation:
   a. 90% to 95% finer than 2 inches
   b. 40% to 60% finer than 0.5 inches
   c. 5% to 15% finer than #10 Sieve

Installation Specifications:
1. Riffle Gravel shall be installed as specified in the Contract Documents and where directed by the Owner.
2. Riffle Gravel shall be uniformly mixed and installed such that it does not stratify during installation. Do not contaminate the Riffle Gravel with soil.
3. Fill voids with smaller material and compact using vibratory methods to obtain a compact, low-permeability mass.
4. After installation, material shall be flooded and further compacted. Continue flooding and compacting until voids are filled and water remains flowing on the surface across the entire length of the installed material.
5. No water used during the flooding process shall be allowed to discharge into the live stream, but may be reused.
6. Fine material washed downstream resulting from flooding shall be fully removed prior to releasing streamflow into project area.

LOG TO LOG ANCHORING
26-27-28-30
Detail Elevation (NTS)

Specification for Anchoring Log Structures

Material Specifications:
1. Log anchoring shall be in accordance with Contract Documents.
2. Threaded rebar, washer and nut shall be steel.
3. Threaded rebar shall be a minimum diameter of 1 inch with min 4-inch x 4-inch x 8 or 8½ inch thick steel washer plate with bolt.

Installation Specifications:
1. Log Anchoring shall be installed as specified on the Contract Documents, and where directed by the Owner.
2. All logs shall be anchored where specified.
3. Rebar shall be inserted through the center of the log and bolted on both ends. Rebar, washer, and nut, shall be fully recessed within the log.
4. Anchor shall be located a minimum of 2 feet from the end of the log.
5. If a through-connection cannot be made with rebar, threaded rebar can be driven a minimum of 1.5-feet into an underdrilled hole in the bottom log. One washer and nut shall be installed so that the uppermost log cannot move vertically.
6. Drilled rebar shall be installed where specified or with the permission of the Owner.
7. To minimize movement of logs, anchoring shall be installed such that connections are tight.
Specification for Log Crib Walls

Material Specifications:
1. Contractor shall use logs provided on site. Logs shall not be cut unless at the direction of the Owner.
2. Logs shall meet the dimensions specified on the Contract Documents.
3. No single log shall be less than 12 feet in length.

Installation Specifications:
1. Log Crib Walls shall be installed as specified on the Contract Documents, and where directed by the Owner.
2. Install bottom Crib Logs on the existing ground surface at the locations specified.
3. Cut deadman logs to form a lap joint with a minimum of 2 feet overlap with the bottom crib log. Deadman log shall be cut to create an approximately 1-foot high gap between bottom and top crib logs.
4. Secure deadman to bottom crib log using a driven rebar connection, with bolt located on top of deadman log.
5. Install top crib log as specified, with a driven rebar connection with bolt located on top of crib log.
6. The cribwall height shall be a minimum of 5 feet, measured vertically.
7. All logs shall be anchored where specified.
8. If lap joints are necessary, joint shall overlap a minimum of 2 feet, anchored with Log to Log Anchoring. The surface of the lap joint shall be installed parallel to the ground surface such that the rebar connection is oriented vertically.
9. Backfill crib wall in accordance with Planting Mound Details.

Log Crib Wall
Elevation (NTS)

Log Crib Wall
Profile (NTS)
Specification for Habitat Logs

Material Specifications
1. Contractor shall use logs provided on site. Logs shall not be cut unless at the direction of the Owner.
2. Logs shall be a single log meeting the dimensions specified on the Contract Documents.
3. Salvaged branches and leaves shall consist of limbs, branches and leaves salvaged from clearing and grubbing operations.

Installation Specifications
1. Habitat Logs shall be installed as specified on the Contract Documents, and where directed by the Owner.
2. Deadman logs can be installed by either trench excavation or driving them into the streambank. Logs shall be installed so that they are roughly parallel, approximately 10 feet apart, and oriented upstream at an angle of 60 to 80 degrees from the streambank.
3. Downstream Deadman Log shall be installed sloping into the streambank at an approximately 10°-15° pitch.
4. If rootwad is present, rootwad shall face upstream.
5. Cross log shall be placed under the downstream Deadman Log near the channel bottom.
6. Where installed logs cross, provide a minimum of 1 foot overhang.
7. All logs shall be anchored where specified.
8. Backfill excavated trench with compacted native material. Loosely pack area between Cross-Log and streambank with salvaged branches, sticks and leaves.
Specification for Planting Mound and Riparian Area Planting Zones

**Material Specifications**

1. Plantings shall consist of 2-year-old potted Sitka Spruce and Red Alder provided by Owner. Live willow stakes shall be as specified in these Contract Documents.
2. Carex shall consist of plants salvaged from the work areas and broken into clumps that contain approximately 1 quart of roots.
3. Cardboard shall consist of corrugated cardboard rolled or fanfolded with cornstarch glues. Minimum width shall be 60 inches.
4. Burlap shall consist of 10-ounce natural fibers with a minimum width of 60 inches.
5. Mulch shall consist of shredded redwood wood and bark. Mulch shall be manufactured from clean wood and shall have a particle size between 1/8 inch and 1 1/2 inches in thickness and one inch to 8 inches in length, and shall be free of salt and deleterious materials such as clods, coarse objects and rocks.
6. Staples shall be 6 inch minimum length and biodegradable.
7. No soil amendments shall be installed.
8. Owner shall be responsible for watering and maintenance after installation.

**Installation Specifications**

1. Invasive grasses within the limit of planting area shall be grubbed to fully remove grass roots, or to a maximum depth of 3 feet below existing grade. Grubbed material shall be disposed of on-site at the direction of the owner.
2. Where existing Carex grasess are present within the limits of excavation of planting mounds, plants shall be excavated to preserve root mat. Grasses shall be stored in a moist, sunny location, with roots covered with soil. Carex shall be replanted along new channel edge and bottom of planting mounds at the direction of the owner.
3. Place cardboard on finished ground surface the full length and width of the planting zone. Cardboard shall overlap a minimum of one foot.
4. Place burlap over cardboard the full length and width of the planting zone. Burlap shall overlap a minimum of one foot. Overlaps shall be located a minimum of 3 feet away from cardboard overlaps. Install staples through cardboard and burlap at 5 ft O.C.
5. Plantings shall be installed as specified on the Contract Documents, and where directed by the Owner.
6. To install plant, cut a small hole, slightly larger than the planting stem through the cardboard and burlap.
7. Installation and mulching of plants shall conform to California, 2006 Section 20 and at the spacing and mulch depth indicated on the Contract Documents. Installed mulch shall not touch stems or branches of planting.
8. Stakes, root, or foliage protectors shall not be installed.
Specification for Live Willow Stakes

Material Specifications
1. Live Willow Stakes shall consist of live willow branches harvested locally at the direction of the Owner.
2. Stakes shall be straight and no shorter than 4 feet in length and 1/2 to 3 inches in diameter.
3. Harvested material shall be live, freshly cut, and dormant. The plant material shall be free from disease and harmful insects. Branch ends shall be cut at an angle to facilitate easy insertion into the soil. The tops shall be cut square or blunt.
4. Plant materials shall not be stored greater than 48 hours after harvesting. Plant material shall be protected from drying by means of covering with canvas, burlap or straw and shall be kept moist.
5. No soil amendments shall be installed.
6. Owner shall be responsible for watering and maintenance after installation.

Installation Specifications
1. Live Willow Stakes shall be installed as specified on the Contract Documents, and where directed by the Owner.
2. Create pilot holes to the full depth of the stake installation.
3. Stakes shall be installed at the spacing indicated on the Contract Documents, with approximately 1-foot of stake extending beyond finished grade after installation. Leaf buds shall point up.
4. Stakes shall be pushed or driven into the bank in a method that minimizes crushing and splitting of the top of the cutting. The tops of the cuttings shall be trimmed as necessary to remove split and crushed wood.

Specification for Nurse Logs

1. Contractor shall use logs provided on-site. Logs shall not be cut unless at the direction of the Owner.
2. Owner shall select logs to be used as Nurse Logs. Logs will typically be the following dimensions:
   a. Nurse Log: 5 to 12-foot long, 4 to 6-inch diameter log.
   b. Footer Log: 5 to 15-foot long, 1.5 to 2-foot diameter logs.
3. Sitka Spruce tubings shall have a minimum rooting depth of 5 inches and a minimum of 5 inches of healthy stem and branch growth.
4. Planting Soil shall be acidic with a uniform mix of equal quantities of sand, soil and humus or peat.
5. Soil stabilization matting shall be biodegradable woven coir matting with an open area of 39 to 50%, and a minimum weight of 20 oz/yd.
6. Logs shall not be anchored together.

Installation Specifications
1. Nurse Logs shall be installed as specified on the Contract Documents and directed by the Owner.
2. Install logs to facilitate use of natural planting areas in logs such as rotten area, splits, or protrusions between roots.
3. Cut planting shelves or trenches in nurse log that provide positive drainage. Cut areas shall be a minimum of 8 inches deep and 8 inches wide.
4. Drill drainage holes.
5. Loosely place planting soil in cut area.
6. Cover entire area of planting soil with double layer soil stabilization matting stapled to wood. Staples shall be placed every 2 inches.
7. Create pilot hole and place tubings such that roots are covered with a minimum of 5 inches of soil and 2 inches of thickness between roots, wood or soil stabilization matting.
8. Plant up to 16 tubings per nurse log.
9. Loosely mound Salvaged Soil on one side of Nurse Log adjacent to planting areas and to provide additional space for root growth.