



## **Sardine Meadow Restoration**

### **Revegetation Plan**

The Revegetation Plan for Sardine Meadows accompanies the “Sardine Meadow Restoration Project, Sierra County, CA – 100% Design Plan” prepared by Balance Hydrologics for the Truckee River Watershed Council (Balance, 2020).

The Revegetation plan consists of:

Section A. Revegetation techniques linked to plan sheets, organized by project area

Section B. Details for implementing revegetation techniques

Total disturbed area requiring revegetation is approximately 19 acres.

### **Section A. Revegetation techniques by plan sheets included in the 100% Design Plans, organized by project area.**

#### **Area 1: Upper Davies Creek Main Channel, areas to be lowered (sheets 3.6 and 3.7)**

- Harvest existing sod, sort into vegetation types, and store near transplant area. Use upland sod type in main channel for fill type B.
- Lower area as per specifications.
- Replant sod from excavation sites in strips throughout the lowered areas, this should cover about 75% of the area. Use sod in 3 foot to six foot square pieces, size depends on equipment used for sod harvesting and planting.
- Between the sod pieces install erosion control blankets as described in the techniques, this must be done in fall 2020. Plant plugs 2 ft. on center, as described in techniques section, may be done on fall 2020 or spring 2021. Plugs will be harvested from specific areas identified by the project botanist, see Attachment A for general overview of sod and plug harvest locations.
- Overseed areas without sod with mesic-wetland seed mix. Seed provided by TRWC. See tables below for material quantities.

#### **Area 2: Upper Davies Creek Main Channel (sheets 3.8, 3.9)**

##### **Fill Type B (Fill to top of existing bank) –**

- Harvest existing sod, sort into vegetation types, and store near transplant area.

- Fill as per specifications.
- Apply salvaged upland/dry meadow sod mats, cover 100% of area.

**Fill Type C (Fill to height of adjacent relic channels) –**

- Harvest existing sod, sort into vegetation types, and store near transplant area.
- Fill as per specifications.
- Transplant sod mats to cover 50% of the area in 2-3 foot wide strips across the channel with no more than 3 foot gaps. Within gaps plant wetland plugs 1 foot on center, cover with a natural fiber erosion control blanket. Make sure blanket overlaps sod mat by at least 6 inches and stake with wooden stakes or live willow stakes.
- Overseed areas with wetland plugs with wetland seed mix. Seed provided by TRWC. See tables below for material quantities.

**Fill Type A (No fill) – The treatments specified for Fill Type A will be completed by other work crews, not by the construction contractor.**

- Not in Contract: Install willow wattles at OHWM (Ordinary High Water Mark). Use locally harvested Lemmon's and Geyers' willows.
- Not in Contract: Plant Obligate wetland plugs at a 1 foot on center along the OHWM.
- Not in Contract: Overseed whole area with Obligate wetland seed mix.

**Area 3: (Lower Davies Creek – main channel below RR grade) 3.10, 3.12, 3.13, 3.14 and 3.15)**

**Fill Type B (Fill to top of existing bank) –**

- Harvest existing sod, sort into vegetation types, and store near transplant area.
- Fill as per specifications.
- Apply salvaged upland/dry meadow sod mats, cover 100% of area.
- Overseed area with wet-mesic meadow seed mix. See tables below for material quantities.

**Fill Type C (Fill to height of adjacent relic channels) –**

- Harvest existing sod, sort into vegetation types, and store near transplant area.
- Fill as per specifications.
- Apply wet/mesic meadow sod mats downstream of the railroad grade cover 100% of the area.
- Overseed areas with wetland plugs with wetland seed mix. See tables below for material quantities.



**Fill Type A (No fill) – The treatments specified for Fill Type A will be completed by other work crews, not by the construction contractor.**

- Not in Contract: Install willow wattles at OHWM (Ordinary High Water Mark). Use locally harvested Lemmon's and Geyers' willows.
- Not in Contract: Plant Obligate wetland plugs at a 1 foot on center along the OHWM.
- Not in Contract: Overseed whole area with Obligate wetland seed mix.

**Area 4: Relict Channels (sheets 3.4, 3.5, 3.9)**

**Fill Type A (No fill) –**

- Hydroseed with wetland seed mix. Seed provided by TRWC.  
See tables below for material quantities.

**Fill Type B (Fill to top of existing bank) –**

- Harvest existing sod, sort into vegetation types, and store near transplant area.
- Fill as per specifications.
- Replace upland/dry meadow sod in the side channel on sheets 3.4, 3.5 and 3.9. Use only sod from the side channel, sod within the main channel may have RCG seed. Existing sod should allow 50% - 75% of the area to be covered. Within gaps cover with erosion control blanket and overseed with mesic/wet meadow seed mix.  
See tables below for estimated quantities of materials

**Fill Type C (Fill to height of adjacent relic channels) –**

- Harvest existing sod.
- Fill as per specifications.
- Transplant in the same area.

**Area 5: Historical Ditch (sheets 3.1, 3.2 and 3.3)**

**Fill Type A (No fill) –**

- No treatment.

**Fill Type B (Fill to top of existing bank) –**

- Harvest existing sod, sort into vegetation types, and store near transplant area. Use wetland vegetation in main channel downstream of the railroad grade.
- Fill as per specifications.



Replace with upland/dry meadow sod from the railroad grade and the historical ditch. Existing sod should allow 50% - 75% of the area to be covered. Place the sod in 2-3 foot wide strips across the channel with no more than 3 foot gaps. Within gaps overseed with upland/dry meadow seed mix. See tables below for material quantities.

**Fill Type C (Fill to height of adjacent relic channels) –**

- Harvest existing sod.
- Fill as per specifications.
- Transplant in the same area.

**Area 6: Historical Railroad Grade (sheets 3.10 and 3.11)**

**Fill Type C (Fill to height of adjacent relic channels) –**

- Harvest existing sod, sort into vegetation types, and store near transplant area. Use wetland sod locally.
- Excavate and fill as per specifications.  
Apply wet/mesic meadow sod mats to cover 100% of the area.

**Fill Type B (remove grade, blend with adjacent meadow grade) -**

- Harvest existing sod, sort into vegetation types, and store near transplant area. Use wetland sod locally.
- Excavate and fill as per specifications.
- Transplant the upland sod that was harvested from the railroad grade.
- Use excess upland sod for fill type B along the historical ditch (Area 5).

**Area 7: Grade Control Structures (sheets 3.14, 3.15, 4.2 and 4.3)**

- Harvest existing sod, sort into vegetation types, and store near transplant area. Remove sod with RCG and treat, see weed control methods. Use weed free wetland sod in main channel downstream of the railroad grade. Use upland sod at grade control structures
- Fill as per specifications.
- Transplant upland sod on top of fill in areas off the channel. Import upland sod from other areas of the project as needed. Seed any upland areas not covered in sod, this could be 25% of the area depending on available sod.
- Harvest willow stakes from willows prior to harvesting sod. Do not transplant willows RCG is growing within the willows and will spread. Treat sod with RCG per weed management plan.



## C.S. Ecological Surveys and Assessments

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Plant willow stakes along channel upstream of the grade control structures for 40 feet, at the OHWM.

See tables below for material quantities.

### **Area 8: Staging Areas and Access Routes**

- De-compact soil to a depth of > 8 inches.
- Till in native woodchips.
- Hydroseed with upland/dry meadow seed mix using tackifier.

In areas to be used after the project for parking cover with native woodchips to a depth of at least 3 inches.

See tables below for material quantities.

## Tables of Materials

### Plugs

Planting Area	Needed	Needed	Available harvest area	Available*
	sq ft	# of plugs	sq ft	# of plugs (Harvest 1'/36' sq. split into 4 or 5)**
Areas 1 and 2: Type C Main Channel Plugs 1 ft O.C.	17,315.22	17,315	102,740.8	14,270
<b>Not in Contract:</b> Type A Obligate Plugs at OHWM 1 ft O.C.	5,228.45	5,228	90,826.83	12,615
Area 1: Lowered Areas 25% 2 ft O.C.	65,293.05	4,080	477,103.5	66,264

\* Table notes available harvest area, but contractor only needs to harvest from enough area to meet needed number of plugs.

\*\*If harvested sod is split into 5 plugs, the # of available plugs will increase.

### Erosion Control Blanket

Erosion Control Blanket	Area sq ft.
Area 1: Lowered areas (25% cover)	65,293
Area 1: Type C upstream of RxR (50% cover)	16,261
Area 4: Type B relict channel (50% cover)	13,065
<b>Total</b>	<b>94,620</b>
<b>Plus 10% for overlap and extra areas</b>	<b>104,082</b>

### Seed

Seed	Area sq ft.	Type
Lowered areas (25% cover)	65,293	Mesic-Wet Meadow
Type C upstream of RxR (50% cover)	16,261	Mesic-Wet Meadow
Type B side channel (50% cover)	13,065	Mesic-Wet Meadow
Type A no fill (100% cover)* not in contract	52,285	Obligate Wetland
Type B historic ditch (100% cover)	57,190	Dry Meadow-Upland
Upland areas of grade control (up to 25% cover)	1,409	Dry Meadow-Upland
Staging area (100% cover)	TBD*	Dry Meadow-Upland
<b>Total</b>	<b>205,503</b>	

\*It is assumed that the actual size of the staging areas will vary from what is shown on the plan

## **Section B: Detailed Revegetation Techniques for Plan Set**

### **Revegetation Techniques**

#### **Erosion control blanket installation and specifications –**

Apply erosion control blankets as specified between sod mats. Place the upstream end of the erosion control blanket under the sod mats, with at least six inches overlap. Place the downstream end of the erosion control blanket over the sod mats with at least six inches overlap. Secure the erosion control blankets with wooden stakes, as per product directions.

Example: <https://beltonindustries.com/wp-content/uploads/2017/10/GeoCoir-Installation-Guidelines.pdf>

Erosion control blankets are intended to protect the bare soil areas where wetland plugs and/or seed is applied, until the vegetation cover is sufficient to stabilize the areas. Where indicated above live willow stakes may be used along with wooden stakes. Hydroseed may be applied over the erosion control blankets. Plugs may be planted prior to installing the erosion control blanket, so long as the foliage of plugs is allowed to extend between the weave of the blanket. Smaller plugs may be planted after the blanket is installed either by planting within the weave of the erosion control blankets, or by pulling back the blanket planting the plugs and then re-securing the blanket.

Erosion control blankets will be provided by the contractor and shall be 100% coir fiber twine with a weight of approximately 400 g/sq.m, 65% open area of weave, such as Geocoir 400 (<https://beltonindustries.com/wp-content/uploads/2017/10/400.pdf>) or equivalent. Product specifications shall be submitted for approval prior to purchase.

#### **Harvesting Wetland Plugs**

Wetland and mesic meadow sedges, grasses, rushes and reeds may be harvested onsite (Attachment A and B) and at approved local offsite areas. Plugs should be harvested and planted in the fall when dormant or in the spring when soils are moist. For salvaged sod plugs timing may have to coincide with excavation plans. Try to use the most local source available, and minimize storage time. Follow directions given in USDA Technical Planting Guide #3, available at:

[https://www.nrcs.usda.gov/Internet/FSE\\_PLANTMATERIALS/publications/idpmcarwproj14.pdf](https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcarwproj14.pdf). Harvest approximately 6 inches of root material. Harvest only one square foot per a 6 foot by 6 foot area. Break the plug into 4 or 5 pieces making sure that for sedges, rushes and reeds each piece has a rhizome (lateral root) with an upright vegetative section. For grasses divide the roots equally among the 4 (or 5) pieces.

On this project it is important to close the holes after extracting the plugs to reduce the danger of livestock stepping in the holes. When planting dig down at least 10 inches, loosen the soil and insert the section of plug.

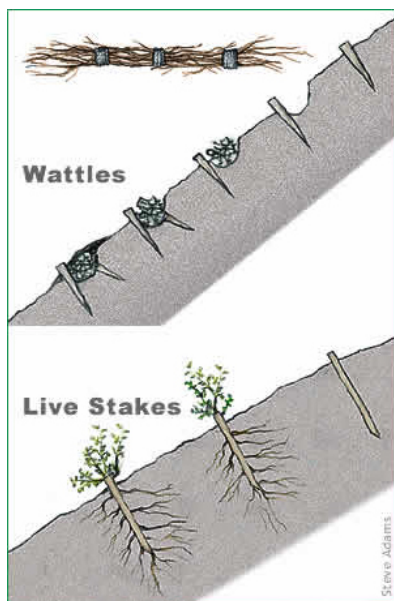
Suitable harvest areas will be mapped within and outside the project area. These areas have appropriate species and are not a source for Reed Canary Grass (RCG) an invasive weed.

### Harvesting Willows

Harvest - Harvest from local areas, harvest when willows are dormant (October to April). When harvesting do not take more than 1/5 of the willow stems/branches. Take stems/branches randomly from each willow shrub, not all concentrated in one area, leave a natural looking shrub. Harvest stems/branches that are at least  $\frac{3}{4}$ " in diameter at the smallest, about the diameter of a large adult thumb. Cut the bottom end of each pole/stake at a diagonal and the top flat so you know which end needs to be planted in the soil. Cut poles/stakes as long as possible, you can cut them shorter later.

Storage and Preparation - Store willows submerged in water, this can be in the stream on the project site. When ready cut stakes to about 2 feet in length, again making sure the bottom end of each stake is cut at a diagonal and the top is cut flat. Cut off any side branches, leaves or shoots.

Planting – If soil is wet enough willows may just be pushed into the soil. Often using a breaker bar or rock bar to make a hole will work best. Plant so that  $\frac{3}{4}$  of the willow is in the soil. Plant willows from the OHWM to 1 foot above the OHWM.



Please see "FIELD GUIDE FOR HARVESTING AND INSTALLING WILLOW AND COTTONWOOD CUTTINGS" available at:

[http://www.southernrockiesseed.org/wp-content/uploads/2020/01/Willow-and-Cottonwood-Guide\\_FINAL-2015.pdf](http://www.southernrockiesseed.org/wp-content/uploads/2020/01/Willow-and-Cottonwood-Guide_FINAL-2015.pdf)

### Willow Wattles –

Wattles, also called live fascines, are bundles of live branches used at the toe (bottom) and on slopes for stabilization and to introduce new plant material. Wattles reduce water velocity, trap sediment, and hold soil in place.

Both live stakes and wattles will sprout and grow, forming a living stabilization system.



## Preparation

Cut live poles/stakes for wattles as described above for willow stakes. Wattles will be anchored with live stakes that are prepared as above.

For wattles, use longer cuttings of the woody species, they can also be narrower ½" to 1" in diameter. Cut branches 5'-10' long or longer and place them in bundles 6"-8" in diameter. Stagger the branches to create longer wattles and distribute the tops throughout the length of the wattle. Use untreated twine or wire to tie the bundles together tightly (photo below).



Wattles are installed at the toe (bottom) of the slope, around the OHWM by excavating a trench similar in size to the wattle. Place the wattle in the trench and stake it in place using live stakes through and at the base of the wattle. Bury the wattle, leaving just the top slightly exposed. Excavate additional trenches on the contour of the slope spaced 2' apart as needed, most areas will only need one to two levels of willow wattles. Install wattles in each trench as described above.

Wetland sedge/reed/rush plugs will be planted above and below the willow wattles at OHWM.

The following website was used as a reference -  
<https://www.dnr.state.mn.us/rys/st/wattles.html>

## **Salvage and Replanting Sod –**

**Harvest Areas-** Sod will be harvested from all areas to be filled, lowered or excavated, with the exception of areas that have known populations of Reed Canary Grass (RCG), an invasive species. At these areas sod will be removed from the site and covered with clear plastic to kill RCG and any propagules (seeds and rooting fragments) of this species. Please see the weed management plan for more details on RCG control.

**Sorting by Vegetation Type and Hydrology –** Harvested sod will be sorted by vegetation type, i.e. upland/dry meadow, mesic/wet meadow, and obligate wetland. Sod will need to be planted in similar hydrologic zones. In general for this project that upland/dry meadow vegetation will be planted in fill type B, mesic/wetland sod will be planted in fill type C and obligate wetland



vegetation will be planted along the edges of the no fill area. Below is a list of species that fall in each of these three categories. Instruction on species and vegetation types will be provided prior and during excavation and planting.

**Timing of Harvest and Storage** – The best time to harvest sod is when the soil is well drained and moist, not wet and not dry. When possible construction should be designed to minimize storage time. If sod is only stored for 2-3 days no special treatment is necessary. For longer storage times please see “USDA TN Plant Materials No. 22, Oct. 2008 – Wetland Sod mats”, available at: <https://www.dnr.state.mn.us/rys/st/wattles.html>.

**Specifics of Harvesting and Planting** - Depending on the material sod mats may be as large as 8' by 8'. Sod mats should only be 6- 8" deep, this is sufficient to harvest the majority of roots. When planting, sod mats should be planted as close together as possible, much like sections of rubber mat, in order to reduce erosion and prevent establishment of weeds in barren ground. Within the project there are some areas where there is only enough appropriate sod to plant strips of sod with areas of scattered plugs in between. For these areas the strips should be placed no more than three feet apart. Natural fiber erosion control blankets will be installed over some sections with wetland plugs, as specified in this revegetation plan. These erosion control blankets will overlap the sod mats by at least six inches and will be anchored with wooden stakes along the junction with the sod mats.

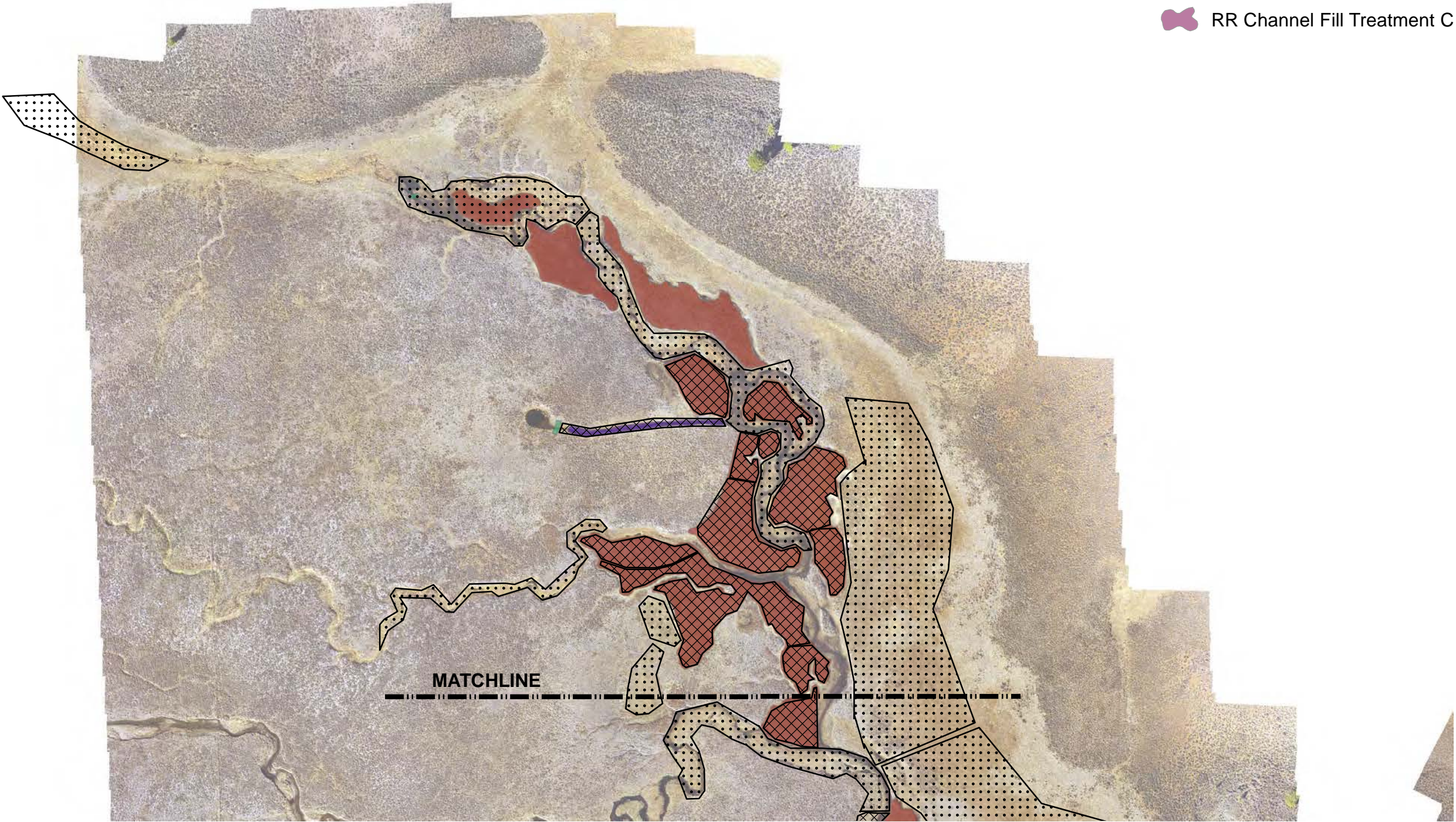
**Table of Observed Species by Vegetation Type**

Upland/Dry Meadow Sod	Wetland/Mesic Sod	Obligate Wetland Sod
Five finger cinquefoil ( <i>Potentilla gracilis</i> )	Baltic rush ( <i>Juncus balticus</i> )	Beaked sedge ( <i>Carex utriculata</i> )
Kentucky bluegrass ( <i>Poa pratensis</i> )	Five finger cinquefoil ( <i>Potentilla gracilis</i> )	Creeping spikerush ( <i>Eleocharis macrostachya</i> )
Lemmon's onion ( <i>Allium lemmonii</i> )	Kentucky bluegrass ( <i>Poa pratensis</i> )	Nebraska sedge ( <i>Carex nebrascensis</i> )
Long stalk clover ( <i>Trifolium longipes</i> )	Long stalk clover ( <i>Trifolium longipes</i> )	
Plumas ivesia ( <i>Ivesia sericoleuca</i> )	Meadow barley ( <i>Hordeum brachyantherum</i> )	
Sagebrush ( <i>Artemisia</i> sps.)	Muhly sps. ( <i>Muhlenbergia</i> sps.)	
Sandberg's bluegrass ( <i>Poa secunda</i> )	Nebraska sedge ( <i>Carex nebrascensis</i> )	
Squirreltail grass ( <i>Elymus elymoides</i> )	Sedge sp. ( <i>Carex</i> sps.)	
Western aster ( <i>Symphyotrichum spathulatum</i> )	Tufted hairgrass ( <i>Deschampsia cespitosa</i> )	
Wheatgrasses ( <i>Elymus</i> and <i>Leymus</i> sp.)	Western aster ( <i>Symphyotrichum spathulatum</i> )	
Yarrow ( <i>Achillea millefolium</i> )		

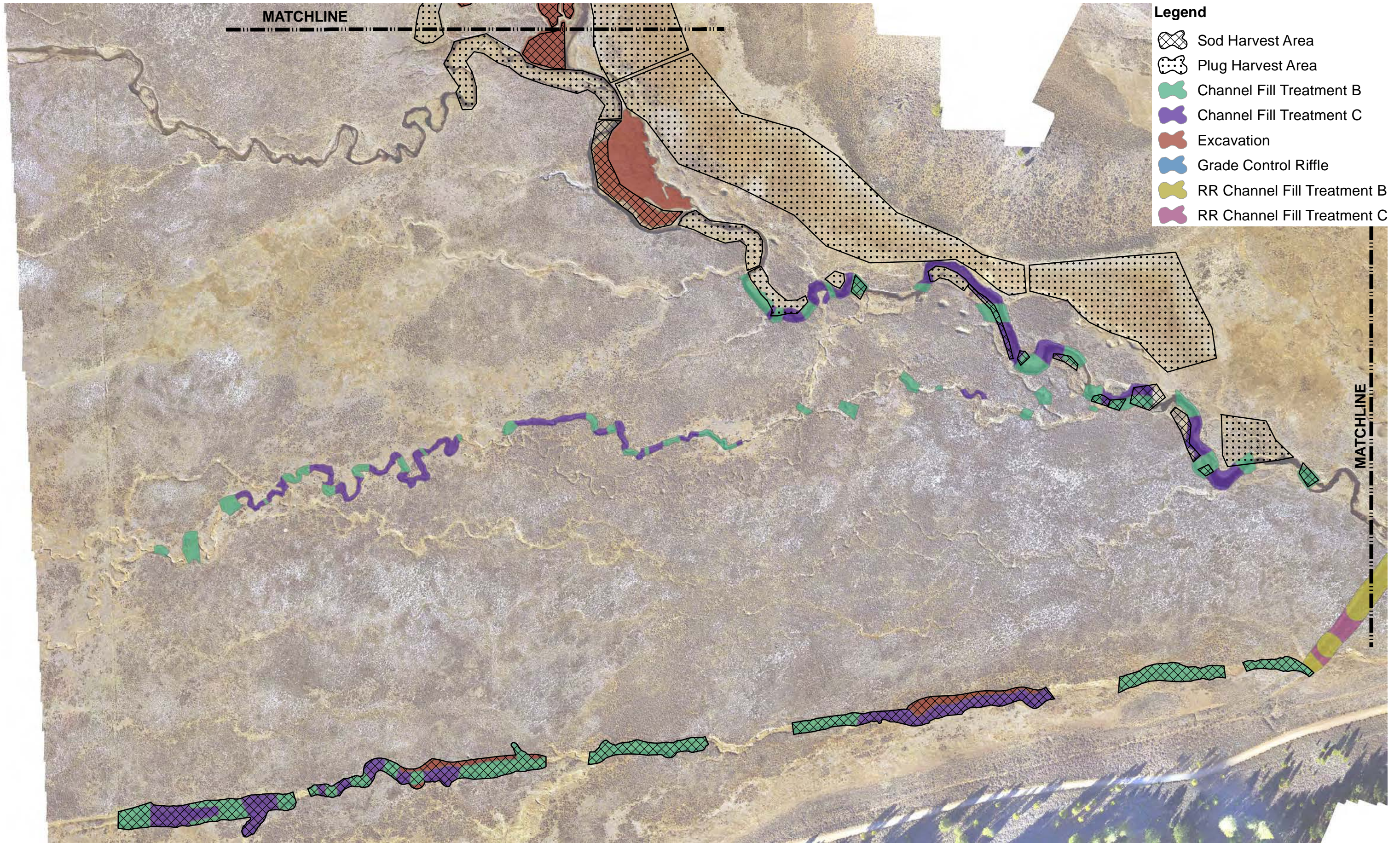


Attachment A. Sod and Plug  
harvest areas - overview

- Legend**
- Sod Harvest Area
  - Plug Harvest Area
  - Channel Fill Treatment B
  - Channel Fill Treatment C
  - Excavation
  - Grade Control Riffle
  - RR Channel Fill Treatment B
  - RR Channel Fill Treatment C

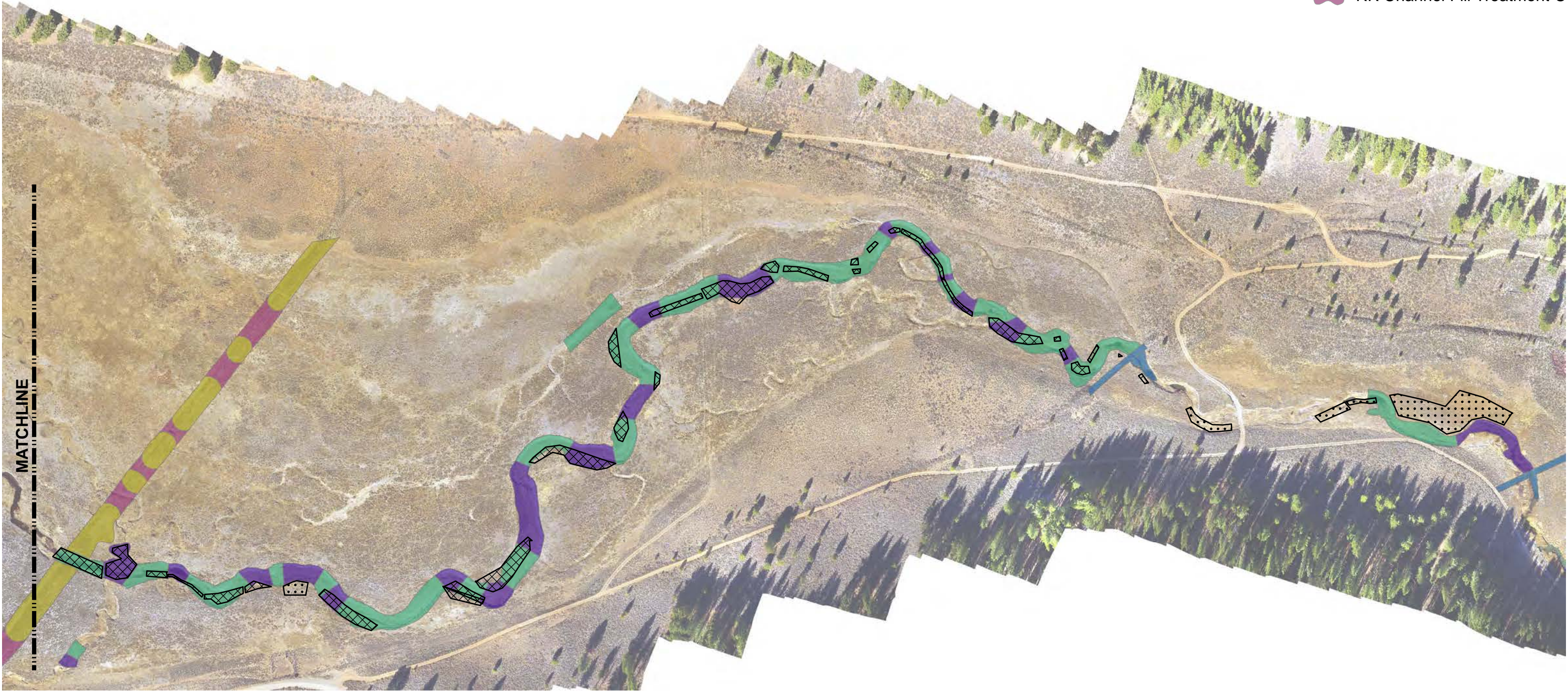




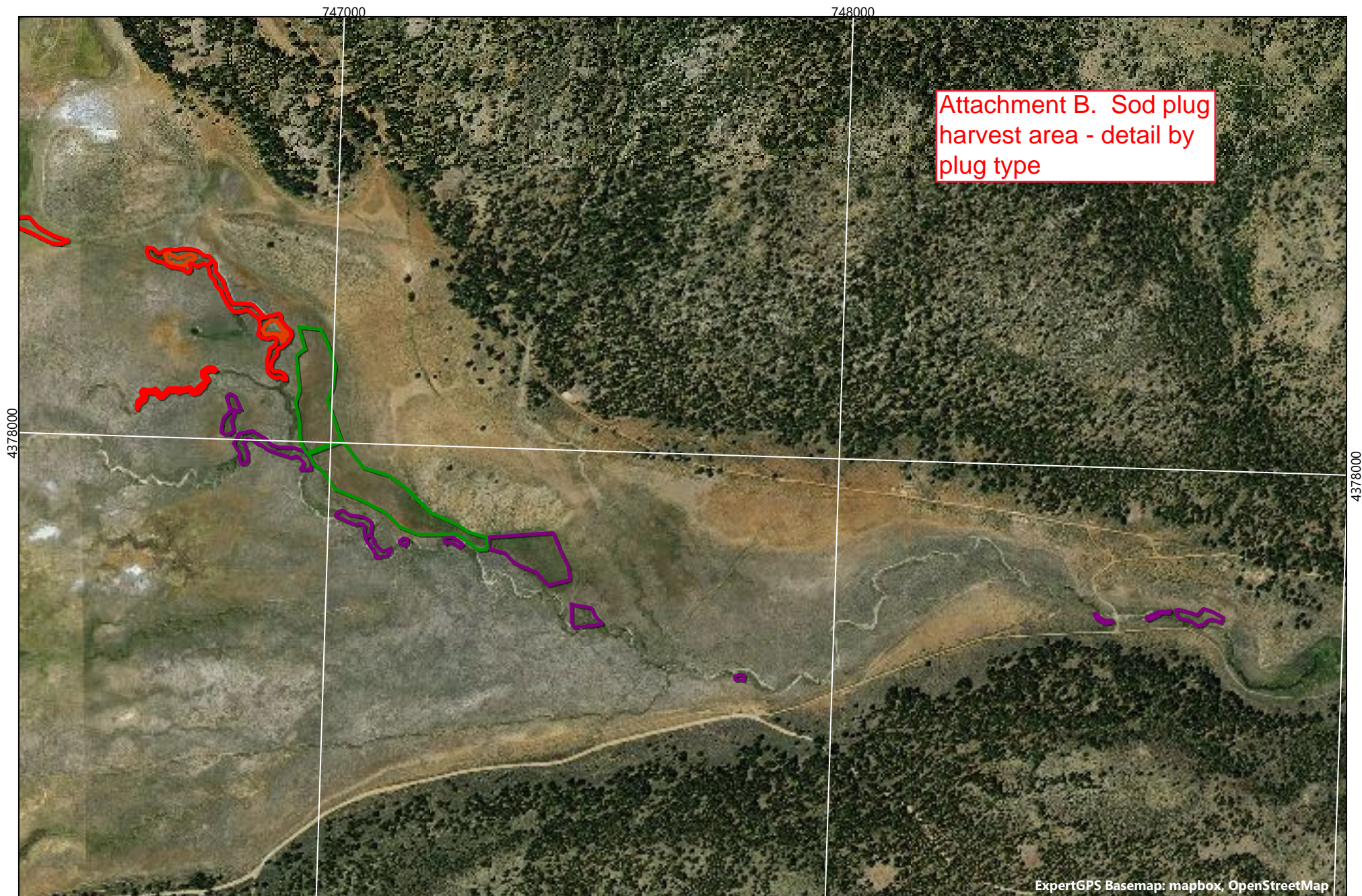




- Legend**
- Sod Harvest Area
  - Plug Harvest Area
  - Channel Fill Treatment B
  - Channel Fill Treatment C
  - Excavation
  - Grade Control Riffle
  - RR Channel Fill Treatment B
  - RR Channel Fill Treatment C







Legend -Red = Obligate plugs, and Plugs for Side Channel; Green = Plugs for Lowered Areas, Purple = Plugs for Main Channel

**ExpertGPS**

## Sardine Meadows Plug Harvest Areas - detail by plug type

500 ft

