

# Mapping Standards, Field Data Collection, and Accuracy Assessment for Vegetation Mapping in Modoc and Lassen Counties, California



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# Mapping Standards

## Overview

The Geographical Information Center (GIC) was contracted by the California Department of Fish and Wildlife (CDFW) to map specific ecoregions in Modoc and Lassen Counties in northeastern California. The mapping was done in a two-part effort. The first phase started in 2016 and covered the ecoregion subsections named Cottonwood-Skedaddle Mountains, Likely Mountain, and the eastern portion of Eagle Lake-Observation Peak (Miles and Goudey 1997) which covered nearly 1.1 million acres. A summary of the mapping units, frequency (number of polygons mapped) and acres for Phase 1 can be found in Table 6. The second phase began in 2018 and covered the ecoregion subsections named Devil's Garden and Adin Mountains, which covered an additional 866,228 acres. A summary of the mapping units, frequency (number of polygons mapped) and acres for Phase 2 can be found in Table 7. The vegetation map followed guidelines set forth by the National Vegetation Classification System and A Manual of California Vegetation. It is an Alliance level map overall, with photo-interpreters attempting to map to the more specific Association level when they were confident to go to that level of detail. The Association level map from the first phase was incorporated into a bird species occupancy study by CDFW to see if birds choose to reside in specific vegetation communities. The digital map can be found on the Biogeographic Information and Observation System (BIOS) website here: [ftp://ftp.wildlife.ca.gov/BDB/GIS/BIOS/Public\\_Datasets/2900\\_2999/ds2910.zip](ftp://ftp.wildlife.ca.gov/BDB/GIS/BIOS/Public_Datasets/2900_2999/ds2910.zip)

## Imagery

The GIC completed a vegetation map using manual digitization techniques in ESRI's ArcMap, which covers portions of Modoc and Lassen Counties. The base imagery was the 2016 and 2018 National Agricultural Inventory Program (NAIP) from the United States Department of Agriculture (USDA). The 2016 NAIP was used for the first phase and 2018 was used for the second phase, described above. The infrared version of each NAIP year was also utilized along with Google Earth as ancillary imagery for aiding with vegetation photointerpretation. Example imagery for each mapping unit used in the map can be found in Appendix F.

## Minimum Mapping Units (MMU)

- Standard vegetation polygons: 1 acre
- Wetland and riparian areas: 0.25 acres
- Polygons on the border of the mapping boundary: no MMU
- Agriculture and Urban areas: 1 acre
- Water: 1 acre (with the exception of small earthen dams which went down to .25 acres)

## Vegetation Cover

All vegetation cover estimates were estimated by way of the birds-eye view perspective, looking straight down on the vegetation, taking into account porosity. An average porosity of 60% was used in this mapping effort, which means if there was 100% tree canopy cover and an assumed 60% porosity, a value of 40% would be chosen for the percent tree. When the overstory layer(s) were 40% or greater the understory vegetation layer was not considered visible and was not evaluated. Percentages were assigned to each strata layer using absolute cover - the

actual percentage of ground covered by a vertical structure, taking into account porosity of the vegetation.

### **Cover Class and Height Code Breaks**

Adjacent polygons of the same vegetation type (typically Alliance level) were separated if the overstory had a break in cover class and each polygon was at least 5 acres, or if the understory had a break in cover class and each polygon was at least 10 acres. The (Braun-Blanquet, J. 1932) cover classes used are as follows:

<1%, 1-5%, 6-15%, 16-25%, 26-50%, 51-75%, >75%

Adjacent polygons of the same Alliance were also broken at 5 acres each when there was a change in the modal height of the overstory layer. Height classes are as follows:

<½ meter, ½-1 m, 1-2 m, 2-5 m, 5-10 m, 10-15 m, 15-20 m, 20-35 m, 35-50 m, >50 m

### **Attributes and Associated Rules**

**Group:** The sixth level in the natural vegetation hierarchy, in which each vegetation unit is defined by a group of plant communities with a common set of growth forms and diagnostic species or taxa (including several characteristic species of the dominant growth forms), preferentially sharing a similar set of regional edaphic, topographic, and disturbance factors. This is the level in which most herbaceous types were mapped.

**Alliance:** A classification unit of vegetation containing one or more Associations and defined by one or more diagnostic species, often of high cover, in the uppermost layer or the layer with the highest canopy cover. Alliances reflect the general form or appearance of the landscape as well as regional to sub-regional climates, substrates, hydrology, and disturbance regimes (Jennings et al. 2006, FGDC 2008). An Alliance was assigned to each polygon and was the target classification level for this map. Group level (one level up in the hierarchy) was utilized when Alliance level was not achievable.

**Association:** A classification unit of vegetation containing diagnostic species, usually from multiple growth forms or layers, which have similar composition that reflects topo-edaphic climate, substrates, hydrology, and disturbance regimes (Jennings et al. 2006, FGDC 2008). Association level was attempted, but not required, when photo-interpreters were confident to map to this level. The Accuracy Assessment showed that it is very challenging to map to this detail and several scores were below 80% accuracy.

**Tree:** A one-stemmed woody plant that normally grows to be greater than 5 meters tall. In some cases trees may be multiple-stemmed following a fire or other disturbance, but the size of mature plants is typically greater than 5 meters and undisturbed individuals of these species are usually single-stemmed. Tree stands must have at least 5% absolute cover of tree species to be determined a tree stand. An exception was made for mature juniper stands in rocky areas with young juniper recruitment, which could be a tree stand at 3% cover (from vegetation key, Appendix G). Percent of estimated absolute **tree cover** was entered as a real number for conifer and hardwoods and 0.2 was entered when there was <1% cover and >0% cover.

**Shrub:** A woody plant that generally has two to several stems from its base, giving it a broad crown, usually below 5 meters in height. Includes dwarf shrubs and low or short woody vines. Shrub stands must have less than 5% tree cover and shrub cover must be >2% and evenly

distributed. **Shrub cover** was estimated when tree cover was <40% and was entered as a real number for estimated absolute cover; 0.2 was entered when there was <1% cover and >0% cover.

**Herbaceous cover** was estimated when total tree and shrub cover was <40% and recorded in the following classes:

<2%, 2-9%, 10-39%, 40-59%, >60

**Isolated tree** was given a “Y” (yes) when tree cover was present but at less than 5% cover in the polygon.

**Juniper Expansion** was recorded to show the presence and cover of young junipers with less than 6 inches diameter at breast height. The categories are as follows:

None visible, .2-1%, 1-4%, and >4%

**Clearing Disturbance** was recorded when there was noticeable clearing, scraping, or other obvious anthropogenic disturbance (other than buildings) and was recorded as follows:

None visible, Low <33%, Moderate 33-66%, High >66%

**Roadedness** was recorded when roads fragmented a polygon as follows:

None visible, Low (>66% is roadless), Moderate (33-66% is roadless), High (<33% is roadless)

**Restoration** was recorded when it was obvious to the photo-interpreter that restoration had occurred. The most obvious categories utilized were for juniper removal projects and thinning of pine and juniper. Juniper removal projects are implemented primarily to restore groundwater to areas where juniper has expanded due to fire suppression. All restoration categories are as follows:

None obvious, *Juniperus occidentalis* removal, grass/forb seeding, shrub/tree planting, thinning pine/juniper, other (see comments)

**Development** was recorded when it was obvious to the photo-interpreter that anthropogenic development was present in a polygon and was recorded as follows:

None visible, Low (<2%, scattered), Moderate (2-5%, multiple examples), High (>5%, multiple examples and evenly distributed)

**Invasive species** were recorded when it was obvious to the photo-interpreter that invasive species were present. Relative cover was used to determine the percentage of invasive species present. Relative cover always totals 100%, even when absolute cover is low, and is a measure of the cover of a species in relation to that of other species within a set area or sample of vegetation. Invasive species were calculated across all strata layers and recorded as follows:

None obvious, Visible patches (<33%), Significant cover (33-66%), Stand characterized by exotics (>66%)

**Comments** are notes from the photo-interpreter pertinent to an individual polygon.

Further information describing attributes used can be found in the metadata of the map.

**For more details for Survey of California Vegetation Classification and Mapping Standards go to:**

## **Field Data Collection**

CDFW lead biologist Todd Keeler-Wolf extensively reviewed existing data for the mapping area and created a list of mapping units (Groups, Alliances, and Associations) expected to be encountered during our field surveys. A GIS specialist created a digital layer of sample-allocation targets using a Generalized Random Tessellation Stratified (GRTS) analysis of a combination of California Existing Vegetation (CalVeg) data and National Wetlands Index data, limited to a 2 kilometer buffer around a Bureau of Land Management (BLM) road layer. The goal of this process was to get the survey crews to field-sample all of the expected mapping units distributed equally over the mapping area. The 2 kilometer buffer goal was to maximize the amount of surveys that could be performed over the summer while still capturing all of the mapping unit types. The rugged rocky terrain, flat tires, slick wet clay soils, and decommissioned and washed-out roads made for a few adventurous but ultimately successful field seasons.

From May 31, 2016 to July 20, 2016, two crews from the GIC performed 325 Rapid Assessments and Relevés following the California Native Plant Society's field protocol. 320 of these surveys were combined with additional surveys done by CDFW that went into the initial classification to determine the mapping units and a vegetation key. From April 30, 2017 to July 13, 2017, the GIC collected an additional 250 Rapid Assessments and Relevés. These surveys were focused in the Cottonwood-Skedaddle Mountains, Likely Mountain, and the eastern portion of Eagle Lake-Observation Peak ecoregion subsections. The protocols and field forms used for these surveys can be found in Appendices A and B. Attributes collected include: location, date, surveyors, coordinates in UTM's, photos taken, stand size, aspect, gradient, topography, geology, soil texture, surface substrate covers, bioturbation presence, fire evidence, disturbance codes (including evidence of grazing or off-road vehicles), tree average diameter at breast height, shrub height, herb height, field Alliance, and species list. The site history, stand age, and any other pertinent information about the stand or its surroundings were also recorded in a comments section.

From August 6, 2018 to September 20, 2018, Rapid Assessments and Relevés were focused in the Devil's Garden and Adin Mountain ecoregion subsections. These additional surveys also went into the vegetation classification and hierarchy.

## **Survey Equipment**

Two crews of two utilized two four-wheel drive vehicles, which were essential to navigate the rugged terrain of Modoc and Lassen Counties. Two Dell Toughbooks (rugged laptops) with built-in GPS were used to collect field data and survey point locations. Rapid Assessment and Relevé data was more thoroughly recorded on "Rite in the Rain" paper and later scanned to digital format in the office. Bushnell rangefinders were used to estimate and record tree heights. Garmin compasses were used to record aspect and gradient. Small shovels were used for collecting soil samples. Photos were taken on either a Sony Cybershot camera or an iPhone. Some crews used the Theodolite application which allowed for labeling pictures in the

field and also contains other labeled attributes such as coordinates, bearing, and elevation (precision was variable depending on cell service range). Shovels, fire extinguishers, water jugs, first aid kits, air compressors, and Delorme InReach GPS trackers were carried for safety purposes. Plant presses were used to preserve sample specimens. The Jepson Manual (Hickman, J. C., & Jepson, W. L. 2012) and Vern Oswald's Selected Plants of Northern California and Adjacent Nevada (Oswald, V. H., Janeway L. 2013), were used to identify and confirm the species of plant samples collected.

## **Mapping Classification**

The vegetation classification was completed by CDFW's Vegetation Classification and Mapping Program (VegCAMP). This classification determines the Alliances and Associations used for this mapping effort. A more detailed report on the vegetation classification process can be found here:

<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=183030>

<https://wildlife.ca.gov/Data/VegCAMP/Reports-and-Maps>

(Classification of the Vegetation of Modoc and Lassen Counties, California. 2020)

For Group level descriptions one can reference:

<https://explorer.natureserve.org/>

Mapping units were utilized from the Group, Alliance, and Association levels of the vegetation classification. Some vegetation types are more difficult to see on imagery and correctly classify at the Association or Alliance level and therefore they were mapped to the Group level. Herbaceous types often fall into this category due to the challenge in differentiating and classifying them on the imagery. Trees and shrubs are typically easier to see on imagery and correctly classify at the Alliance and Association levels. The classification for the mapping area can be found in Appendix E.

The vegetation key that resulted from the vegetation classification can be found in Appendix G.

### **Hierarchy structure:**

1. Formation Class
  2. Formation Subclass
    3. Formation
      4. Division
        5. MacroGroup
          6. Group
            7. Alliance
              8. Association



## Non-vegetation Mapping Units

**Several non-vegetation mapping units** were utilized in this mapping effort and are described below:

*Agriculture (within the current 5-year cycle) Mapping Unit:* areas where the photo-interpreter could clearly determine from NAIP and/or Google Earth imagery that the land was currently agriculture or had been used for agriculture within the five years prior to the NAIP imagery

*Anthropogenic Areas of Little or No Vegetation Mapping Unit:* ground is barren or nearly barren of vegetation and is the result of man-made disturbances such as plowing, disking, scraping, or mining.

*Built-up & Urban Disturbance Mapping Unit:* urban and semi-urban settings where dwellings and anthropogenic disturbance presence is visible.

*Columbia Plateau Cliff, Scree and Rock Mapping Unit:* rocky areas where there was little to no vegetation present, often in talus piles. It has a dark brown to black signature which is representative of the basalt volcanic rock.

*Irrigated Pastures Mapping Unit:* areas are typically wet late into the summer months and show signs of irrigation piping or canals. Livestock and grazing trails are typically present.

*Non-woody Row and Field Agriculture Mapping Unit:* agriculture areas where the photo-interpreter could determine that the crop type is non-woody, which was typically the case in the study area.

Note: When quantifying agriculture for this project, both this mapping unit and *Agriculture (within the past 5 year cycle)* should be used.

*Perennial Stream Channel (Open Water) Mapping Unit:* rivers and creeks that flow or retain water year-round.

*Planted Trees and Shrubs Mapping Unit:* utilized when the photo-interpreter could identify that non-native trees and/or shrubs were planted/present due to human activity. Often found near homes or old homesteads.

*Small Earthen-dammed Ponds & Natural Lakes Mapping Unit:* includes both natural and man-made dams and lakes of varying shapes and sizes.

*Sparsely Vegetated Recently Burned Areas Mapping Unit:* areas where there was very recent fire evidence and the photo-interpreters were not able to see enough vegetation to determine a vegetation type. Dark charred soils were common in these areas. This mapping unit was primarily used in the area of the 2018 Stone Fire.

*Water Impoundment Feature Mapping Unit:* This mapping unit was utilized for man-made features designed to hold water, typically bound on all sides by berms and having a linear form. In this study area, this mapping unit can be found in duck club lands and a wastewater treatment facility.

*Western North American Sparsely Vegetated Rivershore Mapping Unit:* areas where there was no vegetation or very sparse vegetation along the margins of streams and other water bodies, or in the channels of dried-up seasonal waterways.

## **Accuracy Assessment**

Accuracy Assessment (AA) analysis helps map-users determine how much confidence can be assigned to each of the mapped units and provides an understanding of the map's appropriateness for various applications. Federal Geographic Data Committee standards (FGDC 2008) and California standards require a minimum accuracy of 80% for vegetation maps. Groups and Alliances that did not meet the 80% accuracy are discussed starting on page 19.

### **AA Data Collection**

From June 6, 2018 to August 9, 2018, 366 Accuracy Assessment surveys were completed by the GIC for Phase 1 of this mapping project (Figure 1). From June 2, 2020 to August 14, 2020, the GIC completed 416 Accuracy Assessment Surveys for Phase 2 (Figure 2). The field survey form and protocol used for collecting the Accuracy Assessment data can be found in Appendices C and D.

### **AA Scoring Methods**

VegCAMP staff reviewed each AA and removed from consideration those samples that had problems associated with access, vegetation identification, visibility, or significant changes in land use or vegetation since the date of the imagery on which the map was based. Only vegetation types that were surveyed 5 or more times for accuracy were included in the scoring process. Mapping units with counts of each type can be found in Table 2 and Table 4. If the field crews could not identify the vegetation type based on the field key or incorrectly identified the type, senior VegCAMP staff assigned the correct type based on the species covers recorded for the AA, any additional notes taken by the field crews, and sometimes the field photos. All field calls were reviewed and a "final call" was recorded in the database.

The scoring process compared the vegetation label assigned to each polygon in the map (i.e., the photointerpreted map unit attribute) with the "final call" for the polygon. Other attributes (cover, disturbance, height) were not scored, but results were provided to the GIC so the photo-interpreters could correct any systematic errors.

A closeness-of-fit, or fuzzy logic, method was used to score each AA, rather than simply denoting if a sample was correct or incorrect (Gopal and Woodcock 1994; Congalton and Green 1999; Foody 2002; Hagen 2003; Metzler and Sader 2005). Each field-verified polygon was scored according to a set of decision rules (Table 1), with a total of five possible points for each polygon. Scores were summed for each vegetation type, then divided by the total possible score and multiplied by 100 for a percent accuracy. The scores and reviewers' notes were provided to the GIC so systematic errors could be corrected.

**Table 1: Accuracy Assessment scoring rules**

ReasonForScore	Score
PI completely correct	5
Correct next level up in hierarchy	4
Threshold/transition between PI call and Final call	4
Correct two levels up in hierarchy	3
Based on close ecological similarity	3
Correct three levels up in the hierarchy	2
Some floristic/hydrologic similarity	2
Correct only at Lifeform or correct four levels up in the hierarchy	1
No similarity above Formation and incorrect lifeform	0
Survey removed because significant change in polygon	No score
Survey removed because inadequate portion of the polygon viewed	No score
Survey removed because field/PI data is incomplete, inadequate, or confusing	No score
Supplementary point, not scored	No score

**Note:** All Alliances that had a score lower than 80% were reevaluated and changed accordingly by the lead photo-interpreter.

## AA Results

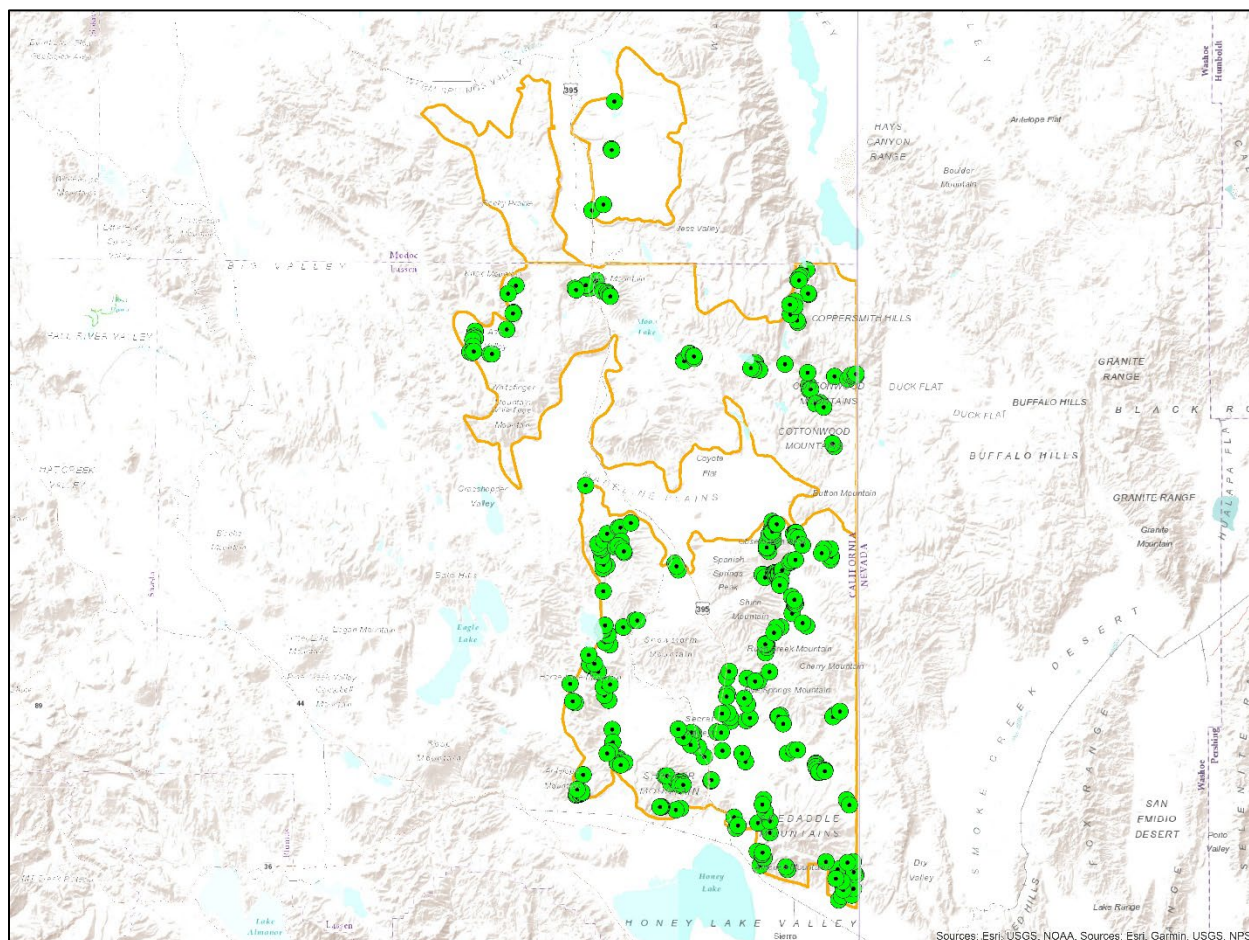
The Accuracy Assessment surveys were reviewed and scored by VegCAMP and it was determined that Phase 1 of this mapping project met an overall accuracy of 86.7%. A summary of Phase 1 scores can be found in Table 2 and a contingency table explaining calls can be found in Table 3. Phase 2 met an overall map accuracy of 81.6%. A summary of Phase 2 scores can be found in Table 4 and a contingency table explaining calls can be found in Table 5. Maps of the Accuracy Assessment locations from Phase 1 can be found in Figure 1 and Phase 2 locations can be found in Figure 2. The frequency (count), total acres mapped, and average acres per polygon can be found for each mapping unit in Tables 6 and 7.

Overall Accuracy tells us out of all of the referenced Accuracy Assessment sites what proportion were mapped correctly. The overall accuracy is usually expressed as a percent, with 100% accuracy being a perfect classification where all reference sites were classified correctly. To calculate the overall accuracy you add the number of correctly classified sites and divide it by the total number of reference sites.

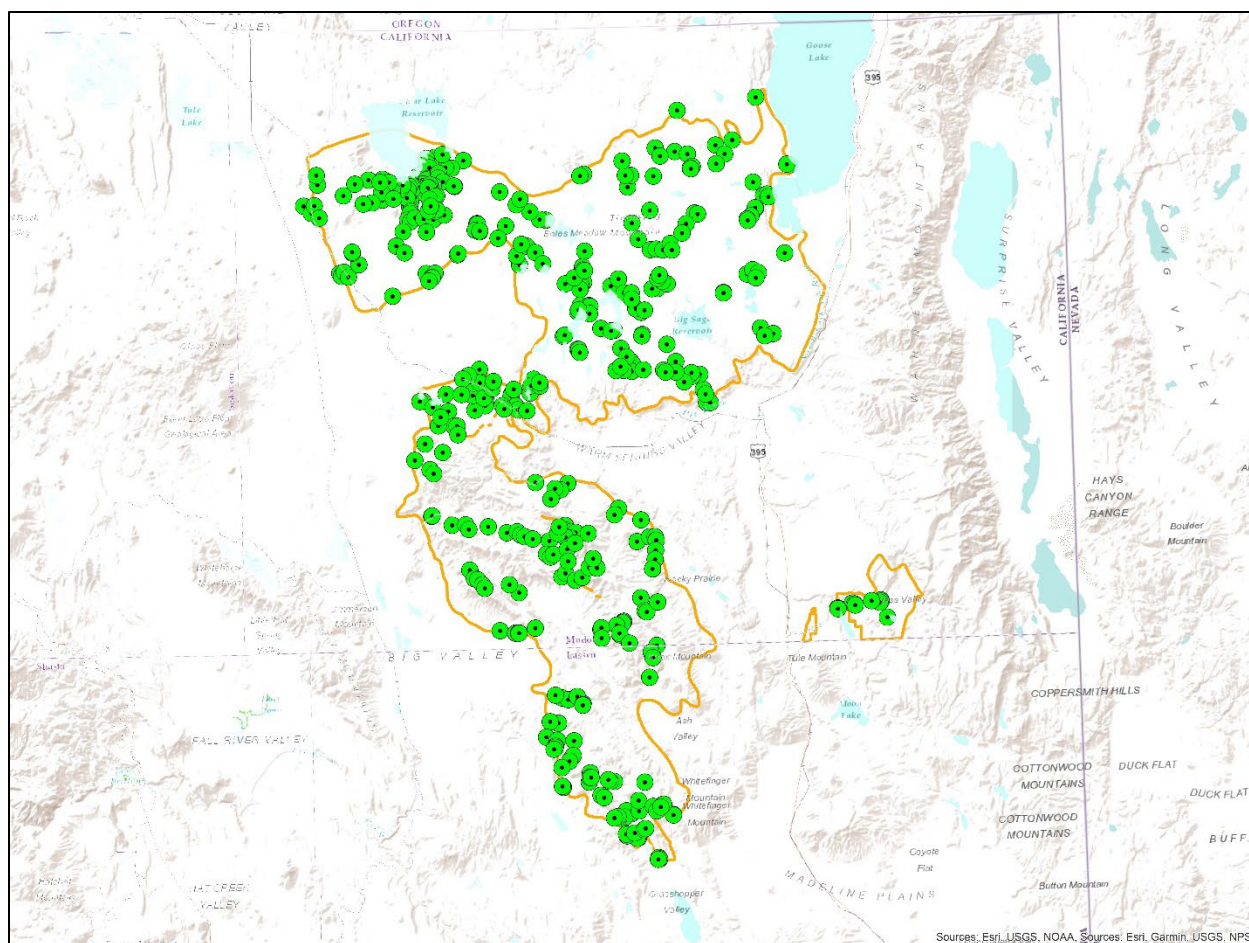
Producer's Accuracy is the map accuracy from the point of view of the map-maker (the producer). This represents how often real features on the ground are correctly categorized on the classified map, or the probability that a certain land cover of an area on the ground is classified as such. It is determined by dividing the number of reference sites classified accurately by the total number of reference sites for that class.

The User's Accuracy is the accuracy from the point of view of a map user, not the map producer. The User's accuracy essentially tells us how often the class on the map will actually be present on the ground. This is referred to as reliability. The User's Accuracy is calculated by

taking the total number of correct classifications for a particular class and dividing it by the row total in the contingency table (Table 3). (*Definitions from CSU, Humboldt*).



**Figure 1.** Locations of all Accuracy Assessment Survey Points completed in summer 2018 for the first mapping effort in the Cottonwood-Skedaddle Mountains, Likely Mountain, and the eastern portion of Eagle Lake-Observation Peak ecoregion subsections





**Table 2. Results and Scores for the 2018 Accuracy Assessment**

Summary table showing user's and producer's scores. Scores in red did not meet the 80% standard and should be treated with more caution when using the map. Alliance level was the expected level for achieving 80% or greater - this score was determined at the more detailed Association level.

Map Class	Users' Accuracy	Users' Count	Producers' Accuracy	Producers' Count
Abies concolor – Pinus ponderosa / Cercocarpus ledifolius Association	93.3	9	82.2	9
Populus tremuloides / Symphoricarpos rotundifolius Association	100.0	15	100.0	16
Juniperus occidentalis – Pinus jeffreyi / (Purshia tridentata, Prunus virginiana) Association	62.5	8	97.5	8
Juniperus occidentalis / Artemisia arbuscula / Poa secunda Association	91.1	18	96.9	13
Juniperus occidentalis / Artemisia tridentata – Purshia tridentata Association	97.0	27	98.8	17
Juniperus occidentalis / Cercocarpus ledifolius Association	84.0	5	100.0	7
Cercocarpus ledifolius – Artemisia tridentata ssp. vaseyana Association	100.0	9	100.0	6
Cercocarpus ledifolius – Prunus virginiana – Symphoricarpos rotundifolius Scrub Association	97.5	8	90.0	12
Bromus tectorum Ruderal Grassland Association	74.0	10	84.2	19
Ericameria nauseosa Shrubland Association	96.7	6	78.3	12
Ericameria nauseosa / Bromus tectorum Ruderal Shrubland Association	75.0	12	78.0	10
Artemisia arbuscula / Poa secunda Association	73.3	24	92.9	17
Artemisia arbuscula / Bromus tectorum Ruderal Shrubland Association	77.5	16	93.3	6
Artemisia nova / Poa secunda Association	84.0	5	88.0	5
Eriogonum sphaerocephalum / Poa secunda Dwarf-shrub Grassland Association	86.0	10	100.0	7
Artemisia tridentata – Ephedra spp. Shrubland Association	92.9	14	94.5	11
Artemisia tridentata Shrubland Association	93.3	9	95.0	12

Map Class	Users' Accuracy	Users' Count	Producers' Accuracy	Producers' Count
Artemisia tridentata – (Ericameria nauseosa) / Bromus tectorum Ruderal Shrubland Association	82.7	15	85.7	7
Artemisia tridentata ssp. vaseyana – Symphoricarpos oreophilus / Bromus carinatus Shrubland Association	84.0	10	100.0	8
Artemisia tridentata ssp. vaseyana / Festuca idahoensis Shrub Grassland Association	97.1	7	97.1	7
Purshia tridentata – Artemisia tridentata Association	78.8	16	90.9	11
Purshia tridentata – Artemisia tridentata – Tetradymia canescens Association	90.0	8	89.1	11
Tetradymia canescens Provisional Association	84.7	17	90.9	11
Ceanothus velutinus Shrubland Association	87.8	18	97.5	16
Prunus emarginata Sierran Chaparral Shrubland Association	62.9	7	52.9	14
Salix lasiolepis – Rosa woodsii / Mixed Herbs Wet Shrubland Association	93.3	6	90.0	6
Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa secunda Wet Shrubland Association	80.0	14	81.5	13
Prunus virginiana / Leymus cinereus Shrubland Association	84.4	9	71.4	14
Vancouverian – Rocky Mountain Montane Wet Meadow & Marsh Group	100.0	6	80.0	8
Juncus balticus Wet Meadow Association	95.0	16	86.3	19
Taraxia tanacetifolia – Iva axillaris Provisional Association	95.0	8	100.0	9
Sarcobatus vermiculatus – Artemisia tridentata Wet Shrubland Association	90.0	20	84.8	21
Elymus cinereus Bottomland Wet Meadow Association	65.5	11	49.3	15
Columbia Plateau cliff, scree and rock mapping unit	100.0	7	86.7	9
Overall Score	86.7		88.4	

Row headings are classes observed in the field. Column headings are classes as mapped by the photo-interpreters. The diagonal indicates completely correct AAs. Producer's (omission) errors can be seen by reading across the table, showing how many polygons in each map class were correctly labeled. User's (commission) errors are read down the table and show how many stands of a vegetation class were not mapped (missed). Use the "Zoom" tool under the "View" tab to magnify table. You may also ctrl + click the table to download it in excel format.

[illegible]

**Table 4. Results and Scores for the 2020 Accuracy Assessment**

Summary table showing user's and producer's scores. Scores in red did not meet the 80% standard and should be treated with more caution when using the map. Alliance level was the expected level for achieving 80% or greater. Use the "Zoom" tool under the "View" tab to magnify table.

Map Class	Users' Accuracy	Users' Count	Producers' Accuracy	Producers' Count
Abies concolor - Pinus ponderosa / Cercocarpus ledifolius Forest Association	100	6	80	3
Abies concolor Dry Forest and Woodland Alliance	100	1	94.2	7
Amelanchier utahensis - Cercocarpus montanus - Cercocarpus intricatus	80	1	0	0
Amelanchier utahensis Association	80	2	0	0
Arctostaphylos patula - Arctostaphylos nevadensis Alliance	80	1	72	5
Arctostaphylos patula - Ceanothus velutinus Association	86.6	3	92	5
Arctostaphylos patula Shrubland Association	100	5	100	3
Artemisia arbuscula - Eriogonum (microthecum, sphaerocephalum) Association	100	4	85	8
Artemisia arbuscula / Bromus spp. - Elymus caput-medusae Association	94	10	97.4	8
Artemisia arbuscula / Poa secunda Association	82.6	15	88.8	9
Artemisia arbuscula Steppe and Shrubland Alliance	0	0	80	5
Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa secunda Association	94	17	0	0
Artemisia cana Mesic-Riparian Shrubland Alliance	65	4	95.4	18
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Association	80	7	60	7
Artemisia tridentata Association	82	20	95	8
Artemisia tridentata Shrubland Alliance	84	5	86	10
Artemisia tridentata ssp. vaseyana - Mixed Steppe and Shrubland Alliance	68	5	100	1
Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Bromus carinatus Association	100	1	80	2
Artemisia tridentata ssp. vaseyana / Festuca idahoensis Association	100	2	80	6

Map Class	Users' Accuracy	Users' Count	Producers' Accuracy	Producers' Count
Bromus tectorum - Elymus caput-medusae Ruderal Annual Grassland Alliance	0	0	71.4	7
Bromus tectorum Association	66.6	3	36.6	6
Californian Vernal Pool	0	0	86.6	6
Carex douglasii Herbaceous Vegetation Association	20	1	0	0
Ceanothus velutinus Shrubland Association	95	4	90	4
Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group	20	1	0	0
Cercocarpus ledifolius - Artemisia tridentata ssp. vaseyana Association	100	4	100	3
Cercocarpus ledifolius Association	66.6	12	92.4	8
Cercocarpus ledifolius Scrub Alliance	75	4	100	4
Chrysolepis sempervirens Association	0	1	0	0
Chrysothamnus viscidiflorus Association	90.8	11	82.6	15
Danthonia spp. - Camassia spp. Wet Meadow Association	100	1	46.6	3
Danthonia unispicata - Poa secunda Wet Meadow Association	40	1	0	0
Eleocharis macrostachya Vernal Pool	90	6	0	0
Eleocharis macrostachya Vernal Pool Provisional Association	80	1	0	0
Elymus caput-medusae Provisional Association	72	10	0	0
Elymus cinereus Association	50	2	60	3
Elymus elymoides Provisional Association	80	2	0	0
Elymus smithii Central Rocky Mountain Grassland Association	30	2	0	0
Elymus triticoides - Poa secunda Association	30	2	0	0
Ericameria nauseosa / Bromus tectorum Association	64.4	9	74.2	7
Ericameria nauseosa Association	72	5	60	4
Ericameria nauseosa Shrubland and Shrub Herbaceous Alliance	100	1	70	4
Eriogonum sphaerocephalum/ Poa secunda Association	80	13	100	4
Eriogonum spp. / Poa secunda Dwarf-shrub Herbaceous Alliance	100	1	73.2	9
Festuca idahoensis - Elymus spicatus - Elymus smithii Alliance	0	0	0	0
Festuca idahoensis - Pseudoroegneria spicata Association	52	10	40	1



Map Class	Users' Accuracy	Users' Count	Producers' Accuracy	Producers' Count
<i>Festuca idahoensis</i> - <i>Elymus spicatus</i> - <i>Poa secunda</i> Alliance	80	3	57.6	9
<i>Juncus arcticus</i> var. <i>balticus</i> - (var. <i>mexicanus</i> ) Association	86.6	6	0	0
<i>Juncus balticus</i> - <i>Juncus mexicanus</i> Wet Meadow Alliance	100	1	84.4	9
<i>Juniperus occidentalis</i> - ( <i>Pinus jeffreyi</i> - <i>Pinus ponderosa</i> ) / <i>Cercocarpus ledifolius</i> Association	81.6	12	92	10
<i>Juniperus occidentalis</i> / ( <i>Poa secunda</i> - <i>Festuca idahoensis</i> - <i>Pseudoroegneria spicata</i> ) Association	100	7	100	6
<i>Juniperus occidentalis</i> / <i>Artemisia arbuscula</i> / <i>Poa secunda</i> Association	96.2	11	98	10
<i>Juniperus occidentalis</i> / <i>Artemisia tridentata</i> - <i>Purshia tridentata</i> Association	100	9	100	8
<i>Navarretia leucocephala</i> ssp. <i>minima</i> - <i>Plagiobothrys cusickii</i> Alliance	87.2	11	97.6	9
Oregon-Washington-British Columbia Vernal Pool Group	70.6	13	60	7
<i>Phalaris aquatica</i> - <i>Phalaris arundinacea</i> Alliance	40	1	0	0
<i>Pinus (jeffreyi, ponderosa)</i> - <i>Juniperus occidentalis</i> Association	91.2	16	97.4	8
<i>Pinus jeffreyi</i> / <i>Artemisia tridentata</i> ssp. <i>vaseyana</i> / <i>Festuca idahoensis</i> Association	100	4	100	3
<i>Pinus ponderosa</i> - <i>Calocedrus decurrens</i> / <i>Ceanothus prostratus</i> Association	95.4	9	74.4	11
<i>Pinus ponderosa</i> - <i>Calocedrus decurrens</i> Forest Alliance	66.6	3	0	0
<i>Pinus ponderosa</i> - <i>Juniperus occidentalis</i> / <i>Artemisia tridentata</i> - <i>Purshia tridentata</i> Association	80	3	95	8
<i>Pinus ponderosa</i> / <i>Arctostaphylos patula</i> - <i>Purshia tridentata</i> Association	93.2	3	93.2	9
<i>Pinus ponderosa</i> / Shrub Understory Central Rocky Mountain Alliance	85	4	0	0
<i>Poa pratensis</i> - <i>Agrostis gigantea</i> - <i>Agrostis stolonifera</i> Alliance	60	1	0	0
<i>Poa secunda</i> - <i>Muhlenbergia richardsonis</i> - <i>Carex douglasii</i> Alliance	100	1	49.2	15
<i>Prunus emarginata</i> - <i>Holodiscus discolor</i> Shrubland Alliance	0	0	80	6
<i>Prunus emarginata</i> Association	86.6	3	26.6	3

Map Class	Users' Accuracy	Users' Count	Producers' Accuracy	Producers' Count
Prunus subcordata Provisional Provisional Association	93.2	3	0	0
Prunus virginiana Alliance	84	5	85	12
Prunus virginiana / Leymus cinereus Association	100	3	0	0
Pseudoroegneria spicata - Poa secunda Association	62.8	7	74	10
Purshia tridentata - Artemisia tridentata Association	93.2	12	88	5
Purshia tridentata - Artemisia tridentata Mesic Steppe and Shrubland Alliance	100	1	95.4	9
Quercus kelloggii Alliance	100	9	84.2	14
Ribes velutinum Provisional Association	100	1	0	0
Rosa woodsii Association	40	1	0	0
Salix boothii - Salix geyeriana - Salix lutea Montane Wet Shrubland Alliance	80	2	0	0
Salix lasiolepis - Rosa woodsii / Mixed Herbs Wet Shrubland Association	100	1	85	4
Salix lucida / Poa pratensis Association	80	1	0	0
Taraxia tanacetifolia - Iva axillaris Association	88	5	100	5
Tetradymia canescens Association	0	0	45	4
Vancouverian - Rocky Mountain Montane Wet Meadow and Marsh Group (WMM)	94.2	7	72.2	13
Ventenata dubia Association	40	15	80	7
Western North America Ruderal Marsh Wet Meadow and Shrubland	70	4	62.8	7
Overall Score	73.5		56.5	

Row headings are classes observed in the field. Column headings are classes as mapped by the photo-interpreters. The diagonal indicates completely correct AAs. Producer's (omission) errors can be seen by reading across the table, showing how many polygons in each map class were correctly labeled. User's (commission) errors are read down the table, and show how many stands of a vegetation class were not mapped (missed). Use the "Zoom" tool under the "View" tab to magnify table. You may also ctrl + click the table to download it in excel format.

## Discussion of Low Scores

As mentioned elsewhere, the goal for Alliance level mapping is 80% accuracy or better. The following discussion is for Alliances from both mapping efforts that scored less than 80%. Some herbaceous types were expected to be mapped at the Group level, and those that scored less than 80% are also discussed below. Associations are not discussed because they were not the targeted classification level for this mapping effort. One should note that due to site access, funding, and time, only a limited number of Accuracy Assessment surveys were allotted for each type, if at all. It can be expected that with more surveys the accuracy would most likely increase. Mapping units that were surveyed less than five times in the Accuracy Assessment did not go into the final scoring calculation. Problem areas were reevaluated by the lead biologist and one can expect a higher degree of accuracy than reported here. The majority of the low scores were in herbaceous categories which are very difficult to discern/interpret via aerial imagery.

*Arctostaphylos patula* – *Arctostaphylos nevadensis* Alliance – Score: 72%. This Alliance has a clumpy dark green signature which can turn into a closed canopy and can easily be mistaken for *Ceanothus velutinus*, which it commonly grows with, and which has a similar signature on imagery. This Alliance was also mistaken for *Prunus virginiana* in one survey. In one other survey there was a borderline amount of tree present to make it a tree Alliance.

*Bromus tectorum* – *Elymus caput-medusae* Ruderal Grassland Alliance – Score: 71.4%. Mapping to the herbaceous Alliance level via photointerpretation is a challenging task. This is a non-native upland herbaceous Alliance which also includes *Ventenata dubia*. These three weedy grasses can have variable signatures depending on thatch from previous years, burns, and general seasonal phenological variation. In one instance there was enough native grasses and herbs to be called the *Festuca idahoensis* – *Pseudoroegneria spicata* – *Poa secunda* Alliance. A grassland only needs to have 10% relative nativity to be called a native grassland Alliance/Group. In two instances there was enough shrub present to be called an *Artemisia tridentata* Alliance. There only needs to be 3% shrub present for certain shrub Alliances, which can be difficult to see on imagery.

*Eriogonum sphaerocephalum* – *Poa secunda* Alliance – Score: 73.2%. This subshrub Alliance is found in very sparse rocky areas. Subshrubs are difficult to see on imagery and interpretation was based more on rocky sparse signatures than visible subshrubs on the imagery. Oftentimes *Eriogonum* was either not present or present but not evenly distributed with high enough density to be called this Alliance. Several of these surveys were determined to be either upland native or non-native low-density grasslands.

*Festuca idahoensis* – *Pseudoroegneria spicata* – *Poa secunda* Alliance – Score: 57.6%. In three surveys there was enough non-native grasses to be called the non-native *Bromus tectorum* – *Elymus caput-medusae* Ruderal Annual Grassland. In two surveys there was enough shrub at low density to take the Alliance.

Oregon-Washington-British Columbia Vernal Pool Group – Score: 60%. One survey turned out to be a ruderal grassland and one was a native upland grassland. A few surveys had enough

shrub present to be called a shrub type. This signature is often variable and mixed with other herbaceous types. It is also variable depending on the type of water year and survey timing/phenology.

*Poa secunda* – *Muhlenbergia richardsonis* – *Carex douglasii* Alliance – Score: 49.2%. This Alliance is a wetter type that can seasonally dry out and has a variable signature. Four of the surveys wound up being *Ventenata dubia*. Part of this low score was due to one misidentified field point that was used as a baseline to extrapolate the signature. This area has been reevaluated by the lead biologist post-Accuracy Assessment. Five surveys were determined to be the Oregon–Washington–British Columbia Vernal Pool Group which is also a wet type with a similar variable signature.

Vancouverian – Rocky Mountain Montane Wet Meadow and Marsh Group – Score: 72.2%. This is a wet native mountain meadow Group which has a variable signature and was often mistaken for other wet herbaceous types and vernal pool types. It is variable depending on the type of water year and survey timing/phenology.

Western North America Ruderal Marsh Wet Meadow and Shrubland – Score: 62.8%. This is a wet type with ruderal non-native bunchgrasses which has a variable signature. It is often found in or nearby grazing areas. It was mistaken for weedy upland grasslands in three surveys and native wetland types in two surveys.



**Table 6. Mapping Results Phase 1**

A summary of the mapping units, frequency (number of polygons mapped), total acres, and average acreage per stand for the ecoregion subsections Cottonwood-Skedaddle Mountains, Likely Mountain, and the eastern portion of Eagle Lake-Observation Peak. These numbers are post-Accuracy Assessment corrections where the GIC made specific and systematic corrections based on the AA scores and reviewer's notes.

Map Class	Count	Total Acres	Average Acreage
<i>Abies concolor</i> - <i>Pinus ponderosa</i> / <i>Cercocarpus ledifolius</i> Association	171	3675.72	21.50
<i>Acmispon americanus</i> Provisional Alliance	1	1.24	1.24
Agriculture (w/in the current 5-year cycle)	10	1543.78	154.38
Anthropogenic Areas of Little or No Vegetation	17	145.79	8.58
<i>Artemisia arbuscula</i> / <i>Bromus</i> spp. - <i>Elymus caput-medusae</i> Association	804	16497.29	20.52
<i>Artemisia arbuscula</i> / <i>Poa secunda</i> Association	6036	89928.27	14.90
<i>Artemisia arbuscula</i> ssp. <i>longicaulis</i> - <i>Grayia spinosa</i> Shrubland Association	3	45.09	15.03
<i>Artemisia cana</i> (ssp. <i>bolanderi</i> , ssp. <i>viscidula</i> ) / <i>Poa secunda</i> Association	492	7542.71	15.33
<i>Artemisia nova</i> / <i>Poa secunda</i> Association	98	1615.40	16.48
<i>Artemisia tridentata</i> - ( <i>Ericameria nauseosa</i> ) / <i>Bromus tectorum</i> Association	2846	48255.23	16.96
<i>Artemisia tridentata</i> - <i>Ephedra viridis</i> / <i>Pseudoroegneria spicata</i> Association	383	5989.28	15.64
<i>Artemisia tridentata</i> - <i>Grayia spinosa</i> Shrubland Association	102	2432.59	23.85
<i>Artemisia tridentata</i> / <i>Distichlis spicata</i> Provisional Association	91	2188.91	24.05
<i>Artemisia tridentata</i> Association	3378	51510.80	15.25
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> - <i>Symphoricarpos oreophilus</i> / <i>Bromus carinatus</i> Association	1343	42822.05	31.89
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i> / <i>Festuca idahoensis</i> Association	490	12835.76	26.20
<i>Atriplex canescens</i> Alliance	1	9.77	9.77
<i>Atriplex confertifolia</i> Alliance	4	8.46	2.12
<i>Betula occidentalis</i> Alliance	4	10.97	2.74
<i>Bromus tectorum</i> - <i>Elymus caput-medusae</i> Alliance	85	1499.44	17.64
<i>Bromus tectorum</i> Association	2417	49983.53	20.68
Built-up and Urban Disturbance	123	831.80	6.76
California Annual Grassland and Forb Meadow Group	47	280.92	5.98
Californian Vernal Pool	32	462.19	14.44

Map Class	Count	Total Acres	Average Acreage
Carex aquatilis - Carex lenticularis Association	9	16.78	1.86
Carex douglasii Association	1	1.13	1.13
Carex simulata Association	3	9.80	3.27
Ceanothus velutinus Association	615	7966.27	12.95
Cercocarpus ledifolius - Artemisia tridentata ssp. vaseyana Association	969	12161.79	12.55
Cercocarpus ledifolius Association	375	4117.33	10.98
Chrysothamnus viscidiflorus Association	129	1189.26	9.22
Columbia Plateau cliff, scree and rock mapping unit	347	1226.25	3.53
Danthonia unispicata - Poa secunda Wet Meadow Association	373	1825.77	4.89
Deschampsia cespitosa Association	3	49.78	16.59
Distichlis spicata Alliance	8	103.12	12.89
Eleocharis macrostachya Provisional Association	26	168.24	6.47
Elymus caput-medusae Provisional Association	492	29257.09	59.47
Elymus cinereus Association	660	7094.43	10.75
Elymus smithii Central Rocky Mountain Grassland Association	13	66.14	5.09
Elymus triticoides - Poa secunda Association	173	906.77	5.24
Ephedra nevadensis - Lycium andersonii - Grayia spinosa alliance	44	467.76	10.63
Ericameria nauseosa / Bromus tectorum Association	493	9891.94	20.06
Ericameria nauseosa Association	1291	16440.51	12.73
Eriogonum sphaerocephalum/ Poa secunda Association	74	556.74	7.52
Festuca idahoensis - Pseudoroegneria spicata Association	10	29.34	2.93
Festuca perennis - Lotus corniculatus Association	3	26.10	8.70
Irrigated Pastures	31	2549.38	82.24
Juncus arcticus var. balticus - (var. mexicanus) Association	598	3723.93	6.23
Juniperus occidentalis - (Pinus jeffreyi - Pinus ponderosa) / Cercocarpus ledifolius Association	3029	73350.93	24.22
Juniperus occidentalis / (Poa secunda - Festuca idahoensis - Pseudoroegneria spicata) Association	916	10192.92	11.13
Juniperus occidentalis / Artemisia arbuscula / Poa secunda Association	5571	119709.31	21.49
Juniperus occidentalis / Artemisia tridentata - Purshia tridentata Association	6334	134952.79	21.31
Juniperus occidentalis Alliance	91	438.30	4.82
Krascheninnikovia lanata Alliance	5	6.65	1.33
Navarretia leucocephala ssp. minima - Plagiobothrys cusickii	9	107.10	11.90

Map Class	Count	Total Acres	Average Acreage
Non-woody Row and Field Agriculture	15	1252.74	83.52
Perennial Stream Channel (Open Water)	9	8.32	0.92
Pinus (jeffreyi, ponderosa) - Juniperus occidentalis Association	7	718.70	102.67
Pinus jeffreyi / Artemisia tridentata ssp. vaseyana / Festuca idahoensis Association	30	1191.70	39.72
Pinus ponderosa - Calocedrus decurrens / Ceanothus prostratus Association	10	264.15	26.42
Pinus ponderosa - Juniperus occidentalis / Artemisia tridentata - Purshia tridentata Association	114	2604.22	22.84
Pinus ponderosa / Shrub Understory Alliance	484	9546.53	19.72
Planted Trees and Shrubs	26	55.24	2.12
Populus tremuloides / Symphoricarpos rotundifolius Association	351	2749.64	7.83
Populus trichocarpa Alliance	3	10.16	3.39
Prunus emarginata Association	662	5007.21	7.56
Prunus virginiana / Leymus cinereus Shrubland Association	816	4880.05	5.98
Prunus virginiana Alliance	1	4.43	4.43
Pseudoroegneria spicata - Poa secunda Association	4635	129681.74	27.98
Purshia tridentata - Artemisia tridentata / Achnatherum hymenoides Association	16	321.59	20.10
Purshia tridentata - Artemisia tridentata Alliance	494	6730.53	13.62
Purshia tridentata - Artemisia tridentata Association	3465	69890.74	20.17
Quercus kelloggii Alliance	1	2.92	2.92
Rosa woodsii Association	16	9.77	0.61
Salix exigua / Mesic Forbs Shrubland Association	58	64.17	1.11
Salix lasiolepis - Rosa woodsii / Mixed Herbs Association	173	584.79	3.38
Salix lucida / Poa pratensis Association	4	17.36	4.34
Sarcobatus vermiculatus - Artemisia tridentata Association	580	15704.46	27.08
Schoenoplectus americanus - Schoenoplectus acutus - Schoenoplectus californicus Alliance	19	82.92	4.36
Small Earthen-dammed Ponds and Natural Lakes	99	167.34	1.69
Symphoricarpos oreophilus Association	593	24287.11	40.96
Taraxia tanacetifolia - Iva axillaris Association	102	4615.76	45.25
Tetradymia canescens Association	825	17873.53	21.66
Typha domingensis Association	22	63.47	2.89
Vancouverian - Rocky Mountain Montane Wet Meadow and Marsh Group (WMM)	618	4554.38	7.37
Ventenata dubia Provisional Association	25	281.08	11.24

Map Class	Count	Total Acres	Average Acreage
Water	38	5044.26	132.74
Western North America Ruderal Marsh Wet Meadow and Shrubland	207	1976.88	9.55
Western North American Sparsely Vegetated Rivershore mapping unit	35	112.70	3.22
Western North American Temperate Freshwater Aquatic Vegetation Group	10	218.49	21.85

**Table 7. Mapping Results Phase 2**

A summary of the mapping units, frequency (number of polygons mapped), total acres, and average acreage per stand for the ecoregion subsections Devil's Garden and Adin Mountains. These numbers are post-Accuracy Assessment corrections where the GIC made specific and systematic corrections based on the AA scores and reviewer's notes.

MapClass	Count	Total Acres	Average Acreage
Abies concolor - Pinus ponderosa / Amelanchier alnifolia Association	122	10779.23	88.35
Abies concolor Alliance	243	28384.17	116.81
Agropyron cristatum Semi-natural Stands	1	125.48	125.48
Amelanchier utahensis - Cercocarpus montanus - Cercocarpus intricatus Alliance	4	13.58	3.39
Amelanchier utahensis Association	13	60.71	4.67
Anthropogenic Areas of Little or No Vegetation	24	273.86	11.41
Arctostaphylos patula - Arctostaphylos nevadensis Alliance	152	1537.12	10.11
Arctostaphylos patula - Ceanothus velutinus Association	65	1049.25	16.14
Arctostaphylos patula Association	27	327.01	12.11
Artemisia arbuscula - Eriogonum (microthecum, sphaerocephalum) Association	590	6249.36	10.59
Artemisia arbuscula / Bromus spp. - Elymus caput-medusae Association	1310	23956.82	18.29
Artemisia arbuscula Alliance	4191	86848.55	20.72
Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa secunda Association	19	209.34	11.02
Artemisia cana Alliance	911	13400.73	14.71
Artemisia tridentata - (Ericameria nauseosa) / Bromus tectorum Association	384	6609.03	17.21
Artemisia tridentata Alliance	636	8611.33	13.54
Artemisia tridentata Association	637	8636.17	13.56
Artemisia tridentata ssp. vaseyana - Symphoricarpos oreophilus / Bromus carinatus Association	113	874.84	7.74
Artemisia tridentata ssp. vaseyana / Festuca idahoensis Association	69	362.32	5.25
Artemisia tridentata ssp. vaseyana Alliance	290	3733.06	12.87
Bromus tectorum - Elymus caput-medusae Alliance	2286	27439.52	12.00
Bromus tectorum Association	406	4406.64	10.85
Built - up and Urban Disturbance	50	774.50	15.49
Californian Annual Grassland and Forb Meadow Group	29	268.32	9.25
Californian Ruderal Grassland, Meadow and Scrub Group	28	511.85	18.28

MapClass	Count	Total Acres	Average Acreage
Californian Vernal Pool Group	64	14118.71	220.60
Carex praegracilis Association	2	9.58	4.79
Ceanothus velutinus Alliance	40	406.23	10.16
Ceanothus velutinus Association	207	2449.86	11.84
Cercocarpus ledifolius - Artemisia tridentata ssp. vaseyana Association	35	691.51	19.76
Cercocarpus ledifolius Alliance	409	2837.16	6.94
Cercocarpus ledifolius Association	117	1185.98	10.14
Chrysolepis sempervirens Alliance	1	1.04	1.04
Chrysolepis sempervirens Association	20	76.21	3.81
Chrysothamnus viscidiflorus Association	112	433.98	3.87
Columbia Plateau cliff, scree and rock mapping unit	97	399.92	4.12
Cornus sericea - Rosa woodsii - Ribes spp. Alliance	5	14.50	2.90
Distichlis spicata Alliance	6	226.07	37.68
Eleocharis (acicularis, macrostachya) Alliance	28	1008.70	36.02
Elymus caput-medusae Provisional Association	109	1303.50	11.96
Elymus cinereus Association	57	482.98	8.47
Elymus elymoides Provisional Association	2	8.04	4.02
Elymus smithii Association	7	206.76	29.54
Elymus triticoides - Poa secunda Association	4	26.46	6.61
Ericameria nauseosa / Bromus tectorum Association	116	1568.38	13.52
Ericameria nauseosa Alliance	240	2698.30	11.24
Ericameria nauseosa Association	69	702.24	10.18
Eriogonum sphaerocephalum / Poa secunda Association	20	143.66	7.18
Eriogonum spp. / Poa secunda Alliance	1420	5832.60	4.11
Festuca idahoensis - Pseudoroegneria spicata - Poa secunda Alliance	1127	9651.24	8.56
Festuca idahoensis - Pseudoroegneria spicata Association	56	249.20	4.45
Holodiscus discolor Association	7	31.62	4.52
Hordeum brachyantherum Association	1	15.55	15.55
Irrigated Pastures	32	1818.24	56.82
Juncus arcticus var. balticus - (var. mexicanus) Association	4	10.73	2.68
Juncus balticus - Juncus mexicanus Alliance	41	1150.18	28.05
Juniperus occidentalis - (Pinus jeffreyi - Pinus ponderosa) / Cercocarpus ledifolius Association	1751	50102.45	28.61
Juniperus occidentalis / (Poa secunda - Festuca idahoensis - Pseudoroegneria spicata) Association	743	23422.72	31.52
Juniperus occidentalis / Artemisia arbuscula / Poa secunda Association	3819	148551.10	38.90

MapClass	Count	Total Acres	Average Acreage
Juniperus occidentalis / Artemisia tridentata - Purshia tridentata Association	1384	46098.70	33.31
Juniperus occidentalis Alliance	2150	45562.19	21.19
Navarretia leucocephala ssp. minima - Plagiobothrys cusickii Alliance	62	1083.30	17.47
Non - woody Row and Field Agriculture	47	3646.91	77.59
Oregon-Washington-British Columbia Vernal Pool Group	140	4003.62	28.60
Perennial Stream Channel (Open Water)	17	258.41	15.20
Phalaris arundinacea Association	1	1.13	1.13
Pinus (jeffreyi, ponderosa) / (Ceanothus prostratus - Purshia tridentata) Association	1389	39580.27	28.50
Pinus jeffreyi / Artemisia tridentata ssp. vaseyana / Festuca idahoensis Association	67	1556.37	23.23
Pinus ponderosa - Calocedrus decurrens - Pseudotsuga menziesii Alliance	137	9740.60	71.10
Pinus ponderosa - Calocedrus decurrens / Ceanothus prostratus Association	217	22001.06	101.39
Pinus ponderosa - Juniperus occidentalis / Artemisia tridentata - Purshia tridentata Association	358	9944.69	27.78
Pinus ponderosa / Arctostaphylos patula - Purshia tridentata Association	73	3673.05	50.32
Pinus ponderosa / Shrub Understory Alliance	1908	65021.90	34.08
Planted Trees and Shrubs	10	29.63	2.96
Poa pratensis - Agrostis gigantea - Agrostis stolonifera Alliance	1	1.08	1.08
Poa secunda - Muhlenbergia richardsonis - Carex douglasii Alliance	2	6.61	3.30
Populus tremuloides Alliance	18	51.22	2.85
Populus trichocarpa Alliance	36	179.73	4.99
Prunus emarginata - Holodiscus discolor Alliance	57	254.28	4.46
Prunus emarginata Association	12	50.24	4.19
Prunus subcordata Provisional Association	6	28.37	4.73
Prunus virginiana / Symphoricarpos rotundifolius Association	2	7.31	3.65
Prunus virginiana Alliance	70	319.99	4.57
Pseudoroegneria spicata - Poa secunda Association	1798	32340.50	17.99
Purshia tridentata - Artemisia tridentata Alliance	214	3112.64	14.55
Purshia tridentata - Artemisia tridentata Association	237	7336.58	30.96
Quercus kelloggii Alliance	299	3243.00	10.85
Ribes velutinum Provisional Association	2	2.78	1.39



MapClass	Count	Total Acres	Average Acreage
Rosa woodsii Association	2	5.59	2.80
Salix boothii - Salix geyeriana - Salix lutea Alliance	24	121.41	5.06
Salix exigua Alliance	34	103.47	3.04
Salix lasiolepis - Rosa woodsii / Mixed Herbs Association	41	134.53	3.28
Salix lasiolepis Alliance	3	6.45	2.15
Salix lucida / Poa pratensis Association	4	15.31	3.83
Schoenoplectus americanus Alliance	3	13.12	4.37
Small Earthen - dammed Ponds and Natural Lakes	249	7026.51	28.22
Sparsely Vegetated Recently Burned Areas	367	18407.79	50.16
Symphoricarpos oreophilus Association	65	195.71	3.01
Taraxia tanacetifolia - Iva axillaris Provisional Association	18	1442.70	80.15
Tetradymia canescens Provisional Association	22	248.89	11.31
Typha domingensis Association	4	14.47	3.62
Vancouverian - Rocky Mountain Montane Wet Meadow and Marsh Group	689	9195.98	13.35
Water	11	7817.64	710.69
Water Impoundment Feature	4	118.51	29.63
Western North American Ruderal Marsh, Wet Meadow and Shrubland Group	142	4707.59	33.15
Western North American Sparsely Vegetated Rivershore mapping unit	3	8.76	2.92

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<b>For Office Use:</b>	<b>Final database #:</b>	<b>Final vegetation type:</b>	<b>Alliance Association</b>
<b>I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION</b>			circle: <b>Relevé or RA</b>
<b>Database #:</b>	<b>Date:</b>	<b>Name of recorder:</b>	
		<b>Other surveyors:</b>	
	<b>UID:</b>	<b>Location Name:</b>	
<b>GPS name:</b> _____		For Relevé only: <b>Bearing°</b> , left axis at ID point ____ of <b>Long / Short</b> side <b>UTME</b> _____ <b>UTMN</b> _____ <b>Zone:</b> 11 NAD83 GPS error: ft./ m./ PDOP _____ Decimal degrees: <b>LAT</b> _____ - _____ <b>LONG</b> _____ - _____	
<b>GPS within stand?</b> Yes / No If No, cite from GPS to stand: distance (m) _____ bearing ° _____ inclination ° _____ and record: Base point ID _____ Projected UTM's: UTME _____ UTMN _____			
<b>Camera Name:</b> _____ Cardinal photos at ID point: <b>Other photos:</b>			
<b>Stand Size (acres):</b> <1, 1-5, >5   <b>Plot Area (m²):</b> 100 / _____   <b>Plot Dimensions</b> ____ x ____ m   <b>RA Radius</b> ____ m <b>Exposure, Actual °:</b> _____ NE NW SE SW Flat Variable   <b>Steepness, Actual °:</b> _____ 0° 1-5° > 5-25° > 25			
<b>Topography:</b> Macro: top upper mid lower bottom   Micro: convex flat concave undulating <b>Geology code:</b> _____ <b>Soil Texture code:</b> _____   <b>Upland or Wetland/Riparian</b> (circle one)			
% Surface cover: (Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) ( <u>2mm</u> -7.5cm) (Incl sand, mud) <b>H2O:</b> BA Stems: Litter: Bedrock: Boulder: Stone: Cobble: Gravel: Fines: =100%			
% Current year bioturbation _____ Past bioturbation present? Yes / No   % Hoof punch _____ <b>Fire evidence:</b> Yes / No (circle one) If yes, describe in Site history section, including date of fire, if known.			
<b>Site history, stand age, comments:</b> _____ _____ _____ _____ _____ _____ _____			
<b>Disturbance code / Intensity (L,M,H):</b> _____ / _____ / _____ / _____ "Other" _____			
<b>II. HABITAT DESCRIPTION</b>			
<b>Tree DBH :</b> T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover) <b>Shrub:</b> S1 seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead) <b>Herbaceous:</b> H1 (<12" plant ht.), H2 (>12" ht.) <b>Desert Riparian Tree/Shrub:</b> 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.) <b>Desert Palm/Joshua Tree:</b> 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)			
<b>III. INTERPRETATION OF STAND</b>			
<b>Field-assessed vegetation Alliance name:</b> _____ <b>Field-assessed Association name (optional):</b> _____ <b>Adjacent Alliances/direction:</b> _____ / _____ , _____ / _____ <b>Confidence in Alliance identification:</b> L M H Explain: _____ <b>Phenology (E,P,L):</b> Herb Shrub Tree Other identification or mapping information:			

#### IV. VEGETATION DESCRIPTION

% NonVasc cover: \_\_\_\_\_ Total % Vasc Veg cover: \_\_\_\_\_

% Cover - Conifer tree / Hardwood tree: /

**Regenerating Tree:** \_\_\_\_\_ **Shrub:** \_\_\_\_\_ **Herbaceous:** \_\_\_\_\_

**Height Class** - Conifer tree / Hardwood tree: \_\_\_\_/

Regenerating Tree: \_\_\_\_\_ Shrub: \_\_\_\_\_ Herbaceous: \_\_\_\_\_

Height classes: 1=<1/2m, 2=1/2-1m, 3=1-2m, 4=2-5m, 5=5-10m, 6=10-15m, 7=15-20m, 8=20-35m, 9=35-50m, 10=>50m

Stratum categories: T=Tree, A = SApling, E = SEedling, S = Shrub, H= Herb, N= Non-vascular

**% Cover Intervals for reference:** r = trace, + = <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

[illegible]

**CDFW-CNPS Protocol for the  
Combined Vegetation Rapid Assessment and Relevé Field Form  
Modoc–Lassen  
(May 5, 2016)**

## **Introduction**

This protocol describes the methodology for both the Relevé and Rapid Assessment (RA) vegetation sampling techniques as recorded in the Combined Vegetation Rapid Assessment and Relevé Field Form. The same environmental data are collected for both techniques. However, the relevé sample is a plot demarcated with a measuring tape, and each species in the plot is recorded along with its cover. The rapid assessment sample is not based on a taped plot, but is based on a visually estimated, usually circular area within a representative portion of the entire stand, with up to 20 of the dominant or characteristic species and their cover values recorded.

For this project, collect rapid assessments in woody vegetation and relevés in herbaceous vegetation. Some parts of this project area have not been sampled before, so RAs in woody vegetation may list more than 20 species.

## **Defining a Stand**

A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some vegetation stands are very small, such as a portion of a vernal pool, and some may be several square kilometers in size, such as a forest type. All samples should be in stands that meet the minimum mapping unit of 1 acre for upland and 0.5 acre for special stands such as small wetlands, riparian and serpentine barrens.

A stand is defined by two main unifying characteristics:

- 1) It has compositional integrity. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or indistinct.
- 2) It has structural integrity. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes but not the lower, would be divided into two stands. Likewise, sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The structural and compositional features of a stand are often combined into a term called homogeneity. For an area of vegetated ground to meet the requirements of a stand, it must be homogeneous (uniform in structure and composition throughout).

## **Selecting a bounded plot (Relevé) or representative area (Rapid Assessment) to sample within a stand**

Stands to be sampled may be selected by evaluation prior to a site visit (e.g., from aerial photos) or they may be selected on site during reconnaissance to determine extent and boundaries, location of other similar stands, etc.

Because many stands are large, it may be difficult to summarize the species composition, cover, and structure of an entire stand. We are usually trying to capture the most information as efficiently as possible. Thus, we are typically forced to select a representative portion to sample.

When sampling a stand of vegetation, the main point is to select a sample that, in as many ways possible, is representative of that stand. This means that you are not randomly selecting a plot; on the contrary, you are actively using your own best judgment to find a representative example of the stand.

Selecting a relevé plot or RA area requires that you see enough of the stand you are sampling to feel comfortable in choosing a representative plot location. Take a brief walk through the stand and look for variations in species composition and in stand structure. In hilly or mountainous terrain, look for a vantage point from which you can get a representative view of the whole stand. Variations in vegetation that are repeated throughout the stand should be included in your plot. Once you assess the variation within the stand, attempt to find an area that captures the stand's common species composition and structural condition to sample.

### **Tracking sampled vegetation types**

For large projects, the number of samples should be tracked daily or weekly by field-assessed Alliance type so that samples are spread as evenly as possible over types and time is not wasted collecting excessive numbers of samples of certain types. When multiple teams are in the field in the same week, daily communication between teams about Alliances sampled can ensure even sampling. *Prior to selecting a stand to sample, determine if what you are going to sample is needed based on this Alliance tracking.*

### **Selecting plots to avoid spatial autocorrelation**

When possible, do not sample adjacent stands. Do not take more than one sample of the same vegetation type within a sub-watershed. Exceptions can be made due to limited access to private lands. For example, samples from different formations, subclasses or classes (e.g., wetlands vs. uplands, lithomorphic vs. mesomorphic) may be sampled in the same sub-watershed, however, avoid sampling a grassland adjacent to an open woodland, even though they are technically different formations.

### **Plot Size**

For this project, the herbaceous relevé plot size is 100 m<sup>2</sup>. In a very few cases, such as vernal pools, the plot size can be less (10 m<sup>2</sup>).



## **Plot Shape**

A relevé has no fixed shape, though plot shape should reflect the character of the stand and is either a square or a rectangle. Adjust the orientation and dimensions of the plot to incorporate the best approximation of stand homogeneity. If the stand is about the same size as a Relevé, the plot boundaries may be similar to that of the entire stand. If we are sampling streamside riparian or other linear communities, our plot dimensions should not go beyond the community's natural ecological boundaries. Thus, a relatively long, narrow plot capturing the vegetation within the stand, but not outside it, would be appropriate. Species present along the edges of the plot that are clearly part of the adjacent stand should be excluded from the plot.

## **Location of GPS Points**

For Relevés, one corner will be considered the plot Identifier (ID point) and should be in the SW corner, if possible. If it is taken in another corner, this should be noted in the Site History section.

## **Definitions of fields in the Field Form**

### **I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION**

**Relevé or RA:** Circle the appropriate survey type.

**Database #:** This is the unique ID number for Relevés and Rapid Assessments, in the form of PPPPxxxx, where PPPP is the 4-character project code and xxxx is a unique 4-digit number (e.g. MOLA0001 for Modoc-Lassen sample #1). If this is a long term plot, a character from A to Z can be added to the unique ID for each re-sampling survey; so the first re-sample for MOLA0001 would be MOLA0001A.

**Date:** Date of the sampling.

**Name of recorder:** The full name of the recorder should be provided for the first field form for the day. On successive forms, initials can be recorded.

**Other Surveyors:** The full names of each person assisting should be provided for the first field form for the day. On successive forms, initials of each person assisting can be recorded.

**Location Name:** The name of the property or park, or the location within large holdings (like USFS or BLM properties).

**GPS name:** The name/number assigned to each GPS unit. This can be the serial number if another number is not assigned.

**Bearing°, left axis at ID point of Long / Short side:** Fill this in for Relevés only. For square or rectangular plots: from the ID Point, looking towards the plot, record the bearing of the axis to your left. If the plot is a rectangle, indicate whether the left side of the plot is the long or short side of the rectangle by circling "long" or "short" side (no need to circle anything for square plots). If there are no stand constraints, set up the plot with boundaries running in the cardinal directions and place the ID Point in the SW corner.

**UTM coordinates:** Easting (**UTME**) and northing (**UTMN**) location coordinates using the Universal Transverse Mercator (UTM) grid. Record the information from your GPS unit. These coordinates are always the base point of the survey. Soil samples and photos are taken from this point, and exposure, steepness, topography, etc. are measured here. If the GPS is not within the stand (i.e., the point is projected), these are the UTM coordinates of the base point.

*For Relevé plots, take the GPS point in the southwest corner of the plot whenever possible or in the center of a circular plot.*

**Zone:** Universal Transverse Mercator zone. Zone 10 is for California west of the 120<sup>th</sup> longitude; zone 11 is for California east of 120<sup>th</sup> longitude. The UTM Zone is 10 for this project.

**NAD83:** This is the default GPS datum. If you use a different one, cross this out and write in the correct datum.

**GPS error: ft./m./PDOP:** Circle the appropriate unit of measure and record the error reading from the GPS unit.

**Decimal degrees:** *Use this only if your GPS unit will not record UTM coordinates.* Latitude–Longitude reading in decimal degrees. Record the information from your GPS unit. These coordinates are always the base point of the survey. Soil samples and photos are taken from this point, and exposure, steepness, topography, etc. are measured here.

*For Relevé plots, take the waypoint in the southwest corner of the plot whenever possible or in the center of a circular plot.*

**GPS within stand? Yes / No:** Circle “Yes” to denote that the GPS waypoint was taken directly within or at the edge of the stand being assessed for a Rapid Assessment, or circle “No” if the waypoint was taken at a distance from the stand (such as with a binocular view of the stand). If the point is taken at the edge of the stand, note the direction to the stand.

**If No, cite from GPS to stand: distance (m), bearing°, inclination°:** From the base GPS point, measure the distance to the projected point using a range finder. Record the compass bearing from the base point to the projected point; record the inclination if the base and projected points are not at the same elevation.

**and record Base point ID:** This is the waypoint # of the base GPS point, where the surveyors were standing to record the distance survey.

**and Projected UTM coordinates:** These are the coordinates of the projected point, the point being surveyed. They are generated in the field if the GPS units have the ability to calculate projected points. If the GPS unit does not have this capability, make a note to that effect and leave these fields blank.

**Camera Name:** Write the camera name.

**Cardinal photos at ID point:** Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the ID Point, and record the jpeg numbers here. Try to include the horizon in at least some of these photos. If this is a distance survey to a projected point, take the four cardinal photos at the base point and at least one photo of the stand.

**Other photos:** This may include cardinal photos at additional corners or other relevant photos. Notes regarding photo locations or subjects can go here.

**Stand Size:** Estimate the size of the entire stand in which the sample is taken. As a measure, one acre is about 4,000 square meters (approximately 64 x 64 m), or 208 feet by 208 feet. One acre is similar in size to a football field.

**Plot Size:** If this is a Relevé, circle “100” for a 100m<sup>2</sup> plot, or record the plot size.

**Plot Shape:** Record the length and width of the Relevé plot in meters.

**RA Radius:** Enter the radius in meters of the visually estimated sample area for Rapid Assessments (should be a 20-meter radius at minimum). For a large stand, this limits the area covered by the RA. If you can see and assess the entire stand, the length and width should be recorded. If it is a long, narrow stand, note the width of the stand at your location. If your point is on the edge of the stand, record the radius into the stand, but note your location and the direction to which the RA Radius applies in the Site History section.

**Exposure:** (Enter Actual ° and circle general category): While facing in the general downhill direction, read degrees of the compass for the aspect or the direction you are standing, using degrees from north, adjusted for declination. Average the reading over the entire stand, even if you are sampling a Relevé plot, since your plot is representative of the stand. If estimating the exposure, write “N/A” for the actual degrees, and circle the general category chosen. “Variable” may be selected if the same, homogenous stand of vegetation occurs across a varied range of slope exposures.

**Steepness:** (Enter Actual ° and circle general category): Read degree slope from your compass. If estimating, write “N/A” for the actual degrees, and circle the general category chosen. Make sure to average the reading across the entire stand even if you are sampling in a Relevé plot.

**Topography:** First assess the broad (**Macro**) topographic feature or general position of the stand in the surrounding watershed, that is, the stand is at the top, upper (1/3 of slope), middle (1/3 of slope), lower (1/3 of slope), or bottom. **Circle all of the positions that apply for macrotopography.**

Then assess the local (**Micro**) topographic features or the lay of the area (e.g., surface is flat or concave). **Circle only one of the microtopographic descriptors.**

**Geology code:** Geological parent material of stand. If exact type is unknown, use a more general category (e.g., igneous, metamorphic, sedimentary). *See code list for types.*

**Soil Texture code:** Record soil texture that is characteristic of the plot (e.g., coarse loamy sand, sandy clay loam). *See soil texture key for types.*

**Upland or Wetland/Riparian:** Indicate if the stand is in upland or wetland/riparian setting. (Wetland and riparian are one category.) Note that a site need not be officially delineated as a wetland to qualify as such in this context (e.g., seasonally wet meadow).

**% Surface cover:** The abiotic substrates of the plot. The total should sum to 100%. It is helpful to imagine “mowing off” all of the live vegetation at the base of the plants and removing it – you will be estimating what is left covering the surface. Note that non-vascular cover (lichens, mosses, cryptobiotic crusts) is not estimated in this section.

**H<sub>2</sub>O:** Percent surface cover of running or standing water, ignoring the substrate below the water.

**BA Stems:** Percent surface cover of the basal area of stems at the ground surface. For most vegetation types, BA is 1-3% cover.

**Litter:** Percent surface cover of litter, duff, or wood on the ground.

**Bedrock:** Percent surface cover of bedrock, including outcrops.

**Boulder:** Percent surface cover of rocks >60 cm in the longest dimension.

**Stone:** Percent surface cover of rocks >25–60 cm in the longest dimension.

**Cobble:** Percent surface cover of rocks >7.5–25 cm in the longest dimension.

**Gravel:** Percent surface cover of rocks 2 mm–7.5 cm in the longest dimension.

**Fines:** Percent surface cover of bare ground and fine sediment <2 mm in the longest dimension (e.g., dirt, sand).

**% Current year bioturbation:** Estimate the percent of the plot exhibiting soil disturbance by any organism that lives underground. Do not include disturbance by ungulates. Note that this is a separate estimation from surface cover.

**Past bioturbation present?** Circle Yes if there is evidence of bioturbation from previous years in the plot.

**% Hoof punch:** Note the percent of the plot surface that has been punched down by hooves (cattle or native grazers) in wet soil. Depressions must be >2 cm deep.

**Fire Evidence:** Circle Yes if there is visible evidence of fire within the stand, and note the type of evidence in the “Site history, stand age, comments section,” for example, “charred dead stems of *Quercus berberidifolia* extending 2 feet above resprouting shrubs.” If you are certain of the year of the fire, put this in the Site history section.

**Site history, stand age, comments:** Briefly describe the stand age/seral stage, disturbance history, nature and extent of land use, and other site environmental and vegetation factors, such as distribution of species. Examples of disturbance history: fire, landslides, avalanching, drought, flood, animal burrowing, or pest outbreak. Also, try to estimate year or frequency of disturbance. Examples of land use: grazing, timber harvest, or mining. Examples of other site factors: exposed rocks, soil with fine-textured sediments, high litter/duff build-up, multi-storied vegetation structure, or other stand dynamics.

**Disturbance code / Intensity (L, M, H):** List codes for potential or existing impacts on the stability of the plant community. See code list for impacts and definitions of levels of disturbance. Characterize each impact each as **L** (=Light), **M** (=Moderate), or **H** (=Heavy). Disturbance is evaluated on a stand basis.

## II. HABITAT AND VEGETATION DESCRIPTION

### California Wildlife Habitat Relationships (CWHR)

**For CWHR, identify the size/height class of the plot using the following tree, shrub, and/or herbaceous categories. These categories are based on functional life forms.**

**Tree DBH:** Circle one of the tree size classes provided when the tree canopy closure exceeds 10% of the total cover, or if young tree density indicates imminent tree dominance. Size class is based on the average diameter at breast height (dbh) of each trunk (standard breast height is 4.5ft or 137cm). When marking the main size class, make sure to estimate the mean diameter of all trees over the entire stand, and weight the mean toward the larger tree dbh's. The "**T6 multi-layered**" dbh size class signifies a multi-layered tree canopy (with a size class T3 and/or T4 layer growing under a T5 layer and a distinct height separation between the classes) exceeding 60% total cover. Stands in the T6 class need also to contain at least 10% cover of size class 5 (>24" dbh) trees growing over a distinct layer with at least 10% combined cover of trees in size classes 3 (>6-11" dbh) or 4 (>11-24" dbh).

**Shrub:** Circle one of the shrub size classes provided when shrub canopy closure exceeds 10% (except in desert types) by recording which class is predominant in the survey. Shrub size class is based on the average amount of crown decadence (dead standing vegetation on live shrubs when looking across the crowns of the shrubs).

**Herbaceous:** Circle one of the herb height classes when herbaceous cover exceeds 2% by recording the predominant class in the survey. Note: *This height class is based on the average plant height at maturity, not necessarily at the time of observation.*

## III. INTERPRETATION OF STAND

**Field-assessed vegetation Alliance name:** Enter the name of the Alliance following the Manual of California Vegetation, 2<sup>nd</sup> Edition (Sawyer, Keeler-Wolf and Evens 2009). Please use scientific nomenclature, e.g., *Quercus agrifolia* forest. An Alliance is based on the dominant or diagnostic species of the stand, and usually reflects the uppermost and/or dominant height stratum. A dominant species covers the greatest area. A diagnostic species is consistently found in some vegetation types but not others.

The field-assessed Alliance name may not exist in the present classification, in which case you can provide a new Alliance name in this field. If this is the case, also make sure to state that it is not in the MCV under "Explain" below.

**Field-assessed Association name** (optional): Enter the name of the species in the Alliance and additional dominant/diagnostic species from any strata. In following naming conventions, species in differing strata are separated with a slash, and species in the uppermost stratum are

listed first (e.g., *Quercus douglasii* / *Toxicodendron diversilobum*). Species in the same stratum are separated with a dash (e.g., *Quercus lobata* – *Quercus douglasii*).

The field-assessed Association name may not exist in the present classification, in which you can provide a new Association name in this field.

**Adjacent Alliances/direction:** Identify other vegetation types that are directly adjacent to the stand being assessed by noting the dominant species (or known type). Also note the distance in meters from the GPS waypoint and the direction in degrees that the adjacent Alliance is found

(e.g., *Amsinckia tessellata* / 50m, 360° N or *Eriogonum fasciculatum* / 100m, 110°).

**Confidence in Alliance identification: (L, M, H)** With respect to the “Field-assessed Alliance name,” note whether you have L (=Low), M (=Moderate), or H (=High) confidence in the interpretation of this Alliance name.

**Explain:** Please elaborate if your “Confidence in Alliance identification” is low or moderate. Low confidence can occur from such things as a poor view of the stand, an unusual mix of species that does not meet the criteria of any described Alliance, or a low confidence in your ability to identify species that are significant members of the stand.

**Phenology:** Indicate early (E), peak (P), or late (L) phenology for each of the strata. For herbs, this generally indicates if species are in flower and/or fruit and are therefore identifiable. For shrubs and trees, this attribute generally refers to cover, e.g., a tree that is fully leafed out will be considered peak (P) even if it is not in flower. Phenology is useful for cover estimation and species identification issues, and should be elaborated upon in the next field.

**Other identification or mapping information:** Discuss any further problems with the identification of the assessment or issues that may be of interest to mappers. Note if this sample represents a type that is likely too small to map.

#### IV. VEGETATION DESCRIPTION

**Database #:** Copy the database # from Page 1.

##### ***Overall Cover of Vegetation***

**Provide an estimate of cover for the life-form categories below. Record a specific number for the total aerial cover or “bird’s-eye view” looking from above for each category, estimating cover for the living plants only. Litter/duff should not be included in these estimates.**

**The porosity of the vegetation should be taken into consideration when estimating percent foliar cover for all categories below: consider how much of the sky you can see when you are standing under the canopy of a tree, or how much light passes through the canopy of the shrub layer to help you estimate foliar cover.**

**% NonVasc cover:** The total cover of all lichens, bryophytes (mosses, liverworts, hornworts), and cryptogamic crust on substrate surfaces including downed logs, rocks and soil, but not on standing or inclined trees or vertical rock surfaces.

**Total % Vasc Veg cover:** The total cover of all vascular vegetation taking into consideration the porosity, or the holes, in the vegetation, and disregarding overlap<sup>1</sup> of the various tree, shrub, and/or herbaceous layers and species.

##### ***% Cover by Layer***

**Conifer Tree /Hardwood Tree:** The total foliar cover (considering porosity) of all live tree species, disregarding overlap<sup>1</sup> of individual trees. Estimate conifer and hardwood covers separately. **Please note:** These cover values should not include the coverage of regenerating tree species (i.e., tree seedlings and saplings).

**Regenerating Tree:** The total foliar cover of seedlings and saplings, disregarding overlap<sup>1</sup> of individual recruits. See seedling and sapling definitions below.

**Shrub:** The total foliar cover (considering porosity) of all live shrub species disregarding overlap<sup>1</sup> of individual shrubs.

**Herbaceous:** The total cover (considering porosity) of all herbaceous species, disregarding overlap<sup>1</sup> of individual herbs.

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<sup>1</sup> Porosity reduces the total cover of the canopy. Overlapping strata should not be included in the total cover percent; for instance, if a shrub is growing under a tree, only the cover of the tree will be added into the total; the cover of the shrub will be disregarded, except for the amount by which it fills in the porosity of the tree canopy.



### **Height Class by Layer**

Modal height for conifer tree / hardwood tree, regenerating tree, shrub, and herbaceous categories. Record an average height value for each category by estimating the mean height for each Group. Please use the following height intervals to record a height class: 1 = <1/2 m, 2 = 1/2-1 m, 3 = 1-2 m, 4 = 2-5 m, 5 = 5-10 m, 6 = 10-15 m, 7 = 15-20 m, 8 = 20-35 m, 9 = 35-50 m, 10 => 50 m.

*Note: For the herbaceous layer height, this height class is based on the average plant height at the time of observation, as opposed to how this is recorded in the CWHR section (at maturity).*

### **Species List and Coverage**

**For Rapid Assessments:** List up to 20 species that are dominant or that are characteristically consistent within the assessment area. These species may or may not be abundant, but they should be constant representatives in the survey. When different layers of vegetation occur, make sure to list species from each stratum. As a general guide, make sure to list at least 1-2 of the most abundant species per stratum. There is a heavy line on the form under the 20<sup>th</sup> line to limit the RA section of the species list.

*Note: If constant, diagnostic, or interesting species occur outside the assessment area but in the stand, list the species and estimated stand cover in the Site History section.*

**For Relevés:** list all species present in the plot, using a second species list page if necessary.

\*\* If using a second species list page, note "Continued" on the bottom of the first page and be sure to note the **Database #** on the second page.

**For both sample types,** provide the stratum:

**T = Tree.** A woody perennial plant that has a single trunk.

**A = SApling.** 1" - <6" dbh and young in age, OR small trees that are <1" dbh, are clearly of appreciable age, and are kept short by repeated browsing, burning, or other disturbance. Includes trees that are re-sprouting from roots or stumps following fire, logging or other disturbance. These re-sprouts may exhibit a shrubby form, with multiple small trunks, but are species that are generally considered trees. If a majority of the trunks are >6" dbh, then the re-sprouts would be recorded under the "Tree" stratum.

**E = SEedling.** A tree species clearly of a very young age that is <1" dbh or has not reached breast height. Applies only to trees propagating from seed; resprouts are not recorded here even if they meet the size requirements.

**S = Shrub.** A perennial, woody plant, that is multi-branched and doesn't die back to the ground every year.

**H = Herb.** An annual or perennial that dies down to ground level every year.

**N = Non-vascular.** Includes moss, lichen, liverworts, hornworts, cryptogamic crust, and algae.

Be consistent and don't break up a single species into two separate strata. The only time it would be appropriate to do so is when one or more tree species are regenerating, in which

case the SEedling and/or SApling strata should be recorded for that species. These may be noted on the same line, e.g.:

Strata	Species	%Cover	C
T/A/E	Quercus douglasii	40/<1/<1	

In some cases, the stratum of a particular species might not be obvious. Some examples are *Juniperus californica*, which has the size and growth habit of a shrub, but it is considered a tree, and mistletoe, which is considered a shrub. It is useful to have a list of species with ambiguous strata for each project. Consult the MCV or contact VegCAMP if you are unsure.

**C.** If a species collection is made, it should be indicated in the collection column with a “C” (for collected). If the species is later keyed out, cross out the species name or description and write the keyed species name in pen on the data sheet. Do not erase what was written in the field, because this information can be used if specimens get mixed up later. If the specimen is then thrown out, add a “T” to the “C” in the collection column (CT = thrown out after confirmation) or cross out the “C”. If the specimen is kept but is still not confidently identified, add a “U” to the “C” in the collection column (CU = collected and unconfirmed). In this case the unconfirmed species epithet should be put in parentheses [e.g., *Hordeum (murinum)*]. If the specimen is kept and is confidently identified, add a “C” to the existing “C” in the collection column (CC = collected and confirmed). If the specimen is later deposited in an herbarium, add a “D” to the existing “C” in the collection column (CD = collected and deposited) and note the receiving herbarium.

Use Jepson Manual nomenclature. Write out the genus and species of the plant. Do not abbreviate except for dominant species that do not have ambiguous codes. If you aren’t sure there aren’t duplicate codes, don’t use a code. When uncertain of an identification (which you intend to confirm later) use parentheses to indicate what part of the determination needs to be confirmed. For example, you could write out *Brassica (nigra)* if you are sure it is a *Brassica* but you need further clarification on the specific epithet.

Provide the % absolute foliar cover for each species listed, considering porosity. When estimating, it is often helpful to think of coverage in terms of the following cover intervals at first:

<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%.

Keeping these classes in mind, refine your estimate to a specific percentage. All species percent covers may total over 100% because of overlap.

Include the percent cover of snags (standing dead) of trees and shrubs. Use the code “SNAG.” Note their species, if known, in the “Species” column (i.e. SNAG – *Quercus wislizeni*).

For Rapid Assessments, make sure that the major non-native species occurring in the stand also are listed in the space provided in the species list with their strata and % cover.

For Relevés, all non-native species should be included in the species list.

Also for Relevés, record the <1% cover in one of two categories: “r” for trace (i.e., rare in plot, or solitary individuals) and “+” for <1% but not rare or solitary individuals.

**Unusual species:** List species that are locally or regionally rare, endangered, or atypical (e.g., range extension or range limit) within the stand. This field will be useful to the Program for obtaining data on regionally or locally significant populations of plants.

**Note:** Field forms are generally filled out in pencil, so that changes may be made easily while working in the plot or stand. Once out of the stand, however, entries on the field form should not be erased, but should be crossed out and corrected in a different-colored ink.

### Accuracy Assessment – Devil's Garden 2020

## Appendix D. Protocol for Accuracy Assessment Surveys 2018-2020

This protocol describes Accuracy Assessment (AA) data collection procedures. The primary purpose of the AA fieldwork is to supply data to test the accuracy of a specific vegetation map. The information collected can also contribute additional data for the classification of vegetation communities. The primary sampling units are the vegetation polygons delineated by photo-interpreters in the creation of the vegetation map.

If an entire AA polygon cannot be fully investigated due to terrain or other reasons, as much of the polygon as can be evaluated should be assessed.

Note that a delineated polygon may differ from the conventional definition of a stand of vegetation. A stand is the basic physical unit of vegetation in a landscape. It has no set size. Some stands of vegetation are very small while some may be several square kilometers in size. A stand is defined by two main unifying characteristics:

- 1) It has compositional integrity. Throughout the site, the combination of species is similar. The stand is differentiated from adjacent stands by a discernable boundary that may be abrupt or indistinct.
- 3) It has structural integrity. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes, but not the lower, would be divided into two stands. Likewise, sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The structural and compositional features of a stand are often combined into a term called homogeneity. For an area of vegetated ground to meet the requirements of a stand, it must be homogeneous.

A properly delineated polygon may contain more than one stand. One example is a stand that is below the minimum mapping unit (MMU); it cannot be mapped separately and will be absorbed into the surrounding vegetation type. Another example is vegetation that is difficult to identify accurately on photo imagery. Several similar-looking stands may be Grouped into one polygon and assigned a vegetation type at a high level, such as Group.

### **Selecting a location to sample within a polygon**

Once you are inside the polygon, you must find a representative example of the vegetation in the polygon. Look for variations in species composition and in stand structure. In the process, decide whether the polygon includes more than one mappable vegetation type or if the stand boundaries don't seem to match up with the polygon delineation. A vegetation type is considered mappable if it is large enough to meet MMU and can be delineated without creating unreasonably shaped polygons. For the Modoc-Lassen project, the MMU is 2 acres for upland and 0.25 acre for special stands such as small wetlands and riparian areas. The minimum width is 15 meters. Small variations in vegetation that are repeated throughout the polygon should be included in your sample. Once you assess the variation within the polygon, attempt to find an area that captures the stand's species composition and structural condition to sample.

In some cases, safe travel to the allocated polygons may not be possible. The reasons include gated roads or roads in poor condition, one-way foot travel between vehicle and polygon in excess of an hour, and other safety concerns. If a polygon is inaccessible, make a note on the map as to the reason it cannot be reached.

## **Survey Activities**

When a survey location has been chosen, a waypoint is recorded on a GPS device. At a minimum, these data should be recorded in the device: Waypoint ID, Polygon UID, Date, Surveyors, GPS Name, Projected, and Map Unit.

Four photos are taken in the cardinal directions, starting at the north and proceeding in a clockwise direction (N, E, S, W). Additional photos may be taken of the stand vegetation if considered useful.

The paper Accuracy Assessment Field Form is filled out completely. Descriptions of all fields on the form are provided below.

### **How to enter fields on the form**

**Surveyor:** The full name of the person recording should be provided on the first field form for the day. On successive forms, initials can be recorded.

**Other Surveyors:** The full names of each person assisting should be provided on the first field form for the day. On successive forms, initials of each person assisting can be recorded.

**Date:** The date the AA point was sampled. Use the standard U.S. format of “month-day-year” or use letters to write out the month.

**Location Name:** The name of the property, park, or the location within large holdings (like USFS or BLM properties).

**Waypoint ID:** The Waypoint ID in this format: GPS device name + date (yymmdd) + time (hhmm). For example, for a survey taken on iPad “V” on March 27 at 1:45 in the afternoon, the Waypoint ID will be “V1803271345.”

**Polygon UID:** The unique identifier (UID) assigned to each polygon, displayed in the GPS data and on paper maps.

**GPS name:** The name/number assigned to the GPS unit.

**Projected? Yes / No / Base:** Circle the appropriate option

**Yes** - The point is a projected, or offset point. The surveyors used a bearing, distance, and inclination to project the point into the polygon they are describing.

**No** - The surveyor is within the boundary of the polygon being assessed and the point is where the observer was standing for photographs. This location can also be used as a base location for an offset survey.

**Base** - Base point only. This is where a surveyor was standing when taking an offset survey to describe vegetation not at that point. No plant data or vegetation descriptions are associated with this location. However, cardinal photos taken at this point will be stored in a directory of this name.

## If Projected = Yes

**Bearing (°):** The compass bearing from the Base point to the Projected point.

**Distance (m):** The distance in meters from the Base point to the Projected point, determined by use of a range finder.


**Inclination (°):** The vertical offset from the Base point to the Projected point.

**Base Waypoint ID:** The location where the surveyor was standing when the information was collected. Cardinal photographs will be taken at this point and will be stored on the computer under this ID. Photographs of the stand vegetation will be taken from this point and will be stored on the computer under the Projected point's ID.

**Base UTM / Projected UTM:** If the point is projected or digitized, circle whether the UTM coordinates of the base point or the projected point have been recorded. These will generally be for the base point.

**UTM coordinates:** Easting (**UTME**) and Northing (**UTMN**) location coordinates using the Universal Transverse Mercator (UTM) grid. Record this information from a GPS unit. Record either UTM or Decimal Degrees.

**Decimal degrees:** Latitude–Longitude reading in decimal degrees. Record the information from your GPS unit. Record either UTM or Decimal Degrees.

**Camera name / Photo #s:** Write the name of the camera, JPG numbers, and direction of photos. *Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the GPS location.* This symbol can be used to indicate the cardinal photos: . Make sure to take additional photos of the general composition of the stand if the cardinal photos do not do an adequate job; note the JPG numbers and a description and direction of each additional photo.

## Species list and coverage

List up to twelve species that are dominant or that are characteristically consistent throughout the stand. These species may or may not be abundant, but they should be constant representatives in the survey. When different layers of vegetation occur in the stand, make sure to list species from each stratum. As a general guide, make sure to list at least 1-2 of the most abundant species per stratum.

### Strata:

**T = Overstory tree.** A woody perennial plant that has a single trunk.

**S = Shrub** A perennial, woody plant that is multi-branched and doesn't die back to the ground every year.

**H = Herb** An annual or perennial that dies down to ground level every year.

**N = Non-vascular** Includes mosses, liverworts, hornworts, and algae.

**Species:** Use Jepson Manual nomenclature. When uncertain of an identification (which you intend to confirm later) use parentheses to indicate what part of the determination needs to be confirmed. For example, you could write out *Brassica (nigra)* if you are sure it is a *Brassica* but you need further clarification on the specific epithet.



**% cover:** provide the % absolute aerial cover for each species listed. All species percent covers may total over 100% because of overlap.

**C:** If a species collection is made, it should be indicated with a “C” (for collected). If the species is later keyed out, cross out the species name or description and write the keyed species name in pen on the data sheet. Do not erase what was written in the field, because this information can be used if specimens get mixed up later. If the specimen is then thrown out, add a “T” to the “C” in that column (CT = thrown out after confirmation) or cross out the “C”. If the specimen is kept but is still not confidently identified, add a “U” to the “C” (CU = collected and unconfirmed). In this case the unconfirmed species epithet should be put in parentheses [e.g. *Hordeum (murinum)*]. If the specimen is kept and is confidently identified, add a “C” to the existing “C” (CC = collected and confirmed). If the specimen is later deposited in an herbarium, add a “D” to the existing “C” (CD = collected and deposited) and note the receiving herbarium.

**Notes:** Describe the stand age or seral stage, disturbance history, nature and extent of land use, and other site environmental and vegetation factors. Include recommendations for line-work revision, discernibility of the vegetation based on season and topography, problems with classification interpretation, homogeneity of vegetation, and unusual sightings of plants or animals.

**Map Unit Name:** Enter the vegetation type name here. Refer to the Modoc-Lassen Vegetation Key to select the type. If the vegetation in this polygon does not exactly match the descriptions in the key, enter the best-fitting vegetation type here and the second-best type in the next field (see **Secondary** below). For further verification of the vegetation, refer to the Stand Tables.

**Secondary** (Optional): Assign a second-best-fitting name for the vegetation within the polygon. Assign a secondary code **only** if there is some ambiguity in assigning the polygon to a primary vegetation. Note the reason for assigning a secondary call within the “*Confidence in map unit ID*” field below.

**Confidence in map unit ID? L M H Explain:** Note the level of confidence you feel in the map unit identification by circling **Low**, **Moderate**, or **High**. This is an area to describe how well the stand characteristics match the Vegetation Key. Are all diagnostic species present in proper proportions? If not, how do they differ? If a secondary type is identified, what made the stand type ambiguous? ***Note that if you choose low or moderate confidence, you should have a secondary call, as an alternative way to classify the vegetation.***

**Linework problems:** Check the box if the polygon boundary line does not surround a distinct vegetation type. Examples for which you would check the box include situations where there is more than one type of mappable vegetation within the polygon, when a portion of the boundary includes part of an adjacent stand, or when the stand continues beyond the polygon boundary. If checked, provide comments in the Notes section to explain.

**More than 1 vegetation type in this polygon:** Check if there is more than one vegetation type within the polygon. If the polygon includes more than one type, note the additional vegetation types in the Notes section. Your survey should be taken in the vegetation type that covers the largest area in the polygon.

**Vegetation change since imagery taken:** Check the box if the vegetation in the polygon has changed since the aerial imagery used as the base of the vegetation map was taken. If yes,

provide a description in the Notes section of how the vegetation has changed (for example: burned, developed, visible dominance change over time).

**Conifer Cover:** The total foliar cover (considering porosity) of all live conifer trees, disregarding overlap of individual trees.

**Hardwood Cover:** The total foliar cover (considering porosity) of all live hardwood trees, disregarding overlap of individual trees.

**Total Tree Cover:** The total foliar cover (considering porosity) of all live tree species, disregarding overlap of individual trees. This value may be less than the sum of the conifer and hardwood covers due to overlap.

**Shrub Cover:** The total foliar cover (considering porosity) of all live shrubs, disregarding overlap.

**Herb Cover Class:** The total cover (considering porosity) of all herbaceous species, disregarding overlap. Circle the appropriate cover class range.

**Tree Height:** Circle the height range of the modal tree height.

**Tree DBH:** Circle one of the tree size classes provided. Size class is based on the average diameter at breast height (dbh) of each trunk (standard breast height is 4.5ft or 137cm). When marking the main size class, make sure to estimate the mean diameter of all trees over the entire stand, and weight the mean toward the larger tree dbh's.

**Exotics:** Circle the appropriate level.

None or not visible

<33%                      Light, less than 33% of total cover is non-native

33-66%                  Moderate, between 33% and 66% of total cover is non-native

>66%                     Heavy, more than 66% of total cover is non-native

**Juniper Expansion:** Circle the percent cover range of all young *Juniperus occidentalis* (<6" dbh) that are found in the stand.

None visible

0.2-1%

1-4%

4-10%

>10%

**Rough % of polygon viewed:**

Enter a rough estimate of the **percent of the polygon** that you were able to assess from your point AND any additional area that you were able to view while driving or walking around or through the polygon.

## Appendix E. Vegetation Classification and Hierarchy

Vegetation Classification organized within the current USNVC hierarchy. NatureServe global (G) and California state (S) rarity ranks are given for new and mapped types in the Rank column. GNR or CNR are global or California unranked types for which the entire range is not yet known; N/A means the type is not ranked because it is a semi-natural community; “?” indicates our best interpretation, based on the standardized rank estimator, given we have not sampled and mapped all of California; Y and N indicate whether or not an Association is rare when more specific rarity ranks have not been assigned; a rank of S4 or S5 indicates a vegetation community that is not sensitive ; a rank of S1, S2 or S3 indicates a sensitive natural community; “–” is used for upper levels of the hierarchy that are not given rarity ranks. The status column indicates whether the type is newly added for this project (New) or had a range extension because of mapping for this project (RE).

Vegetation Type	Rank	Status
Forest & Woodland Class	–	–
Temperate & Boreal Forest & Woodland Subclass	–	–
Cool Temperate Forest & Woodland Formation	–	–
Rocky Mountain Forest & Woodland Division	–	–
Central Rocky Mountain Dry Lower Montane – Foothill Forest MacroGroup	–	–
Central Rocky Mountain Ponderosa Pine Open Woodland Group	–	–
Pinus ponderosa / Shrub Understory Alliance	GNR/S4	New
Pinus (jeffreyi, ponderosa) / (Ceanothus prostratus – Purshia tridentata) Association	Y	
Pinus ponderosa – Juniperus occidentalis / Artemisia tridentata – Purshia tridentata Association	Y	New
Pinus jeffreyi / Artemisia tridentata ssp. vaseyana / Festuca idahoensis Association	Y	
Pinus ponderosa / Arctostaphylos patula – Purshia tridentata Association	Y	New
Pinus ponderosa var. washoensis / Arctostaphylos nevadensis Association	Y	
Pinus ponderosa var. washoensis / Symphoricarpos spp. / Pseudostellaria jamesiana Association	Y	
Rocky Mountain Subalpine – High Montane Conifer Forest MacroGroup	–	–
Rocky Mountain Subalpine Moist Spruce – Fir Forest & Woodland Group	–	–
Populus tremuloides Alliance	G5/S3	
Populus tremuloides / Symphoricarpos rotundifolius Association	Y	
Vancouverian Forest & Woodland Division	–	–

Vegetation Type	Rank	Status
Southern Vancouverian Montane – Foothill Forest MacroGroup	–	–
Californian Montane Conifer Forest & Woodland Group	–	–
Abies concolor Alliance	G4/S4	
Abies concolor - Pinus ponderosa / Amelanchier alnifolia Association	N	
Pinus ponderosa – Calocedrus decurrens – Pseudotsuga menziesii Alliance	G4/S4	RE
Pinus ponderosa – Calocedrus decurrens / Ceanothus prostratus Association	N	
Cascadian Oregon White Oak - Conifer Forest & Woodland Group	–	–
Quercus garryana Alliance	G4/S3	
Quercus garryana / Ceanothus cuneatus / Festuca idahoensis Association	Y	
Western North American Pinyon – Juniper Woodland & Scrub Division	–	–
Intermountain Singleleaf Pinyon – Juniper Woodland MacroGroup	–	–
Columbia Plateau Western Juniper Open Woodland Group	–	–
Juniperus occidentalis Alliance	G5/S4	
Juniperus occidentalis – (Pinus jeffreyi – Pinus ponderosa) / Cercocarpus ledifolius Association	N	
Juniperus occidentalis / Artemisia arbuscula / Poa secunda Association	N	
Juniperus occidentalis / Artemisia tridentata – Purshia tridentata Association	N	New
Juniperus occidentalis / (Poa secunda – Festuca idahoensis – Pseudoroegneria spicata) Association	N	New
Intermountain Basins Curl-leaf Mountain-Mahogany Woodland & Scrub Group	–	–
Cercocarpus ledifolius Alliance	G5/S4	
Cercocarpus ledifolius – Artemisia tridentata ssp. vaseyana Association	Y	New
Cercocarpus ledifolius Association	N	
Temperate Flooded & Swamp Forest Formation	–	–
Rocky Mountain – Great Basin Montane Flooded & Swamp Forest Division	–	–
Rocky Mountain – Great Basin Montane Riparian & Swamp Forest MacroGroup	–	–
Northern Rocky Mountain Lowland – Foothill Riparian Forest Group	–	–
Populus trichocarpa Alliance	G5/S3	
Warm Temperate Forest & Woodland Formation	–	–
Californian Forest & Woodland Division	–	–
Californian Ruderal Forest MacroGroup	–	–
Californian Ruderal Forest Group	–	–
Eucalyptus spp. – Ailanthus altissima – Robinia pseudoacacia Alliance	N/A	

Vegetation Type	Rank	Status
Californian Forest & Woodland MacroGroup	–	–
Californian Broadleaf Forest & Woodland Group	–	–
Quercus kelloggii Alliance	G4/S4	
Desert & Semi-Desert Formation Class	–	–
Cool Semi-Desert Scrub & Grassland Formation Subclass	–	–
Cool Semi-Desert Scrub & Grassland Formation	–	–
Western North American Cool Semi-Desert Scrub & Grassland Division	–	–
Great Basin – Intermountain Dry Shrubland & Grassland MacroGroup	–	–
Great Basin-Intermountain Ruderal Dry Shrubland & Grassland Group	–	–
Bromus tectorum – Elymus caput-medusae Alliance	N/A	
Bromus tectorum Association	N/A	
Elymus caput-medusae Provisional Association	N/A	New
Ventenata dubia Provisional Association	N/A	New
Intermountain Semi-Desert Steppe & Shrubland Group	–	–
Krascheninnikovia lanata Alliance	G4/S3	
Chrysothamnus viscidiflorus Alliance	G5/S5	RE
Chrysothamnus viscidiflorus Association	N	
Ericameria nauseosa Alliance	G5/S5	
Ericameria nauseosa Association	N	
Ericameria nauseosa / Bromus tectorum Association	N	
No Alliance	–	–
Iliamna bakeri stands		
Mojave Mid-Elevation Mixed Desert Scrub Group	–	–
Ephedra nevadensis - Lycium andersonii - Grayia spinosa Alliance	G5/S3S4	
Intermountain Tall and Dwarf Sagebrush Scrub Steppe MacroGroup	–	–
Intermountain Ruderal Steppe and Shrubland Group	–	–
Bromus tectorum – Elymus caput-medusae Alliance	N/A	
Bromus tectorum Association	N/A	
Elymus caput-medusae Provisional Association	N/A	
Ventenata dubia Provisional Association	N/A	
Great Basin – Intermountain Dwarf Shrub Steppe Group	–	–
Artemisia arbuscula Alliance	G5/S4	
Artemisia arbuscula / Poa secunda Association	Y	New

Vegetation Type	Rank	Status
Artemisia arbuscula / Bromus spp. – Elymus caput-medusae Association	N/A	New
Artemisia arbuscula – Eriogonum (microthecum, sphaerocephalum) Association	Y	
Artemisia arbuscula ssp. arbuscula / Festuca idahoensis Association	Y	
Artemisia arbuscula ssp. longicaulis – Grayia spinosa Shrubland Association	N	
Artemisia nova Alliance	G4/S3	
Artemisia nova / Poa secunda Association	Y	
Eriogonum spp. / Poa secunda Alliance	GNR/S3	New
Eriogonum sphaerocephalum / Poa secunda Association	Y	New
Intermountain Big Sagebrush Steppe & Shrubland Group	–	–
Artemisia tridentata Alliance	G5/S5	
Artemisia tridentata / Distichlis spicata Provisional Association	Y	New
Artemisia tridentata – Ephedra viridis / Pseudoroegneria spicata Association	N	New
Artemisia tridentata Association	N	
Artemisia tridentata – (Ericameria nauseosa) / Bromus tectorum Association	N	
Artemisia tridentata ssp. vaseyana Alliance	G4/S4	
Artemisia tridentata ssp. vaseyana / Festuca idahoensis Association	Y	New
Artemisia tridentata ssp. vaseyana – Symphoricarpos oreophilus / Bromus carinatus Association	N	New
Symphoricarpos oreophilus Association	N	New
Artemisia tridentata – Salvia dorrii – Chamaebatiaria millefolium Association	Y	
Purshia tridentata – Artemisia tridentata Alliance	G4/S3	
Purshia tridentata – Artemisia tridentata Association	Y	
Purshia tridentata – Artemisia tridentata / Achnatherum hymenoides Association	Y	
Tetradymia canescens Provisional Association	Y	New
No Alliance	–	–
Prunus andersonii Provisional Association		
Great Basin Saltbush Scrub MacroGroup	–	–
Intermountain Shadscale – Saltbush Scrub Group	–	–
Atriplex canescens Alliance	G5/S4	
Atriplex confertifolia Alliance	G5/S4	
Shrub & Herb Vegetation Formation Class	–	–
Temperate & Boreal Grassland & Shrubland Formation Subclass	–	–
Temperate Grassland & Shrubland Formation	–	–

Vegetation Type	Rank	Status
Western North American Interior Chaparral Division	–	–
Cool Interior Chaparral MacroGroup	–	–
Western North American Montane Scrub Group	–	–
Ceanothus velutinus Alliance	G5/S4	
Ceanothus velutinus Association	N	
Ceanothus velutinus – Prunus emarginata – Artemisia tridentata Association	Y	New
Prunus emarginata – Holodiscus discolor Alliance	G4/S4	
Prunus emarginata Association	N	
Holodiscus discolor Association	Y	New
Ribes velutinum Provisional Association	Y	New
Amelanchier utahensis – Cercocarpus montanus – Cercocarpus intricatus Alliance	G4/S3	RE
Amelanchier utahensis Association	Y	New
Cercocarpus montanus / Pseudoroegneria spicata Association	Y	New
Prunus virginiana Alliance	G4/S2?	
Prunus virginiana / Symphoricarpos rotundifolius Association	Y	New
Arctostaphylos patula - Arctostaphylos nevadensis Alliance	G5/S3S4	
Arctostaphylos patula Association	N	
Arctostaphylos patula – Ceanothus velutinus Association	Y	New
Chrysolepis sempervirens Alliance	G4/S3	
Chrysolepis sempervirens Association	S3	
Western North American Grassland & Shrubland Division	–	–
Central Rocky Mountain Montane – Foothill Grassland & Shrubland MacroGroup	–	–
Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group	–	–
Festuca idahoensis – Pseudoroegneria spicata – Poa secunda Alliance	GNR/S3	
Pseudoroegneria spicata – Poa secunda Association	S2	
Festuca idahoensis – Pseudoroegneria spicata Association	Y	New
Elymus smithii Unique Stands		
Rocky Mountain-Vancouverian Subalpine-High Montane Mesic Meadow	–	–
Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow	–	–
Poa secunda – Muhlenbergia richardsonis – Carex douglasii Alliance	G4?/S3	
Carex douglasii Association	Y	
Mediterranean Scrub & Grassland Formation	–	–
Californian Scrub & Grassland Division	–	–

Vegetation Type	Rank	Status
Californian Ruderal Grassland, Meadow & Scrub MacroGroup	–	–
Californian Ruderal Grassland, Meadow & Scrub Group	–	–
Lolium perenne Alliance	N/A	
Lolium perenne – Lotus corniculatus Association	N/A	
Californian Annual & Perennial Grassland MacroGroup	–	–
Californian Annual Grassland & Forb Meadow Group	–	–
Acmispon americanus Provisional Alliance	G4?/S4?	
Californian Perennial Grassland Group	–	–
Corethrogyne filaginifolia – Eriogonum (elongatum, nudum) Alliance	G4/S4	
Shrub & Herb Wetland Formation Subclass	–	–
Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation	–	–
Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division	–	–
Western North American Montane – Subalpine – Boreal Marsh, Wet Meadow & Shrubland MacroGroup	–	–
Western Montane – Subalpine Riparian & Seep Shrubland Group	–	–
Western North American Sparsely Vegetated River shore mapping unit	–	–
Salix lasiolepis Alliance	G4/S4	
Salix lasiolepis – Rosa woodsii / Mixed Herbs Association	Y	
Salix boothii – Salix geyeriana – Salix lutea Alliance	GNR/S2	RE
Salix lucida / Poa pratensis Association	Y	
Betula occidentalis Alliance	G4/S2	
Cornus sericea – Rosa woodsii – Ribes spp. Alliance	G5/S3	
Cornus sericea Association	Y	New
Rosa woodsii Association	N	
Rocky Mountain – Great Basin Lowland – Foothill Riparian Shrubland Group	–	–
Artemisia cana Alliance	G5/S3	RE
Artemisia cana (ssp. bolanderi, ssp. viscidula) / Poa secunda Association	Y	New
Salix exigua Alliance	G5/S4	
Vancouverian – Rocky Mountain Montane Wet Meadow & Marsh Group	–	–
Carex (aquatilis, lenticularis) Alliance	G5/S3	RE
Carex aquatilis – Carex lenticularis Association	Y	
Carex simulata Alliance	G4/S3	



Vegetation Type	Rank	Status
Carex simulata Association	Y	
Carex nebrascensis Alliance	G5/S4	
Carex nebrascensis Association	N	
Juncus nevadensis Alliance	G3?/S3?	
Juncus nevadensis Association	Y	
Eleocharis quinqueflora Alliance	G4/S4	
Carex scopulorum Alliance	G4/S3	
Carex scopulorum Association	Y	
Juncus arcticus (var. balticus, mexicanus) Alliance	G5/S4	
Juncus arcticus var. balticus – (var. mexicanus) Association	N	
Danthonia californica – Deschampsia cespitosa – Camassia quamash Alliance	GNR/S4	New
Danthonia unispicata – Poa secunda Association	Y	
Hordeum brachyantherum Association	G2	
Deschampsia cespitosa Association	Y	
Scirpus microcarpus Alliance	G4/S2	
Scirpus microcarpus Association	Y	
Solidago canadensis Alliance	G4?/S4?	
Carex douglasii Association	Y	
Vancouverian Lowland Marsh, Wet Meadow & Shrubland MacroGroup	–	–
Temperate Pacific Freshwater Wet Mudflat Group	–	–
Bidens cernua – Euthamia occidentalis – Ludwigia palustris Alliance		RE
Artemisia douglasiana Provisional Association	N	
Western North American Vernal Pool MacroGroup	–	–
Californian Vernal Pool Group	–	–
Eleocharis (acicularis, macrostachya) Alliance	GNR/S3S4	
Eleocharis macrostachya Provisional Association	N	
Oregon-Washington-British Columbia Vernal Pool Group	–	–
Navarretia leucocephala ssp. minima – Plagiobothrys cusickii Alliance	GNR/S2	New
Taraxia tanacetifolia – Iva axillaris Provisional Association	Y	New
Arid West Interior Freshwater Marsh MacroGroup	–	–
Arid West Interior Freshwater Marsh Group	–	–
Typha domingensis – Typha latifolia – Typha angustifolia Alliance	G5/S5	
Typha domingensis Association	N	

Vegetation Type	Rank	Status
Schoenoplectus americanus Alliance	S3	
Schoenoplectus americanus Association	Y	
Western North American Ruderal Marsh, Wet Meadow & Shrubland MacroGroup	–	–
Western North American Ruderal Marsh, Wet Meadow & Shrubland Group	–	–
Phalaris aquatica – Phalaris arundinacea Alliance	GNR/SNR	
Phalaris arundinacea Association	N	
Poa pratensis – Agrostis gigantea – Agrostis stolonifera Alliance	N/A	
Agrostis (gigantea, stolonifera) Association	N/A	
Poa pratensis Association	N/A	
Salt Marsh Formation	–	–
North American Western Interior Brackish Marsh, Playa & Shrubland Division	–	–
Warm & Cool Desert Alkali-Saline Marsh, Playa & Shrubland MacroGroup	–	–
North American Desert Alkaline-Saline Wet Scrub Group	–	–
Sarcobatus vermiculatus Alliance	G5/S4	
Sarcobatus vermiculatus – Artemisia tridentata Association	Y	New
Sarcobatus vermiculatus – Atriplex confertifolia – (Picrothamnus desertorum, Suaeda moquinii) Association	Y	
North American Desert Alkaline-Saline Marsh & Playa Group	–	–
Distichlis spicata Alliance	GNR/S4	
Leymus cinereus – Leymus triticoides Alliance	G3/S3	
Leymus cinereus Association	G2G3/S2?	
Leymus triticoides – Poa secunda Association	Y	
Eleocharis (palustris, rostellata) Alliance	GNR/S2S3	
Eleocharis rostellata Association	G3/S3	
Open Rock Vegetation Class	–	–
Temperate & Boreal Open Rock Vegetation Subclass	–	–
Temperate & Boreal Cliff, Scree & Other Rock Vegetation Formation	–	–
Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation Division	–	–
Western North American Cliff, Scree & Rock Vegetation MacroGroup	–	–
Columbia Plateau cliff, scree and rock mapping unit	–	–
Agricultural & Developed Vegetation Class	–	–
Herbaceous & Woody Developed Vegetation Subclass	–	–
Other Developed Vegetation Formation	–	–

<b>Vegetation Type</b>	<b>Rank</b>	<b>Status</b>
Other Developed Vegetation Division	—	—
Tree Developed Vegetation MacroGroup	—	—
Aquatic Vegetation Formation Class	—	—
Freshwater Aquatic Vegetation Formation Subclass	—	—
Temperate & Boreal Freshwater Aquatic Vegetation Formation	—	—
North American Freshwater Aquatic Vegetation Division	—	—
Western North American Freshwater Aquatic Vegetation MacroGroup	—	—
Western North American Temperate Freshwater Aquatic Vegetation Group	—	—

## Appendix F. Imagery for each Mapping Unit Classified

Following is a list of classified units that were utilized in the map and the level associated with each map unit, in alphabetical order. First images are NAIP 2016 followed by Google Earth imagery.

### ***Abies concolor* Dry Forest & Woodland Alliance**

*Abies concolor* has a green to blue-green appearance and has a compact upright-branching structure. Pointy crowns and low branching near the ground can often be seen in shadows and differentiate it from *Pinus jeffreyi* or *Pinus ponderosa*, which commonly drop lower branches with age. It can be found at the higher elevations in the study area and often prefers northern cooler aspects.





***Abies concolor* – *Pinus ponderosa* / *Cercocarpus ledifolius* Forest Association**  
*Cercocarpus* and *Abies* are both common in the higher elevations of the study area and frequently mix together. *Cercocarpus* is in the mid-strata layer and appears grey-brown.



### **Agriculture (within the current 5-year cycle) Mapping Unit**

This mapping unit was utilized when the photo-interpreter could see that the land was currently agriculture or had been used for agriculture production within the past five years of the imagery used.





***Amelanchier utahensis* – *Cercocarpus montanus* – *Cercocarpus intricatus*  
Alliance**

***Amelanchier utahensis* Association**

*Amelanchier* is the dominant shrub in this Association and was not typically mixed with *Cercocarpus* in the study area. *Amelanchier* is a taller deciduous shrub with a slightly blue-green signature. It has a rough texture which can be used to separate it from *Symphoricarpos*, which has a smoother appearance.





### **Anthropogenic Areas of Little or No Vegetation Mapping Unit**

Ground is barren or nearly barren of vegetation and is the result of man-made disturbances such as plowing, disking, scraping, or mining.





***Arctostaphylos patula* – *Arctostaphylos nevadensis* Alliance**  
***Arctostaphylos patula* Shrubland Association**

*Arctostaphylos patula* is a mid-sized common shrub typically in the 1 to 2 meter height range and has an army-green to brownish-green appearance on imagery. Dead grey branches can often be spotted on the imagery, especially in decadent stands. This species can easily be mistaken for *Ceanothus velutinus*, which has a similar signature and often grows together with *Arctostaphylos*.





***Arctostaphylos patula* – *Ceanothus velutinus* Association**

This signature is very similar to the above Association, with an army-green to brown-green appearance. When these two species mix, the stands typically become denser with a more closed-off canopy. Both species are pyrophytic and regenerate quickly post-fire.





***Artemisia arbuscula* Steppe & Shrubland Alliance**

***Artemisia arbuscula* / *Poa secunda* Association**

*Artemisia arbuscula* is a shrub which does not exceed ½ meter in height. It grows well in thin clay soils and prefers flat to moderately sloped terrain. It has a dull grey to light blue-grey appearance on imagery. *Poa secunda* was commonly found in the majority of stands surveyed and indicated the presence of native grasses and herbs.



***Artemisia arbuscula* / *Bromus* spp. – *Elymus caput-medusae* Association**

This Association was commonly found in disturbed areas post-fire or after a juniper removal project. *Bromus tectorum* (a frequent fire successor) can be detected by its reddish hue in the herbaceous layer, which can be better seen in the Google Earth imagery.





***Artemisia arbuscula* – *Eriogonum* (*microthecum*, *sphaerocephalum*) Association**

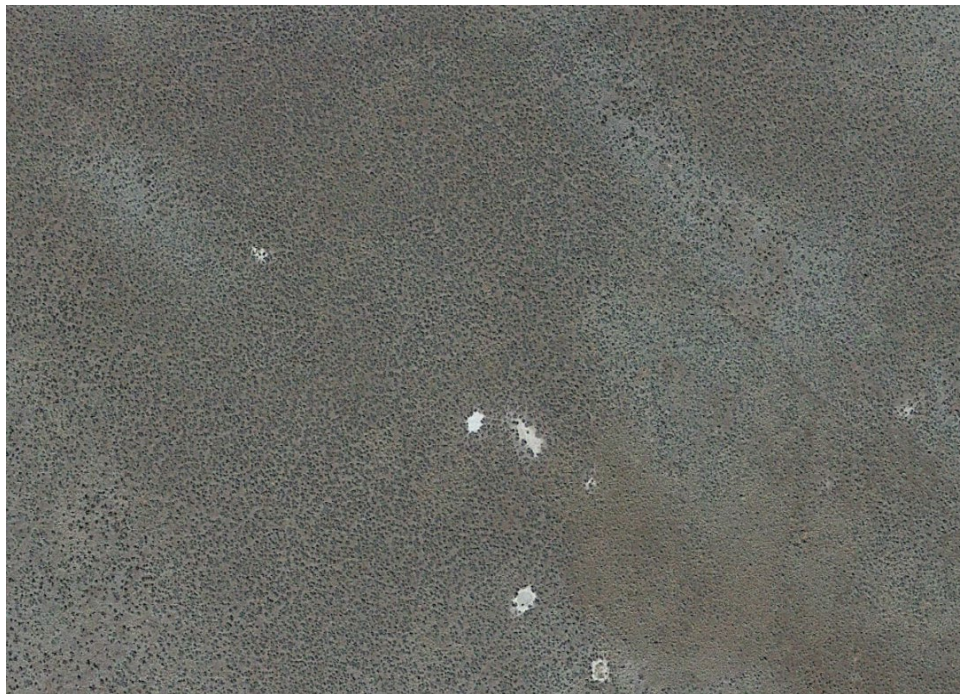
Comonly found in flat areas with thin volcanic soils where the overall vegetation cover is sparse. *Artemisia arbuscula* and *Eriogonum* species are often difficult to see due to their small stature, but will often have a grey dappled appearance over a dark substrate.





### ***Artemisia cana* Mesic-Riparian Shrubland Alliance**

*Artemisia cana* prefers flat low-lying areas that are commonly seasonally inundated with water and have thick deep-cracking clay soils. It is larger than *A. arbuscula* but often found adjacent to it, and has a slightly more blue-green hue than *A. arbuscula* and *A. tridentata*. Alkalinity is common in the soils (indicated by the white scalds) and the herbaceous layer is often sparse with vernal pool species.





### ***Artemisia tridentata* Shrubland Alliance**

#### ***Artemisia tridentata* – (*Ericameria nauseosa*) / *Bromus tectorum* Association**

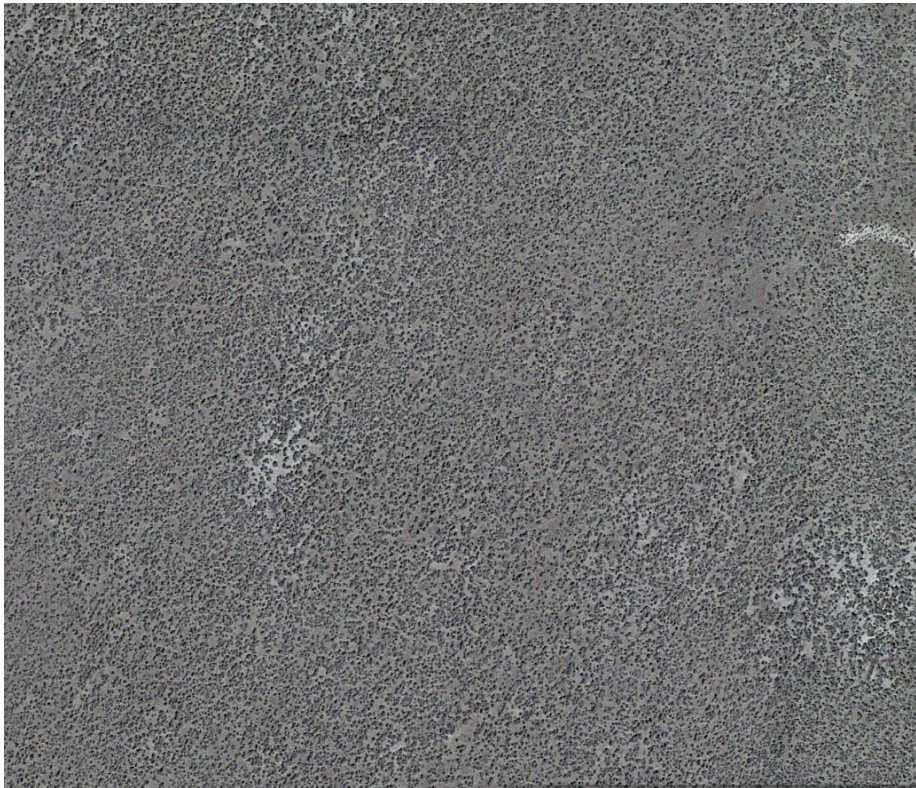
*Artemisia tridentata* is the largest of the *Artemisia* species in the study area and can reach heights over 2 meters. It can have a variable signature depending on growing conditions, but is generally robust with a grey-green to blue-green appearance on imagery. This Association was commonly found in disturbed areas, indicated by the presence of *Ericameria* and *Bromus*.





### ***Artemisia tridentata* Association**

This Association has high relative nativity and signs of disturbance are minimal. *Artemisia tridentata* is one of the most commonly found shrubs in the study area and can be found on a wide variety of slopes, aspects and soil conditions.





***Artemisia tridentata* ssp. *vaseyana* – Mixed Steppe & Shrubland Alliance**

***Artemisia tridentata* ssp. *vaseyana* / *Festuca idahoensis* Association**

*Artemisia tridentata* ssp. *vaseyana* can start being found near 5,000 feet elevation and above, in cold environments where moderate to deep winter snow accumulation is common. This subspecies can be identified by its blue-purple hue using the Color Infrared (CIR) imagery (not shown here). This Association typically did not have other shrub types mixing with *A. tridentata*.





***Symphoricarpos oreophilus* Association (*Wyethia mollis*)**

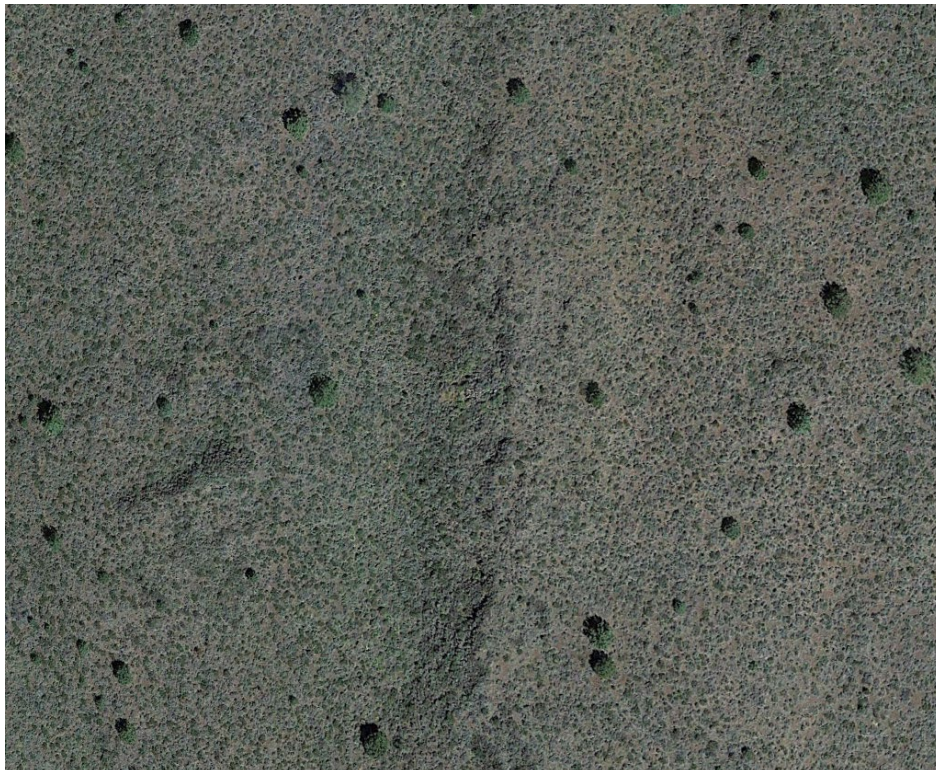
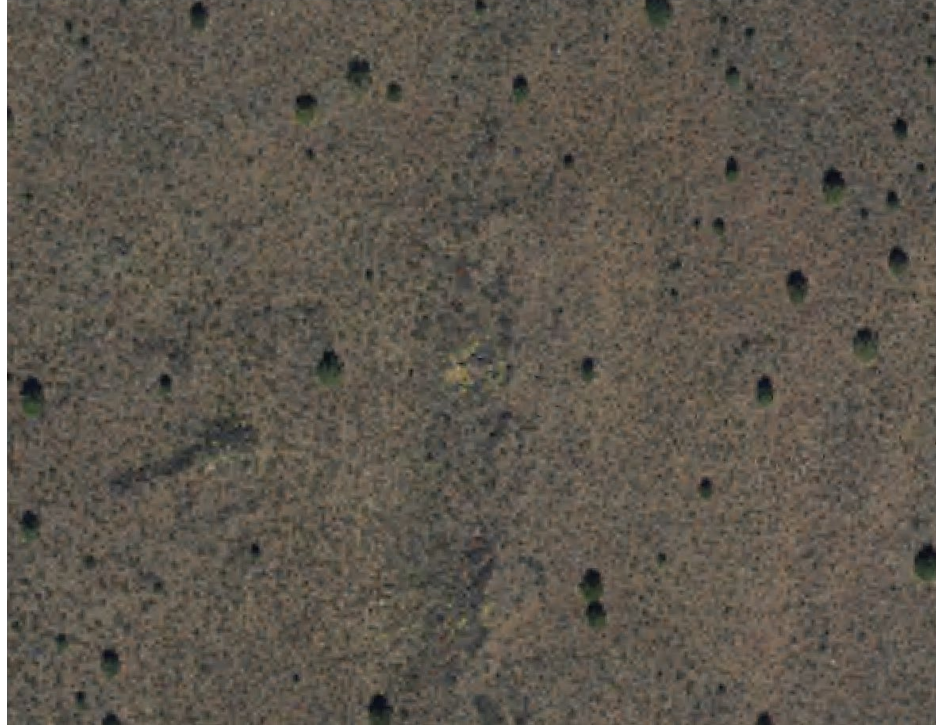
This Association was used when *A. tridentata* ssp. *vaseyana* was not present and *Wyethia* ssp. was dominant in the herbaceous layer. It was commonly found in disturbed areas post-fire or in heavily grazed areas. The signature can vary from a bright light green to a darker mid-green.





***Artemisia tridentata* ssp. *vaseyana* – *Symphoricarpos oreophilus* / *Bromus carinatus* Association**

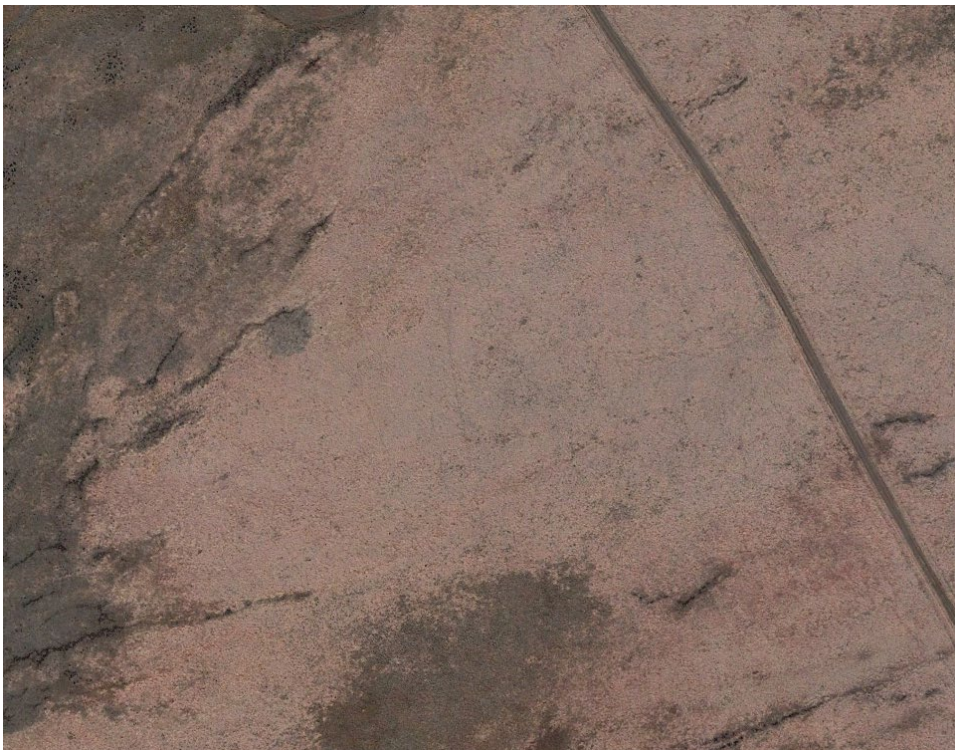
*Symphoricarpos* is commonly found at higher elevations mixing with *A. tridentata* ssp. *vaseyana* and typically is larger in size, reaching 1-2 meters. It is smooth in texture, symmetrically rounded, and has a mid- to dark-green signature.





***Bromus tectorum* – *Elymus caput-medusae* Ruderal Annual Grassland Alliance  
*Bromus tectorum* Association**

*Bromus tectorum* typically shows up as a bright yellow to white signature on NAIP imagery and commonly has a red hue to it on Google Earth imagery. It was commonly found in our study area in disturbed areas post-fire or in juniper removal areas.



### ***Elymus caput-medusae* Provisional Association**

This Association was common in the study area. *Elymus caput-medusae* can create thick monocultures as well as mix with other weedy grasses and native herbs. Its signature can often be identified by the clumpy thatch piles from the previous year's dead vegetation mixing with the current year's growth. This can best be seen in the second Google Earth image.





### ***Ventenata dubia* Association**

*Ventenata dubia* was most commonly found in the northernmost portions of the study area (generally north of Alturas, CA). It grows well in volcanic clay soils of variable depths and is a quick successor of large areas post-fire. It commonly has a light yellow to white signature.



### **Built-up & Urban Disturbance Mapping Unit**

This mapping unit was used for urban and semi-urban settings where dwellings and anthropogenic disturbance is present.





### **California Annual Grassland and Forb Meadow Group**

This Group contains native forbs and grasses, but was fairly uncommon in our mapping area. Grasslands were typically dominated by invasives or other native grasses and forbs which were mapped under other Group level herbaceous mapping types. This Group typically has a light to mid-brown hue and is texturally fairly smooth.





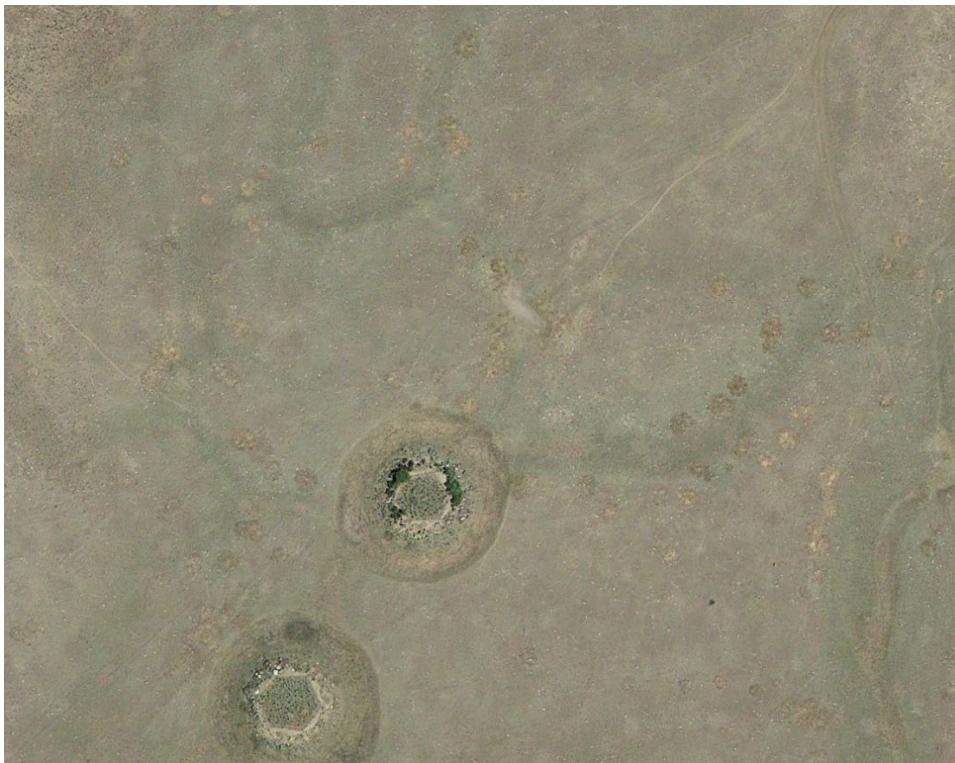
### **Californian Ruderal Grassland, Meadow & Scrub Group**

This grassland Group is mainly composed of annual grasses that grow in semi-wet environments and is found in heavily grazed or disturbed areas. Fences, grazing trails, and the lack of perennial grasses are indicative of this grassland Group. Its signature is highly variable due to mixing of species and variable water years and was commonly mistaken for the Western North American Ruderal Marsh, Wet Meadow & Shrubland Group.



### **Californian Vernal Pool Group**

These stands are seasonally wet and are commonly found on the edges of drying lakes, livestock ponds, vernal pools or swales. Swales can be seen in the imagery below along with a man-made pool/island for wildlife enhancement.



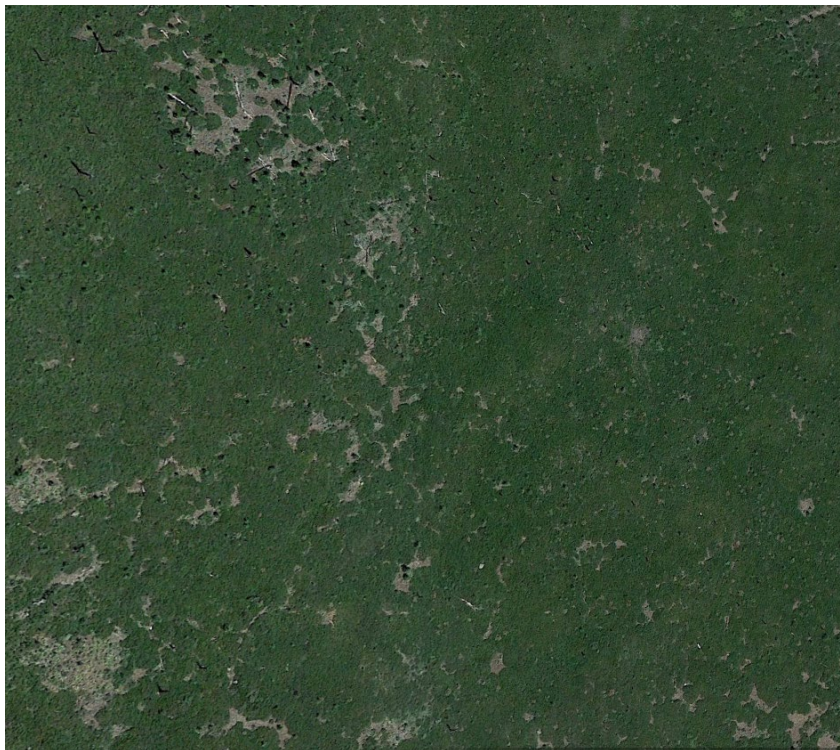
***Carex (pansa, praegracilis) Alliance***

***Carex praegracilis* Association (No good imagery for this mapping unit)**



***Ceanothus velutinus* Shrubland Alliance**  
***Ceanothus velutinus* Shrubland Association**

*Ceanothus velutinus* was commonly found in higher elevation areas. It thrives after fire or disturbance. It has a variable signature from bright to mid-green, to dark or army-green. It is a low-growing shrub (approx. 1 meter) that commonly forms dense thick mats. It has a fairly smooth and flat texture and grows well on most aspects and slopes.





***Cercocarpus ledifolius* Scrub Alliance**  
***Cercocarpus ledifolius* Association**

*Cercocarpus* was most commonly found on mountaintops, mixing with low covers of *Artemisia tridentata*, *Symphoricarpos rotundifolius*, and *Ribes* and *Prunus* species. It has a brown to army-green signature and often mixes with *Juniperus occidentalis*, as seen below.





***Cercocarpus ledifolius* – *Artemisia tridentata* ssp. *vaseyana* Association**

This was most commonly found on mountaintops above 5,000 feet elevation where *A. tridentata* ssp. *vaseyana* was co-dominant with *Cercocarpus ledifolius* in the shrub layer and no other shrub species were present with comparable cover. *Cercocarpus* can be seen here as the large brownish-green signature, with the smaller *Artemisia* scattered in between with a light grey-blue signature.





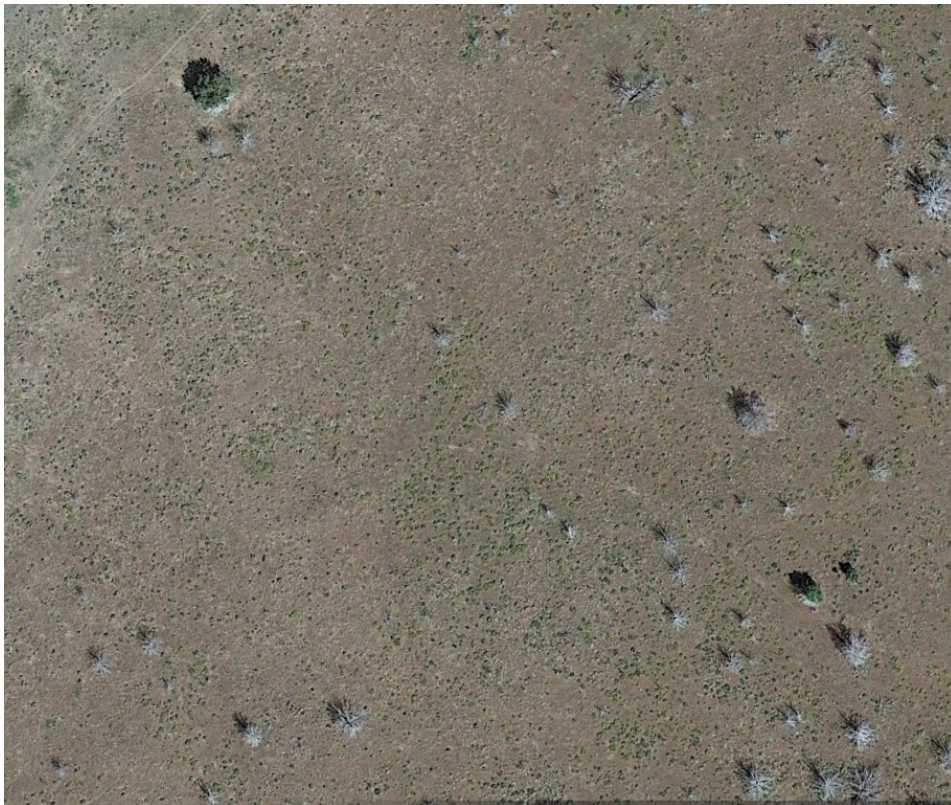
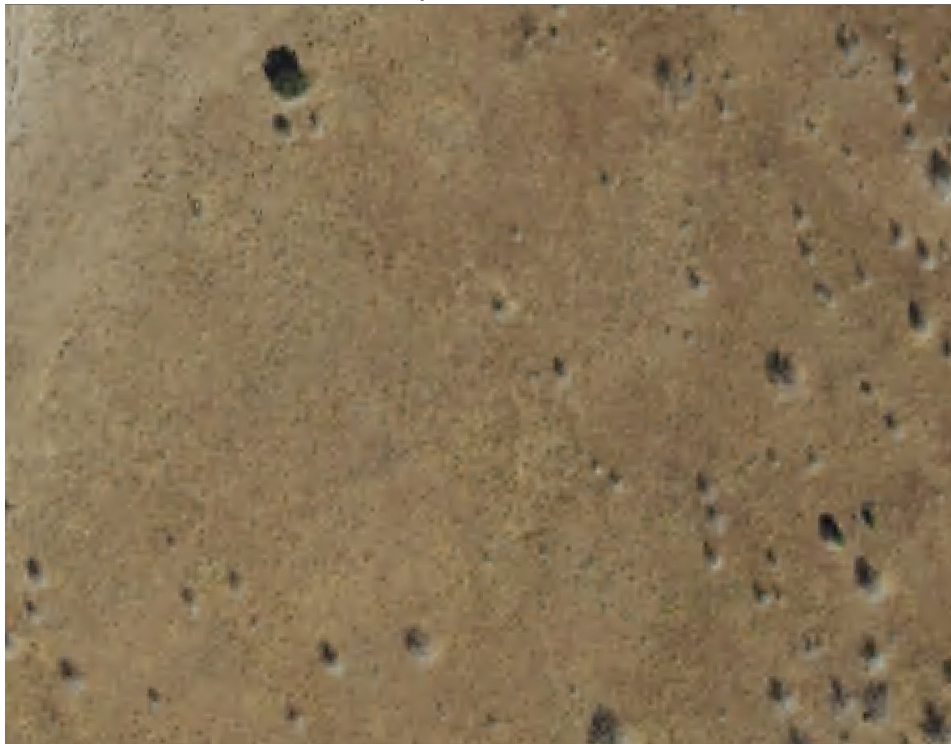
***Chrysolepis sempervirens* Alliance**  
***Chrysolepis sempervirens* Association**

This Association was rare in the study area. It has a distinct bright green signature and typically grows in dense shrub thickets. Stands of this Association were often below the 1 acre minimum mapping unit and were included within other vegetation types.



***Chrysothamnus viscidiflorus* Steppe and Shrubland Alliance**

This small to mid-sized shrub has a mid- to dark-green signature and was commonly found in areas post-fire or disturbance.





### **Columbia Plateau Cliff, Scree and Rock Mapping Unit**

This mapping unit was utilized for rocky areas where there was little to no vegetation present. It has a dark brown to black signature which is representative of the basalt volcanic rocks.





***Cornus sericea* – *Rosa woodsii* – *Ribes spp.* Alliance**

This Alliance rarely occurred in the study area and the species composition was typically mixed. Oftentimes these stands were sub-minimum mapping unit or were covered by the tree overstory. The signature has a bright light green hue and occurs only in wet riparian environments.



***Danthonia* spp. - *Camassia* spp. Wet Meadow Alliance**

This Alliance was typically slightly drier than other wet meadow types and was often found one terrace above them. *Danthonia* and *Camassia* were often co-dominant with wetter species like *Juncus* or *Carex*. It is a difficult signature to map correctly and was often mapped at the Group level.





***Deschampsia cespitosa* Alliance**  
***Deschampsia cespitosa* Association**

This was fairly uncommon in the study area and was mainly identified by verified field points or surveys. Stands consisted of *Deschampsia cespitosa* codominating with other wet meadow herbs, including *Juncus balticus*, *Eleocharis macrostachya*, and *Juncus nevadensis*.



***Distichlis spicata* Alkaline Wet Meadow Alliance**

This Alliance very rarely occurred in the study area. It occurred in alkaline soils near Horse Lake and has a grey to light blue-green signature.





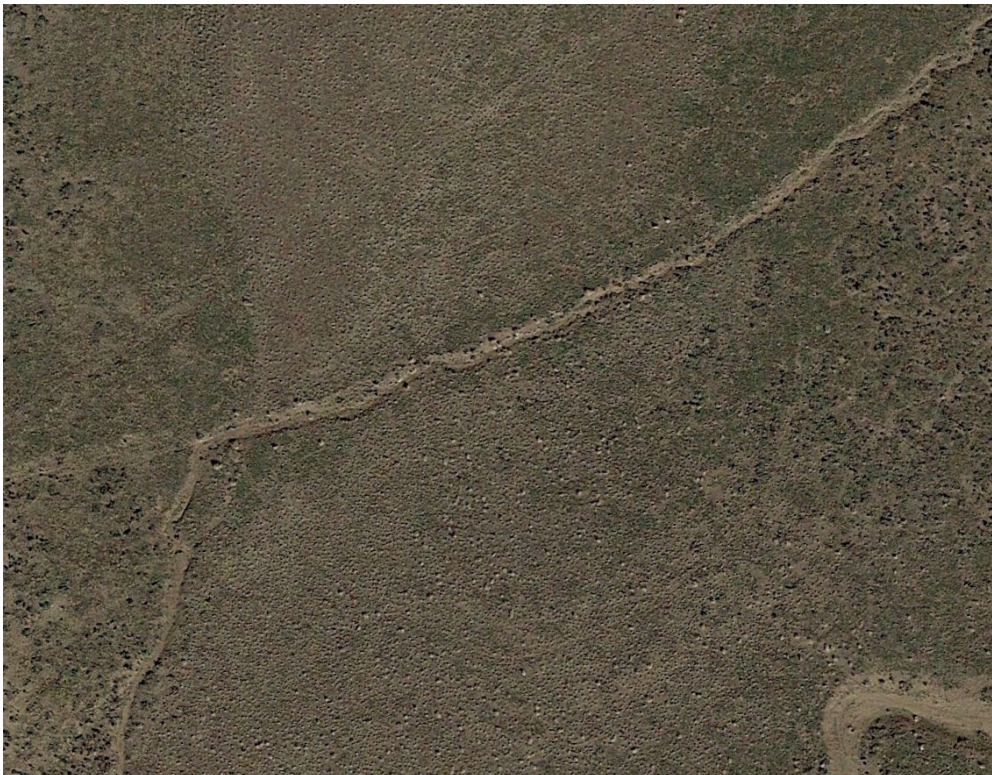
***Elymus cinereus* – *Elymus triticoides* Alkaline Wet Meadow Alliance**  
***Elymus cinereus* Association**

This is a fairly common bunchgrass in the study area, which can sometimes look like a shrub due to its large size. It most often has a deep green signature on Google Earth and can often be distinguished from shrubs by its large white flower stalks. When in drier areas, the signature can be variable and more challenging to pick out.



***Elymus triticoides* – *Poa secunda* Association**

This is an uncommon Association in the study area. It has a clumpy bunchgrass signature that is moderate in size and light in color.

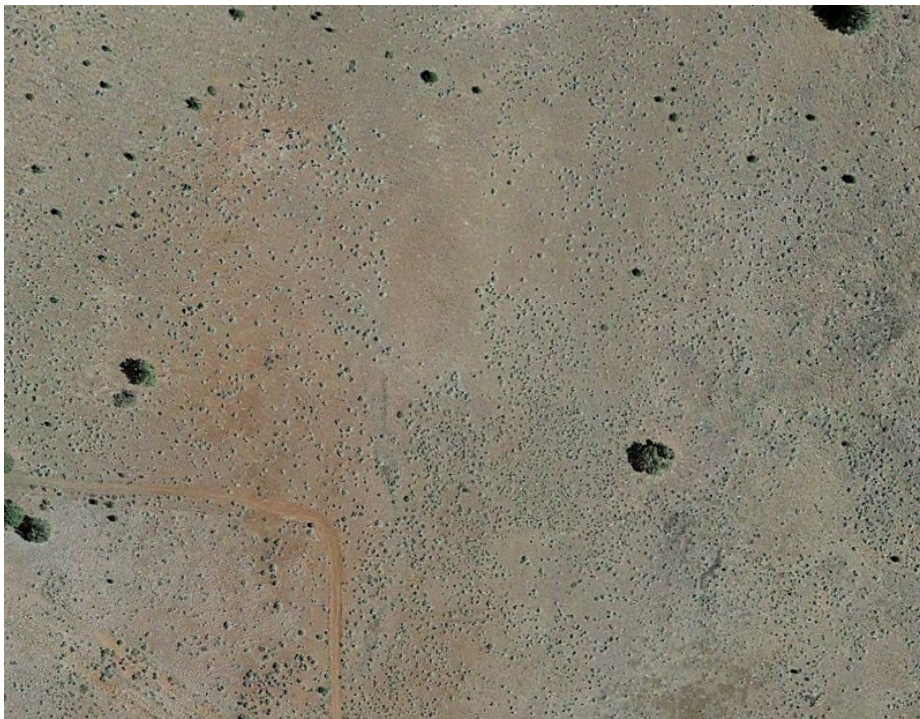




***Ericameria nauseosa* Shrubland & Shrub Herbaceous Alliance**

***Ericameria nauseosa* Association**

This Association has a distinct blue-green signature and when using the CIR layer (not shown here) it will pop out as bubble gum pink. It is often found in disturbed areas and very commonly along roadsides.



### ***Ericameria nauseosa* / *Bromus tectorum* Association**

*Ericameria nauseosa* is often associated with disturbance and mixed with non-native species. In this example, on the upper flat area *Ericameria* is mixing with *Bromus tectorum* (reddish hue) and *Elymus caput-medusae* (clumpy grey-brown signature).





***Eriogonum* spp. / *Poa secunda* Dwarf-shrub Herbaceous Alliance**

Dwarf shrubs of *Eriogonum* species (*E. vimineum*, *E. sphaerocephalum*, *E. prociduum*) are characteristically present, even as low as <1% cover. Generally on flats or exposed hilltops with significant volcanic cobble and/or gravel covering the soil surface. Total vegetation cover is usually <10% and often <5%. Photo-interpreters used the thin volcanic soils as an indicator for this Alliance.



***Festuca idahoensis* - *Pseudoroegneria spicata* - *Poa secunda* Alliance**

***Festuca idahoensis* - *Pseudoroegneria spicata* Association**

Stands dominated or co-dominated by *Festuca idahoensis* with *Bromus tectorum*, *Elymus elymoides*, *Pseudoroegneria spicata*, and/or *Achnatherum thurberianum*. Compared to the *Pseudoroegneria spicata* – *Poa secunda* Grassland Association, stands are generally found on higher upper slopes on cooler aspects above 5500 ft.





### ***Pseudoroegneria spicata* - *Poa secunda* Association**

Stands are characterized by *Pseudoroegneria spicata* and/or *Poa secunda*, usually on warmer aspects with rocky substrate. Non-native species such as *Bromus tectorum* or *Elymus caput-medusae* often co-dominate or dominate the herb layer, but relative native cover is usually >20%. Other native herb species present include *Elymus elymoides*, *Epilobium brachycarpum*, *Blepharipappus scaber*, *Achnatherum thurberianum*, and/or *Lomatium* spp. *Festuca idahoensis* may be present but sub-dominant. Stands have typically burned within the past 10 years.



### ***Hordeum brachyantherum* Association**

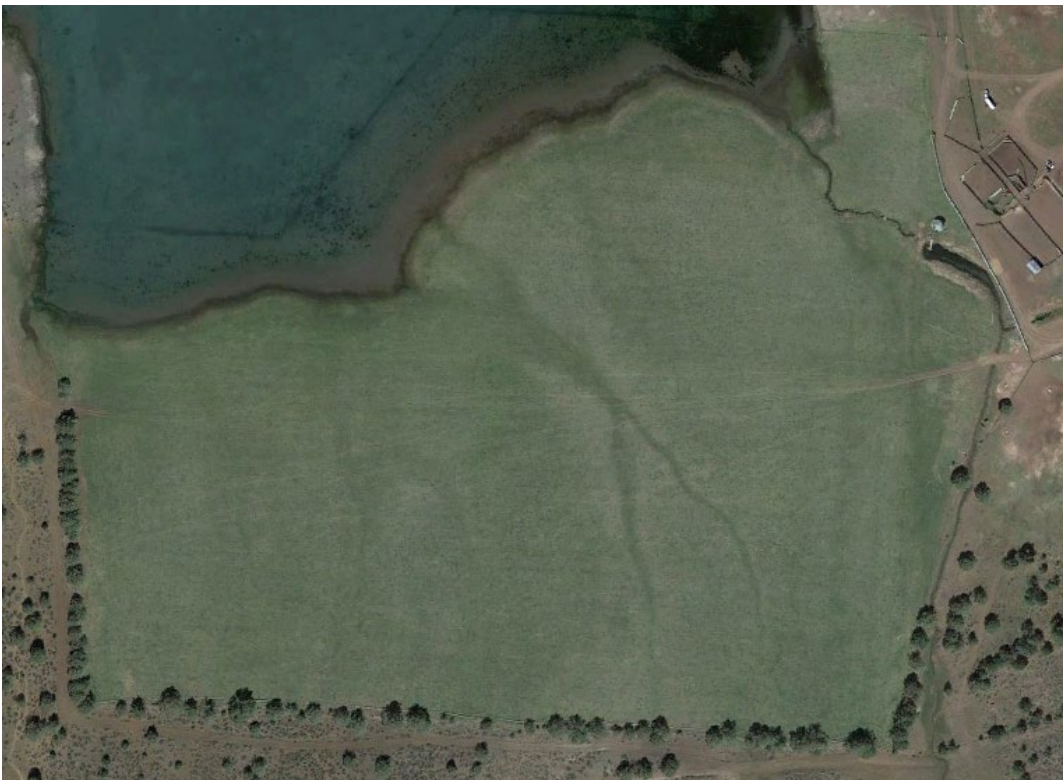
*Hordeum brachyantherum* is dominant to co-dominant in the herb layer with *Juncus arcticus*, *Poa secunda*, and/or *Phleum pratense*. This was fairly uncommon in the study area and was mostly found during field surveys versus photointerpretation.





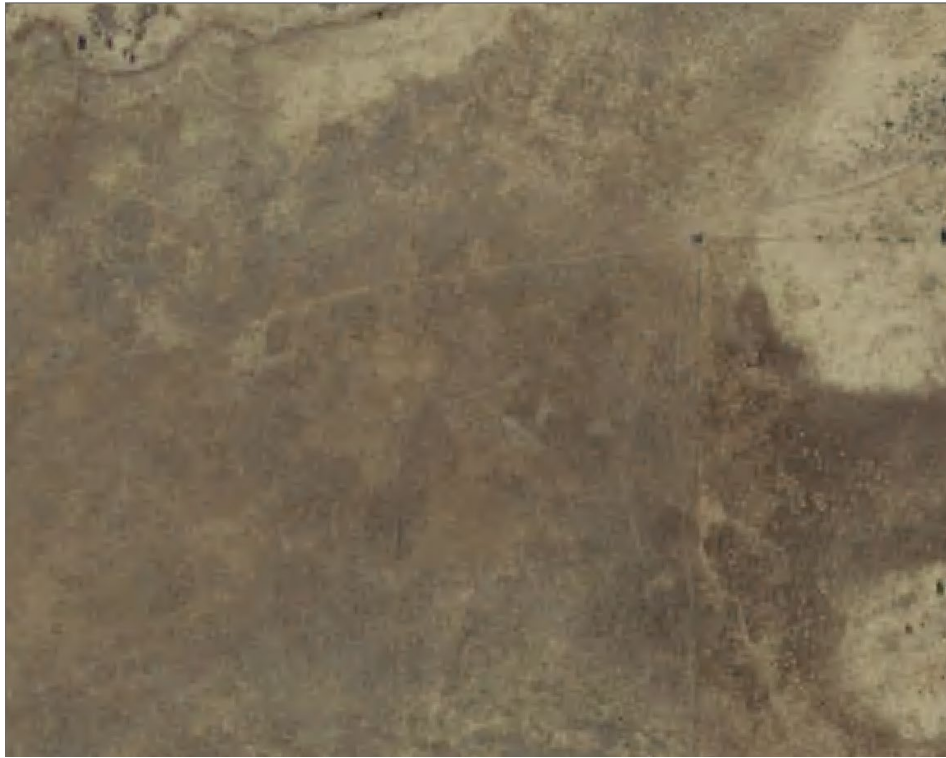
### **Irrigated Pastures Mapping Unit**

These areas are typically wet late into the summer months and show signs of irrigation with piping or canals. Grazing trails and/or livestock are typically present.



***Juncus balticus* – *Juncus mexicanus* Wet Meadow Alliance**

This Alliance is typically found at the lowest, wettest part of a meadow. The signature starts off dark green early in the year and fades to a distinctive mid to dark brown.





***Juncus nevadensis* Herbaceous Alliance**

***Juncus nevadensis* Association**

This Association was uncommon in the study area and most occurrences were determined via field surveys, not photointerpretation. Its signature is similar to the other *Juncus* Alliance, but is slightly lighter brown and more uniform in texture.



***Juniperus occidentalis* Woodland Alliance**

***Juniperus occidentalis* / *Artemisia arbuscula* / *Poa secunda* Association**

Juniper can have various shapes and sizes and can have multiple leaders or one dominant leader. It grows on all aspects, in a variety of soil depths, and covers a wide range of elevation. It typically has an army-green appearance on imagery and rarely exceeds 15 meters in height.





***Juniperus occidentalis* – (*Pinus jeffreyi* – *Pinus ponderosa*) / *Cercocarpus ledifolius* Association**

*Juniperus occidentalis* is dominant with sub-dominant *Pinus jeffreyi* and/or *Pinus ponderosa*, or there is a shrub understory that is indicative of higher elevations. Pines may have as little as 1% cover or occasionally may not be present. The shrub understory is variable. When pines are present the understory can be dominated by *Artemisia tridentata* and *Purshia tridentata*, with some *Cercocarpus ledifolius* or other higher elevation shrub species. When pines are not present, higher elevation shrub species such as *Cercocarpus ledifolius*, *Ribes* spp., *Artemisia tridentata* ssp. *vaseyana*, and *Symphoricarpos* spp. are present in the understory, which differentiates this type from the *Juniperus occidentalis* / *Artemisia tridentata* – *Purshia tridentata* Association.





***Juniperus occidentalis* / *Artemisia arbuscula* / *Poa secunda* Association**

*Artemisia arbuscula* is strongly dominant to co-dominant in the shrub layer with *Purshia tridentata* and *Eriogonum* spp. Rarely, *A. arbuscula* is absent (usually disturbance-related), but associated herbs will still be present. Native grasses are common and diverse, including *Poa secunda*, *Festuca idahoensis*, *Pseudoroegneria spicata*, *Achnatherum thurberianum*, and *Danthonia unispicata*. Other herbs may include *Blepharipappus scaber*, *Epilobium brachycarpum*, and *Lomatium* spp. Stands are rocky with typically >30% surface cover of rocks (cobbles to bedrock).





***Juniperus occidentalis* / *Artemisia tridentata* – *Purshia tridentata* Association**

Pines are typically absent, and stands are at lower elevations compared to the *Juniperus occidentalis* – (*Pinus jeffreyi* – *Pinus ponderosa*) / *Cercocarpus ledifolius*

Association. *Artemisia tridentata* is present with at least 1% cover but typically dominates or co-dominates the shrub layer. *Purshia tridentata* is usually present with *A. tridentata* and may dominate the shrub layer, but less commonly than *A. tridentata*.

*Cercocarpus ledifolius* and *Prunus* spp. are typically absent.





***Juniperus occidentalis* / (*Poa secunda* – *Festuca idahoensis* – *Pseudoroegneria spicata*) Association**

*Juniperus occidentalis* stands with minimal shrub component (typically <4% absolute cover). Juniper cover is usually greater than 10% and trees are of mixed age classes.

Herb layer is sparse to moderate, sometimes with significant cover of non-native grasses such as *Bromus tectorum*. However, native grasses, including *Poa secunda*, *Pseudoroegneria spicata*, *Festuca idahoensis*, and/or *Achnatherum thurberianum*, are characteristic in the herb layer. If shrubs are present, they are patchy and insignificant.





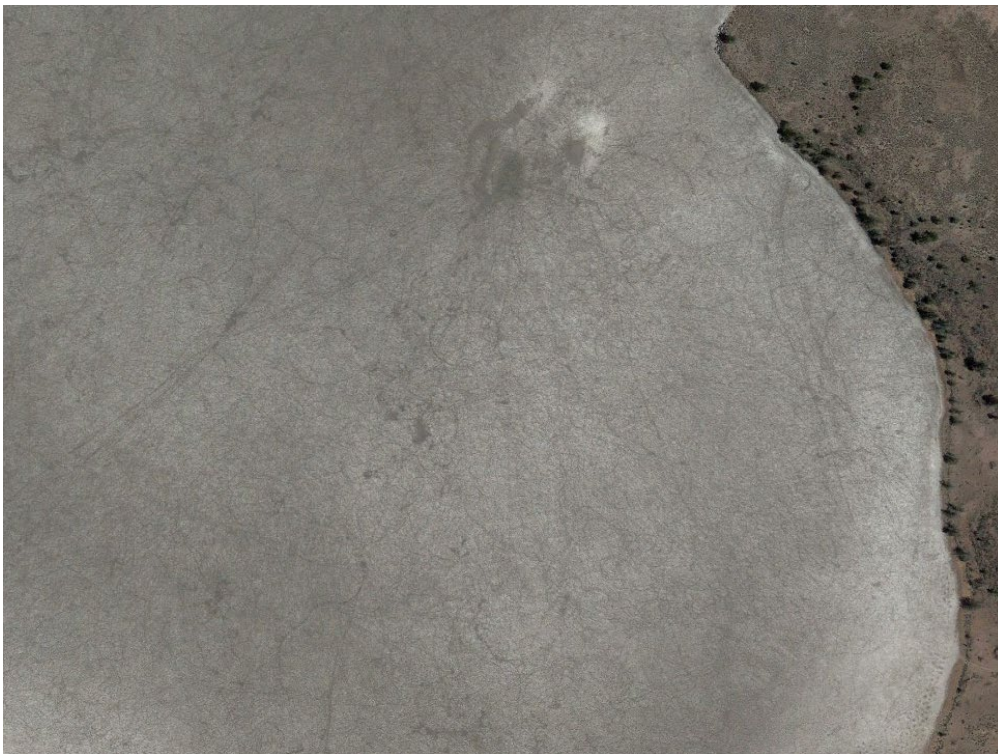
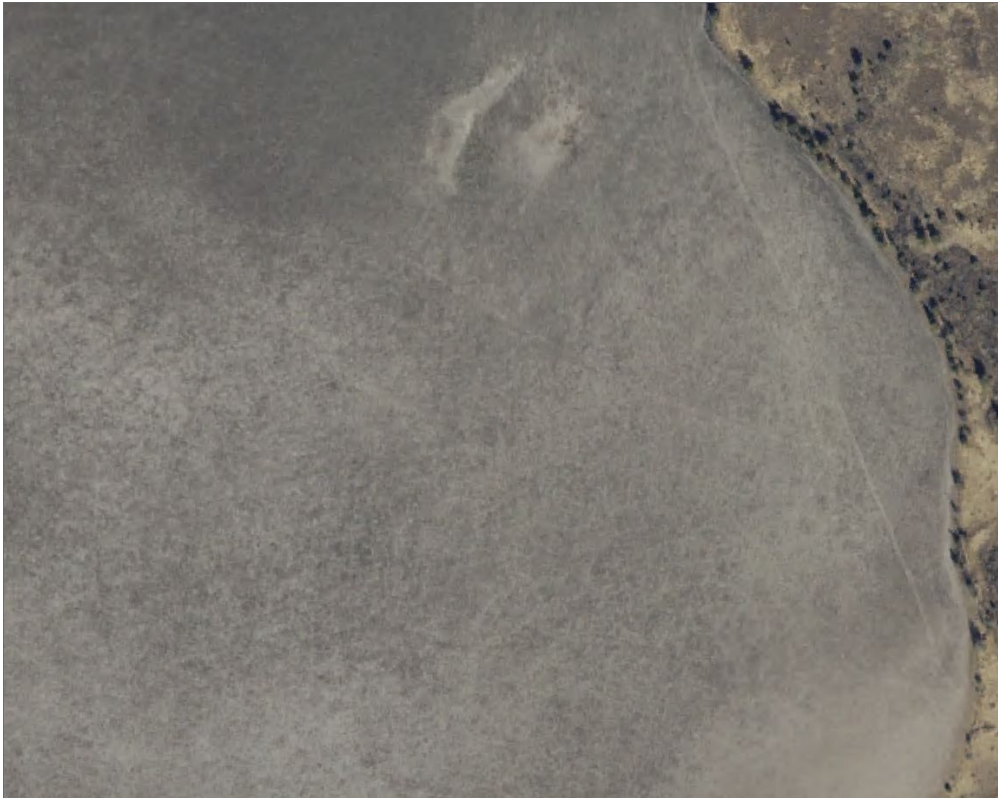
***Navarretia leucocephala* ssp. *minima* – *Plagiobothrys cusickii* Alliance**

This Alliance frequently occurs on the margins of drying lakes and ponds and is often mixed with other herbaceous Alliances. It was not typically mapped by photo-interpretters due to its variable signature and was mainly identified by field surveys.



***Taraxia tanacetifolia* – *Iva axillaris* Association**

*Taraxia* was commonly found in flat dry lakebeds and was typically a sparse monoculture. *Iva* was only common in the Horse Lake area in more alkaline soils.





### **Non-woody Row and Field Agriculture Mapping Unit**

Agricultural areas where the photo-interpreter could determine that the crop type was non-woody, which was typically the case in the study area. *Note: the Agriculture (within the current 5-year cycle)* mapping unit was also used and should be included with this Alliance when quantifying all agriculture in the study area.





### **Oregon-Washington-British Columbia Vernal Pool Group**

Stands, in peak phenology, contain several genera typical of seasonal or ephemeral wetlands of the Great Basin, from montane eastern California, to eastern Oregon and Washington. Settings include vernally saturated or flooded flats and smaller vernal pools. The signature is variable depending on the time of year of the imagery and annual precipitation.



**Perennial Stream Channel (Open Water) Mapping Unit**  
Rivers and creeks that flow or retain water year-round.





***Phalaris aquatica* – *Phalaris arundinacea* Alliance**  
***Phalaris arundinacea* Association**

Grows in thin strips in riparian settings and typically has a deep green signature.





***Pinus ponderosa* – *Calocedrus decurrens* Alliance**

***Pinus ponderosa* – *Calocedrus decurrens* / *Ceanothus prostratus* Association**

*Calocedrus decurrens* is dominant to co-dominant with *Pinus ponderosa*. *Abies concolor* may be present but is sub-dominant to the other conifers. *Juniperus occidentalis* is absent or <1% cover. The mat-forming shrub *Ceanothus prostratus* may be present in the understory, though it may have very little cover. *Calocedrus* typically has a much brighter green signature than *Pinus ponderosa*.





***Pinus ponderosa* / Shrub Understory Central Rocky Mountain Alliance  
*Pinus jeffreyi* / *Artemisia tridentata* ssp. *vaseyana* / *Festuca idahoensis*  
Association**

*Pinus jeffreyi* is dominant in the overstory while *Juniperus occidentalis* may just be present. Though there may be high shrub diversity, *Artemisia tridentata* ssp. *vaseyana* is the dominant shrub. *Festuca idahoensis* is characteristically present and is typically the dominant herb.





***Pinus ponderosa* – *Juniperus occidentalis* / *Artemisia tridentata* – *Purshia tridentata* Association**

*Juniperus occidentalis* is typically present to co-dominant with *Pinus ponderosa*. Lower elevation shrub species such as *Purshia tridentata*, *Artemisia tridentata*, and *Cercocarpus ledifolius* dominate the shrub layer. *Arctostaphylos patula* is typically absent or insignificant.





### **Planted Trees and Shrubs Mapping Unit**

This mapping unit was utilized when the photo-interpreter could identify non-native trees and/or shrubs that were most likely planted by humans and were often found near homes or old homesteads.



***Poa secunda* – *Muhlenbergia richardsonis* – *Carex douglasii* Alliance**

Stands without strong representatives from either the Californian or Oregon-Washington- British Columbia Vernal Pool Groups. Species present were typically more widespread and typical of slightly alkaline western interior seasonal wetlands such as *Muhlenbergia* spp., *Carex douglasii*, and *Poa secunda* (moist meadow ecotypes). This Alliance was mapped more often from ground surveys than by photointerpretation.





### ***Populus tremuloides* Forest Alliance**

The *Populus tremuloides* can be seen here on the NAIP imagery in its yellow fall color, but is typically smoother in texture and deep green in color (such as in the Google Earth imagery). It is typically shorter in size and more clonal than *P. trichocarpa*. It is frequently found in dense thickets on shaded cooler northern slopes near rock outcroppings and seeps.





***Populus trichocarpa* Northern Rocky Mountain Riparian Forest Alliance**

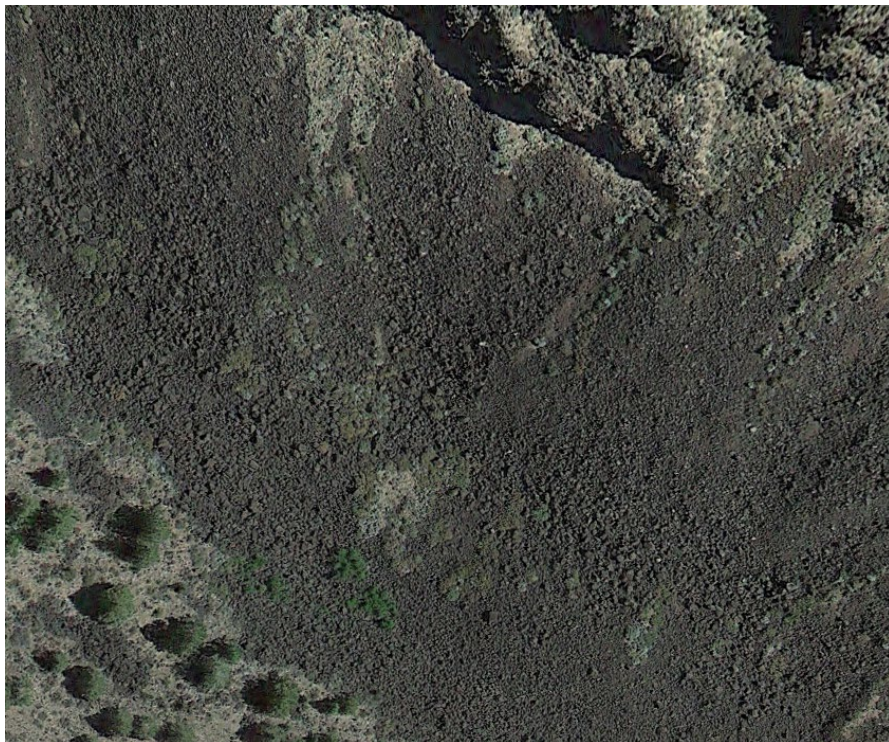
*Populus trichocarpa* was typically found along stream margins and can be seen below in its yellow-green fall colors. It was found in our study area to be taller than *P. tremuloides*, with a greater diameter at breast height and with greater spacing between individuals.





***Prunus emarginata* - *Holodiscus discolor* Shrubland Alliance**  
***Holodiscus discolor* Association**

This Association occurs primarily in rocky outcrops and on mountaintops or in the talus piles below. It has a brown to brown-orange signature and was often identified by photo-interpreters based on its rocky environment.





### ***Prunus emarginata* Association**

This Association was found in similar rocky environments as *Holodiscus* (above) and often contained mixed shrubs. It has a mid to dark green signature. Stands were typically small in size.





### ***Prunus virginiana* Alliance**

This Alliance was utilized for both *Prunus virginiana* and *P. subcordata*, both having a very bright green signature and often found in rocky talus piles, generally preferring north and northeast aspects.





***Purshia tridentata* - *Artemisia tridentata* Mesic Steppe & Shrubland Alliance**

***Purshia tridentata* – *Artemisia tridentata* Association**

These two shrubs frequently were found growing together in the study area. *Purshia* typically has a dark green signature on NAIP and Google Earth and can be differentiated from *Artemisia tridentata* via the CIR layer (not shown here), which makes it stand out with its dark to bright red color.



### ***Tetradymia canescens* Association**

*Tetradymia canescens* or *Tetradymia glabrata* are strongly dominant in the shrub layer with other disturbance-related species such as *Chrysothamnus viscidiflorus* and *Ericameria nauseosa*. Severe disturbance is indicated by lack of *Purshia tridentata* and *Artemisia tridentata* cover. The herb layer is dominated by non-natives such as *Bromus tectorum*, *Tragopogon dubius*, and/or *Sisymbrium altissimum*. This is a mixed signature that was difficult to interpret and was most often identified via field surveys.





### ***Quercus kelloggii* Alliance**

This Alliance is easily identifiable as it is one of the few upland deciduous tree Alliances, with a wide crown and bright yellow fall colors. It was commonly found mixing with juniper and other conifers.



***Salix boothii* – *Salix geyeriana* – *Salix lutea* Montane Wet Shrubland Alliance  
*Salix lucida* / *Poa pratensis* Association**

This riparian mixed shrub Alliance/Association was mainly utilized by photo-interpreters when there was the presence of *Salix lucida*. It was commonly mixed with other *Salix* species and had a variable green signature and yellow fall color.





### ***Salix exigua* Alliance**

*Salix exigua* is a riparian shrub that is typically 2 to 5 meters in height and has a sage-blue signature. It was fairly uncommon in the study area.





### ***Salix lasiolepis* Shrubland Alliance**

#### ***Salix lasiolepis* – *Rosa woodsii* / Mixed Herbs Wet Shrubland Association**

This was most often mapped to the Alliance level and only at the Association level due to ground surveys. *Salix lasiolepis* was commonly found in the study area and often mixed with *Rosa* and other riparian shrubs and herbs. It has a rich dark green signature.



***Schoenoplectus (acutus, californicus)* Alliance**

This Alliance was very uncommon in the mapping area, but was found in flat water-inundated areas. Its signature can vary from whitish brown to brown to dark brown/black.





### **Small Earthen-dammed Ponds & Natural Lakes Mapping Unit**

Most of the water bodies mapped during this project fell under this category, which includes both natural and man-made ponds and lakes of varying sizes.





### **Sparsely Vegetated Recently Burned Areas Mapping Unit**

This mapping unit was utilized when there was very recent fire evidence and the photo-interpreters were not able to see enough vegetation to determine a vegetation classification. Dark charred soils were common in these areas. This type is most often found in the area of the 2018 Stone Fire.



***Typha domingensis* – *Typha latifolia* – *Typha angustifolia* Western Marsh Alliance**

This Alliance was very uncommon in the mapping area, but was found in flat water-inundated areas. Its signature can vary from whitish brown to brown.





### **Vancouverian – Rocky Mountain Montane Wet Meadow & Marsh Group**

Stands occur in flooded, wet, moist, or saturated meadows, stream-sides, springs, or swales. Water is usually fresh and not strongly alkaline or salty. This is a large Group that encompasses stands that hold moisture in the soil until mid- to late summer or stands that dry out before mid-summer. The vegetation is dominated by wet meadow sedges, rushes, and grasses.





### **Water Impoundment Feature Mapping Unit**

This mapping unit was utilized for man-made features designed to contain water, typically bound on all sides by berms and having a linear form. Duck clubs and a wastewater treatment plant contain examples of this mapping unit within the study area.



### **Western North America Ruderal Marsh Wet Meadow and Shrubland Alliance**

Stands dominated by larger non-native perennial pasture grasses (including *Phalaris arundinacea*, *Phleum pratense*, *Poa pratensis*, *Agrostis gigantea*). These large bunchgrasses were sometimes visible on imagery and typically had a clumpy green to whitish-green highly variable signature. This Alliance was commonly found in and near non-irrigated pasture land.





### **Western North American Sparsely Vegetated Rivershore Mapping Unit**

This category was utilized for areas where there was no vegetation or very sparse vegetation along the margins of water bodies or in dried-up seasonal waterways.





## Appendix G. Key to the Vegetation of Modoc and Lassen Counties

This is the vegetation key for Modoc and Lassen Counties. It is based on 2,050 vegetation samples; 627 surveys collected between 2016 and 2019 specifically for the classification and 1,192 surveys collected for other projects and/or by other agencies. This key follows the hierarchy from the most current National Vegetation Classification System (NVCS). This is not a dichotomous key. Follow the instructions in each section carefully and sequentially to arrive at the correct vegetation type. Note that this vegetation key may include types that are not accurately detectable in remotely sensed imagery.

Alliance and Association names are frequently followed by a number, e.g. (n=5). This is the number of vegetation samples that were classified to the type. If there is not a number following the vegetation type, then none of the samples collected thus far have classified to that type. In some cases, the number of samples recorded for an Alliance will equal the sum of the samples recorded for the Associations below it. If this is not the case, then some samples could not be classified below the Alliance level.

I. Trees are evenly distributed and are typically >5% absolute cover in the overstory canopy. When *Juniperus occidentalis* is the sole tree species present it may have as low as 3% cover, but the trees will be of appreciable age, evenly distributed throughout the stand, there will be obvious regenerating juniper in the understory, and shrub cover will be sparse as well (usually <10% absolute cover)

.....**Forest and Woodland**

II. Shrubs are evenly distributed throughout the stand and >4% cover. If the stand is characterized by very low overall vegetation cover (<10%) the shrub cover can be as low as 2%. Trees average less than 5% and are not evenly distributed.....**Shrubland**

III. Annual or perennial herbs, including grasses, graminoids (sedges and rushes), and forbs, average >2% cover and are evenly distributed across the stand. Trees and shrubs, if present, each average less than 4% cover and/or are not evenly distributed.....**Herbaceous stands**

### I. Forest and Woodland

1) Overstory dominated by coniferous tree species.

- a) *Juniperus occidentalis* is the sole coniferous tree species in the overstory or is strongly dominant with *Pinus jeffreyi*. *Juniperus occidentalis* may have as little as 3% cover but the trees will include mature individuals, be evenly distributed throughout the stand, there will be obvious regenerating juniper in the understory, and the shrub layer will usually be less than 10% absolute cover.

***Juniperus occidentalis* Alliance (n=343)**

- i) *Juniperus occidentalis* is dominant with sub-dominant *Pinus jeffreyi* and/or *Pinus ponderosa* or has a shrub understory that is indicative of higher elevations. Pines may have as little as 1% cover or occasionally may not be present. Shrub understory is variable. When pines are present the understory can be dominated by *Artemisia tridentata* and *Purshia tridentata* with some *Cercocarpus ledifolius* and/or may include other higher elevation shrub species. When pines are not present, higher elevation shrub species such as *Cercocarpus ledifolius*, *Ribes* spp., *Artemisia tridentata* ssp. *vaseyana*, and *Symphoricarpos* spp. are present in the understory which differentiate this type from *Juniperus occidentalis* / *Artemisia tridentata* – *Purshia tridentata* Association. If pines are strongly dominant (>60% relative cover in the tree layer) then key to *Pinus ponderosa* / Shrub Understory Alliance.

*Juniperus occidentalis* – (*Pinus jeffreyi* – *Pinus ponderosa*) / *Cercocarpus ledifolius* Association (n=112)

- ii) Pines are typically absent, and stands are at lower elevations compared to *Juniperus occidentalis* – (*Pinus jeffreyi* – *Pinus ponderosa*) / *Cercocarpus ledifolius* Association. *Artemisia tridentata* present with at least 1% cover but typically dominates or co-dominates the shrub layer. *Purshia tridentata* usually present with *A. tridentata* and may dominate. However, *A. tridentata* is commonly the dominant shrub. *Cercocarpus ledifolius* and *Prunus* spp. are typically absent.

*Juniperus occidentalis* / *Artemisia tridentata* – *Purshia tridentata* Association (n=87)

- iii) *Artemisia arbuscula* is strongly dominant to co-dominant in the shrub layer with *Purshia tridentata* and *Eriogonum* spp. Rarely, *A. arbuscula* is absent (usually disturbance-related), but associated herbs will still be present. Native grasses are common and diverse, including *Poa secunda*, *Festuca idahoensis*, *Pseudoroegneria spicata*, *Achnatherum thurberianum*, and *Danthonia unispicata*. Other herbs may include *Blepharipappus scaber*, *Epilobium brachycarpum*, and *Lomatium* spp. Stands are rocky with typically >30% cover of surficial rocks (cobble-bedrock).

*Juniperus occidentalis* / *Artemisia arbuscula* / *Poa secunda* Association (n=112)

- iv) *Juniperus occidentalis* stands with minimal shrub component (typically <4% absolute cover). Juniper cover is usually greater than 10% and trees are of mixed age classes. Herb layer is sparse to moderate, sometimes with significant cover of non-native grasses such as *Bromus tectorum*. However, native grasses including *Poa secunda*, *Pseudoroegneria spicata*, *Festuca*

*idahoensis*, and/or *Achnatherum thurberianum* are characteristic in the herb layer. If shrubs are present, they are patchy and insignificant.

*Juniperus occidentalis* / (*Poa secunda* – *Festuca idahoensis* – *Pseudoroegneria spicata*) Association (n=30)

- b) Other coniferous tree species characterize the overstory with or without *Juniperus occidentalis* as a co-dominant.

- i) *Quercus kelloggii* is dominant to co-dominant with pines.

***Quercus kelloggii* Alliance** (n=3)

- ii) *Pinus ponderosa*<sup>2</sup> and/or *Pinus jeffreyi* is characteristic in the tree layer and are dominant to co-dominant with either *Calocedrus decurrens* or *Juniperus occidentalis*. If *Abies concolor* is present, it is typically sub-dominant in the tree layer and is not evenly distributed

- (1) *Pinus ponderosa* and/or *Pinus jeffreyi* is dominant to co-dominant with *Juniperus occidentalis* in the overstory. *Calocedrus decurrens* is absent.

***Pinus ponderosa* / Shrub Understory Alliance** (n=179)

- (a) *Juniperus occidentalis* is often sub-dominant with *Pinus ponderosa* and/or *Pinus jeffreyi*. Shrub layer is sparse to moderately dense with a variety of higher elevation, cold-tolerant shrubs present including *Amelanchier utahensis*, *Cercocarpus ledifolius*, *Ceanothus prostratus*, *Prunus virginiana*, and *Symphoricarpos* spp. *Artemisia tridentata* is typically absent or only a small component of the shrub layer.

*Pinus (jeffreyi, ponderosa)* / (*Ceanothus prostratus* – *Purshia tridentata*) Association (n=105)

- (b) *Juniperus occidentalis* is typically present to co-dominant with *Pinus ponderosa* and lower elevation shrub species such as *Purshia tridentata*, *Artemisia tridentata*, and *Cercocarpus ledifolius* dominate the shrub layer. *Arctostaphylos patula* is typically absent or insignificant.

*Pinus ponderosa* – *Juniperus occidentalis* / *Artemisia tridentata* – *Purshia tridentata* Association (n=22)

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<sup>2</sup> Treatment of Ponderosa pine in this study: Based on recent taxonomy, “Washoe” pine (formerly *Pinus washoensis*) as discussed by Calliham (2013) is now subsumed into *Pinus ponderosa* ssp. *ponderosa*, Columbia Ponderosa pine. although we use the name here, *Pinus ponderosa* ssp. *ponderosa* is the most widespread subspecies in the study area, although some individuals on the northwest side of the Likely Tableland are probably more closely related to *P. ponderosa* ssp. *critchfieldiana*, Pacific Ponderosa pine.



- (c) *Pinus jeffreyi* is dominant in the overstory while *Juniperus occidentalis* may just be present. Though there may be high shrub diversity, *Artemisia tridentata* ssp. *vaseyana* is the dominant shrub. *Festuca idahoensis* is characteristically present and typically the dominant herb. *Pinus jeffreyi* / *Artemisia tridentata* ssp. *vaseyana* / *Festuca idahoensis* Association (n=6)
- (d) *Pinus ponderosa* is dominant in the overstory while *Juniperus occidentalis* may be present to co-dominant. *Artemisia tridentata* is absent or insignificant in the understory and *Purshia tridentata*, *Ceanothus prostratus*, and *Arctostaphylos patula* dominate the shrub layer. Stands occur at higher elevations in the western portions of the study area or the Warner Mtns., where winter precipitation is relatively greater and persistent snow is more frequent. *Pinus ponderosa* / *Arctostaphylos patula* – *Purshia tridentata* Association (n=37)
- (e) *Pinus ponderosa* var. *washoensis* is dominant in the tree layer with *Arctostaphylos nevadensis* in the understory. *Pinus ponderosa* var. *washoensis* / *Arctostaphylos nevadensis* Association (n=1)
- (f) *Pinus ponderosa* var. *washoensis* is dominant in the tree layer with *Abies concolor* and/or *Pinus contorta*. *Symphoricarpos* spp. is characteristically present in the shrub layer and *Pseudostellaria jamesiana* is characteristically present in the herb layer. Stands of this type are more typical of higher elevation sites in the Warner Mountains (>6500 ft) and are, therefore, not common in the study area. *Pinus ponderosa* var. *washoensis* / *Symphoricarpos* spp. / *Pseudostellaria jamesiana* Association (n=6)
- (2) *Calocedrus decurrens* is dominant to co-dominant with *Pinus ponderosa*. *Abies concolor* may be present but is sub-dominant to the other conifers. *Juniperus occidentalis* is absent or <1% cover. *Pseudotsuga menziesii* is not likely to occur in these stands within the study area. *Pinus ponderosa* – *Calocedrus decurrens* – *Pseudotsuga menziesii* Alliance (n=17)

- (a) The mat-forming shrub *Ceanothus prostratus* may be present in the understory, though it may have very little cover.

*Pinus ponderosa* – *Calocedrus decurrens* / *Ceanothus prostratus*  
Association (n=17)

- iii) *Abies concolor* is dominant to co-dominant in the tree layer with *Pinus ponderosa* or *Pinus jeffreyi*.

***Abies concolor* Alliance** (n=32)

- (1) *Pinus ponderosa* or *Pinus jeffreyi* is co-dominant to absent. *Juniperus occidentalis* may be present but insignificant. *Cercocarpus ledifolius* may or may not be present in the understory. Other higher elevation, cold-tolerant shrubs are present and may include *Ribes* spp., *Symphoricarpos rotundifolius*, *Amelanchier utahensis*, *Artemisia tridentata* ssp. *vaseyana*, and *Prunus* spp. The shrub and herb layers are characteristically sparse (<10% absolute cover) and are low in species diversity.

*Abies concolor* – *Pinus ponderosa* / *Cercocarpus ledifolius* Association  
(n=28)

- 2) Overstory dominated by broad-leaved evergreen or deciduous trees.

- a) Trees are deciduous and depending upon site conditions, may be short and shrubby.

- i) *Quercus kelloggii* is dominant to co-dominant with pines.

***Quercus kelloggii* Alliance** (n=3)

- ii) *Quercus garryana* is dominant to co-dominant with *Juniperus occidentalis*, *Quercus kelloggii*, and/or *Pinus sabiniana*. *Ceanothus cuneatus* is co-dominant in the shrub layer with *Cercocarpus montanus* and *Rhus trilobata*.

*Quercus garryana* / *Ceanothus cuneatus* / *Festuca idahoensis* Association  
(n=4)

of the *Quercus garryana* Alliance (n=4)

- iii) *Populus tremuloides* is dominant to co-dominant in the tree layer (note: stands may be short, resprouting, shrubby “trees”). If co-dominating with *Populus trichocarpa*, then key to *Populus trichocarpa* Alliance.

***Populus tremuloides* Alliance** (n=26)

- (1) *Symphoricarpos rotundifolius* and/or other mesic shrubs are characteristic in the shrub layer. Stands are usually in concavities or on steep sheltered and rocky slopes

*Populus tremuloides* / *Symphoricarpos rotundifolius* Association (n=20)

- iv) *Populus trichocarpa* is dominant to co-dominant in the tree layer along persistent streams. If co-dominant with *Populus tremuloides* key here.

***Populus trichocarpa* Alliance (n=2)**

- b) Trees are evergreen.

- i) Tall shrubs or small trees of *Cercocarpus ledifolius* dominant to co-dominant in the mid/shrub layer. Other shrubs may include *Artemisia tridentata* (various subspecies), *Symphoricarpos rotundifolius*, *Prunus virginiana*, *Ribes velutinum* and/or *Purshia tridentata*. *Juniperus occidentalis* and *Pinus ponderosa* may be emergent in the tree layer but do not have enough cover to key to the *Juniperus occidentalis* Alliance or the *Pinus ponderosa* / Shrub Understory Alliance.

***Cercocarpus ledifolius*<sup>3</sup> Alliance (n=49)**

- (1) *Artemisia tridentata* ssp. *vaseyana* is typically co-dominant in the shrub layer with *Cercocarpus ledifolius*, and no other shrub species are present with comparable cover.

*Cercocarpus ledifolius* – *Artemisia tridentata* ssp. *vaseyana* Association  
(n=16)

- (2) *Cercocarpus ledifolius* is strongly dominant with low cover other shrubs such as *Ribes velutinum*, *Symphoricarpos rotundifolius*, and/or *Prunus virginiana*. *Artemisia tridentata* is typically present at low cover.

*Cercocarpus ledifolius* Association (n=25)

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<sup>3</sup> *Cercocarpus ledifolius* is considered under separate tree and shrub Alliances in the NVCS. However, there is much overlap in California so we put it in one shrub Alliance following Sawyer et al. (2009).



## II. Shrubland

- 1) Upland shrub stands dominated or co-dominated by a species of *Artemisia* and/or *Purshia tridentata*.
  - a) Stands characterized by the low subshrub *Artemisia arbuscula* and/or *A. nova* (dominant layer is generally < 0.5 m tall).
    - i) *Artemisia arbuscula* is strongly dominant to co-dominant in the shrub layer. *Purshia tridentata*, *Artemisia tridentata*, *Ericameria* spp., and *Chrysothamnus* spp. may be co-dominant to sub-dominant. *A. arbuscula* stands tend to grow on flats or gradual slopes and tolerate heavier clay soils ("pimpled plains" clay accretion mounds), or otherwise more impervious (shallow, or very rocky) soil than the various subspecies of *A. tridentata*. Stands are susceptible to type conversion. Many stands are in transition between *Artemisia arbuscula* and non-native annual grasses (*Bromus tectorum*, *Ventenata dubia*, and *Elymus caput-medusae*) or are sites of rapid and recent colonization by *Juniperus occidentalis*. *Artemisia arbuscula* ssp. *arbuscula* dominates. *Artemisia nova* is absent.

### ***Artemisia arbuscula* Alliance (n=192)**

- (1) *Artemisia arbuscula* is dominant and evenly distributed in the shrub layer and is usually >10% absolute cover although it may be as low as 3% absolute cover. Herb layer is sparse to moderately dense and is usually dominated by native grasses such as *Poa secunda* and *Pseudoroegneria spicata* although non-native annual grasses can exceed cover of natives. Other herbs may include *Blepharipappus scaber*, *Epilobium brachycarpum*, and *Antennaria dimorpha*. Typically found on flats or gentle slopes (0-5 degrees) with variable cover (0->35%) of surficial rock (cobble, stone, boulder, and/or bedrock).

#### *Artemisia arbuscula* / *Poa secunda* Association (n=130)

- (2) Stands are in a degraded state from clearing, grazing, fire, or other disturbances (although the mode of disturbance may not be obvious). *A. arbuscula* is dominant in the shrub layer although it may be as low as 5% absolute cover. The herbaceous layer typically has higher cover than more pristine stands of the Alliance and is dominated by non-native annual grasses such as *Bromus tectorum* and *Elymus caput-medusae*. Native herbaceous cover is usually insignificant.

#### *Artemisia arbuscula* / *Bromus* spp. – *Elymus caput-medusae* Association (n=19)

- (3) *Artemisia arbuscula* is the dominant shrub and one or more *Eriogonum* spp. subshrubs is characteristically present. Soils are very shallow with

insignificant organic content, and the substrate is often derived from ash flows or pumice and may often be less weathered than other local subshrub vegetation. Herb layer is very sparse but typically high in native forb diversity including *Phlox hoodii*, *Balsamorhiza hookeri*, *Phoenicaulis cheiranthoides*, *Lomatium* spp., and annual *Eriogonum* spp.

*Artemisia arbuscula* – *Eriogonum* (*microthecum*, *sphaerocephalum*)  
Association (n=27)

- (4) *Festuca idahoensis* dominates the herb layer. Stands occur in the northern portion of the study area at higher elevations where it is cooler and there is more precipitation.

*Artemisia arbuscula* ssp. *arbuscula* / *Festuca idahoensis* Shrub Grassland  
(n=15)

- ii) *Artemisia nova* is dominant to co-dominant in the shrub layer with *Artemisia arbuscula*. Overall shrub cover may be as low as 3% and is often under 10%. Although stands are ecologically similar and often co-dominate with *Artemisia arbuscula*, *A. nova* is much less common than *A. arbuscula* in the study area.

***Artemisia nova* Alliance** (n=11)

- (1) *Poa secunda* is characteristically present in the herb layer. Other common herbs may include *Antennaria dimorpha*, *Blepharipappus scaber*, and *Pseudoroegneria spicata*.

*Artemisia nova* / *Poa secunda* Association (n=8)

- b) *Artemisia tridentata* (ssp. *tridentata* or *vaseyana*) is dominant to co-dominant with *Purshia tridentata*, *Ericameria nauseosa*, *Symphoricarpos rotundifolius*, *Artemisia arbuscula*, or *Chrysothamnus viscidiflorus* in the shrub layer. If *Purshia tridentata* is >50% relative cover then key to *Purshia tridentata* – *Artemisia tridentata* Alliance. *Juniperus occidentalis* may occur at <3% cover in the overstory. Shrub cover is often >10% absolute cover and herb cover often <10% absolute cover with high relative cover of native herbs.

- i) *Artemisia tridentata* is dominant to co-dominant in the shrub layer (if *A. tridentata* ssp. *vaseyana* is present see Associations in the *Artemisia tridentata* ssp. *vaseyana* Alliance). *Purshia tridentata* may be present as a co-dominant but if it is >50% relative cover then key to *Purshia tridentata* – *Artemisia tridentata* Alliance.

***Artemisia tridentata* Alliance<sup>4</sup>** (n=179)

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<sup>4</sup> In the NVCS, *Artemisia tridentata* and its subspecies have been divided into multiple Alliances in the cool deserts of Western North America. Thus, the names for some of

- (1) *Artemisia tridentata* is strongly dominant to co-dominant with *Chrysothamnus viscidiflorus* or *Purshia tridentata* (if *P. tridentata* is >50% relative cover key to *Purshia tridentata* – *Artemisia tridentata* Alliance). The herb layer is sparse to moderately dense with high relative cover of native herbs. Stands are on lower slopes to bottom topographic positions with heavy soils. Many have significant regeneration of *Juniperus occidentalis*. If *A. tridentata* is co-dominating with *Chrysothamnus viscidiflorus* or *Ericameria nauseosa* then the herb layer has high relative nativity and signs of disturbance are minimal.

*Artemisia tridentata* Association (n=118)

- (2) *Artemisia tridentata* is dominant to co-dominant with or without *Ericameria nauseosa* and/or *Chrysothamnus viscidiflorus*. Shrub cover averages around 10% cover but may be as low as 2% and herb cover is typically >10% absolute cover, with very low relative cover of native herbs. Signs of disturbance such as fire, grazing, and roads/trails are present and typically severe. Herb layer is characterized by high non-native grass cover and very low nativity in general.

*Artemisia tridentata* – (*Ericameria nauseosa*) / *Bromus tectorum*  
Association (n=35)

- (3) *Ephedra viridis* is characteristically present in the shrub layer, sub-dominant to dominant with *Artemisia tridentata*. *E. viridis* may be <1%. *Artemisia tridentata* may not be present if the stand has had recent disturbance. *Pseudoroegneria spicata* may co-dominate in the herb layer.

*Artemisia tridentata* – *Ephedra viridis* / *Pseudoroegneria spicata*  
Provisional Association (n=21)

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the Associations technically fall within multiple Alliances, including ***Artemisia tridentata* ssp. *tridentata* – *Artemisia tridentata* ssp. *xericensis* Mesic Shrubland & Steppe Alliance, *Artemisia tridentata* ssp. *tridentata* – *Artemisia tridentata* ssp. *xericensis* Dry Steppe & Shrubland Alliance, *Artemisia tridentata* – Mixed Shrub Dry Steppe & Shrubland Alliance and *Artemisia tridentata* ssp. *wyomingensis* Mesic Steppe & Shrubland Alliance**. The gradational nature of infraspecific taxa in *A. tridentata*, outside of subsp. *vaseyanana*, seem insufficiently differentiated in the California botanical collections and the currently accepted Associations in the USNVC lack strongly diagnostic species. We currently follow the second edition of *A Manual of California Vegetation* (Sawyer et al. 2009) by recognizing only *Artemisia tridentata* ssp. *vaseyana* (mountain big sagebrush) Alliance and a more broadly defined *Artemisia tridentata*.



- (4) *Artemisia tridentata* is dominant to co-dominant with alkali- or salt-tolerant species such as *Distichlis spicata* and *Iva axillaris*. Stands are restricted to valleys or Pleistocene lakebeds with somewhat alkaline soils. Type is uncommon in the study area.

*Artemisia tridentata* / *Distichlis spicata* Provisional Association (n=3)

- ii) *Artemisia tridentata* ssp. *vaseyana* and/or *Symphoricarpos rotundifolius* dominate in the shrub layer. Found at higher elevations on slopes and ridges, often associated with *Cercocarpus ledifolius*, *Abies concolor*, and the winter-deciduous shrubs *Holodiscus discolor*, *Prunus virginiana*, *P. emarginata*, and shrubby *Populus tremuloides*.

***Artemisia tridentata* ssp. *vaseyana* Alliance** (n=92)

- (1) *Artemisia tridentata* ssp. *vaseyana* is strongly dominant to co-dominant in the shrub layer with *Purshia tridentata*, *Tetradymia canescens*, and/or *Chrysothamnus viscidiflorus*. Emergent *Pinus jeffreyi* and *Juniperus occidentalis* are often present although at low cover. *Festuca idahoensis* is dominant to co-dominant in the herb layer with *Poa secunda*, *Achnatherum thurberianum*, *Pseudoroegneria spicata* and/or *Achillea millefolium*.

*Artemisia tridentata* ssp. *vaseyana* / *Festuca idahoensis* Association  
(n=33)

- (2) The sparse shrub layer is co-dominated by *Artemisia tridentata*, *Salvia dorrii* and/or *Chamaebatiaria millefolium*. Shrub diversity can be high but other shrub species will usually have very little cover. Herb cover is usually <10% absolute cover and may include *Penstemon deustus*, *Achnatherum thurberianum*, and *Mimulus suksdorfii*. Stands are on lava breaks or small escarpments where jumbled boulders of basalt and other volcanic rock are present.

*Artemisia tridentata* – *Salvia dorrii* – *Chamaebatiaria millefolium*  
Association (n=19)

- (3) *Artemisia tridentata* ssp. *vaseyana* dominates or co-dominates with mesic shrubs such as *Symphoricarpos rotundifolius* (a synonym for the Jepson manual's *S. oreophilus*), *Ribes velutinum*, and/or *Prunus virginiana*. *Bromus carinatus* and other mesic herbs are found in the understory. *Artemisia tridentata* ssp. *vaseyana* – *Symphoricarpos oreophilus* / *Bromus carinatus* Association (n=29)

- (4) *Symphoricarpos rotundifolius* (a synonym for the Jepson manual's *S. oreophilus*) co-dominates in the shrub layer with *Chrysothamnus viscidiflorus*, but without *Artemisia tridentata* ssp. *vaseyana*. Stands with high cover of *Wyethia mollis* and low shrub cover key here. This type is indicative of disturbance (fire, grazing, clearing) and is successional related to stands formerly dominated or co dominated by *Artemisia tridentata* ssp. *vaseyana*.

*Symphoricarpos oreophilus* Association (n=10)

- c) *Artemisia cana* (ssp. *bolanderi*) is strongly dominant in the shrub layer. *Chrysothamnus* species may co-dominate in disturbed versions of this type. Herb layer may include vernal pool indicators such as *Psilocarphus brevissimus* and *Navarretia* spp. or more generally moist herbs such as *Hordeum brachyantherum*, *Muhlenbergia richardsonis*, and *Juncus* spp. Stands of this type occur on mesic sites including basin bottoms, stream terraces, swales, and flats.

***Artemisia cana* Alliance** (n=55)

*Artemisia cana* (ssp. *bolanderi*, ssp. *viscidula*) / *Poa secunda* Association (n=44)

- d) *Purshia tridentata* is always present with at least 50% relative cover and dominant to co-dominant in the shrub layer with *Artemisia tridentata* and/or *Tetradymia canescens*. If *P. tridentata* does not have at least 50% relative cover, and *A. tridentata* is important, key to *Artemisia tridentata* Alliance. *A. tridentata* may or may not be present. *Juniperus occidentalis* may be present in the overstory at low cover. Typically found on moderately steep, north facing slopes. If stands are disturbed by clearing or fire, *Tetradymia canescens* may replace *P. tridentata* as dominant shrub.

***Purshia tridentata* – *Artemisia tridentata* Alliance** (n=51)

- i) *Purshia tridentata* is dominant to co-dominant in the shrub layer with or without *Artemisia tridentata*. The herb layer is dominated by grasses including *Poa secunda*, *Pseudoroegneria spicata*, *Achnatherum thurberianum*, *Festuca idahoensis*, and/or *Bromus tectorum*.

*Purshia tridentata* – *Artemisia tridentata* Association (n=31)

- ii) *Purshia tridentata* is dominant to co-dominant with *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and/or *Artemisia tridentata* in the shrub layer. Substrate is very sandy and supports a very sparse herb layer that may include *Achnatherum hymenoides*, *Phacelia ramosissima*, and/or *Hesperostipa comata*. Locally stands are best represented on the stabilized dunes on the east side of the Madeline Plain.

*Purshia tridentata* – *Artemisia tridentata* / *Achnatherum hymenoides*  
Association (n=4)

- iii) *Tetradymia canescens* or *Tetradymia glabrata* are strongly dominant in the shrub layer with other disturbance related species such as *Chrysothamnus viscidiflorus* and *Ericameria nauseosa*. Severe disturbance is indicated by lack of *Purshia tridentata* and *Artemisia tridentata* cover. The herb layer is dominated by non-natives such as *Bromus tectorum*, *Tragopogon dubius*, and/or *Sisymbrium altissimum*.

*Tetradymia canescens* Provisional Association (n=11)

- 2) Stands of upland or wetland (riparian, basins, etc.) shrubs without conspicuous presence or dominance of the genus *Artemisia*.

- a) Upland shrub stands.

- i) *Amelanchier utahensis* or *Cercocarpus montanus* are dominant in the shrub layer.

***Amelanchier utahensis* – *Cercocarpus montanus* – *Cercocarpus intricatus* Alliance** (n=2)

- (1) *Amelanchier utahensis* is strongly dominant in the shrub layer.

*Amelanchier utahensis* Association (n=1)

- (2) *Cercocarpus montanus* is co-dominant to dominant in the shrub layer with *Artemisia arbuscula*.

*Cercocarpus montanus* / *Pseudoroegneria spicata* Association (n=1)

- ii) *Tetradymia canescens* or *Tetradymia glabrata* are strongly dominant in the shrub layer with other disturbance related species such as *Chrysothamnus viscidiflorus* and *Ericameria nauseosa*. Significant recent disturbance is indicated by lack of *Purshia tridentata* and *Artemisia tridentata* cover. The herb layer is dominated by non-natives such as *Bromus tectorum*, *Tragopogon dubius*, and/or *Sisymbrium altissimum*.

*Tetradymia canescens* Provisional Association (n=11)  
of the ***Purshia tridentata* – *Artemisia tridentata* Alliance**

- iii) *Ribes velutinum* is dominant in the shrub layer with *Cercocarpus ledifolius*, *Ericameria nauseosa*, *Prunus virginiana*, and/or *Prunus subcordata*. *Leymus cinereus* may be dominant in the herb layer.

*Ribes velutinum* Provisional Association (n=3)  
of the ***Prunus emarginata* – *Holodiscus discolor* Alliance**



- iv) *Chrysothamnus viscidiflorus* dominates in the shrub layer without significant cover of *Artemisia tridentata* or *Purshia tridentata*. *Poa secunda* is generally present in the herb layer. In disturbed sites, *Bromus tectorum* may dominate the herb layer.

*Chrysothamnus viscidiflorus* Association (n=13)  
of the ***Chrysothamnus viscidiflorus* Alliance** (n=13)

- v) Stands are composed of shrubs with evergreen, stiff or thickened leaves.
- (1) *Ceanothus velutinus* is dominant to co-dominant in the shrub layer with *Prunus emarginata*, *Symphoricarpos rotundifolius*, and *Artemisia tridentata*. If *C. velutinus* is co-dominating with *Arctostaphylos patula* then key to the *Arctostaphylos patula* – *Ceanothus velutinus* Association (*Arctostaphylos patula* – *Arctostaphylos nevadensis* Alliance). Typically found on moderately steep (>10 degrees), north-facing slopes. Emergent *Abies concolor* may be present. Herb layer may include *Bromus carinatus*, *Wyethia angustifolia*, and/or *Crepis acuminata*. Evidence of fire is common (locally after fires, *C. velutinus* germinates from seed bank within burned stands of conifers or *Cercocarpus*).

***Ceanothus velutinus* Alliance** (n=16)

- (a) *Ceanothus velutinus* is strongly dominate in the shrub layer. *Prunus emarginata* and *Artemisia tridentata* (ssp. *vaseyana*) might be present as sub-dominants.

*Ceanothus velutinus* Association (n=11)

- (b) *Ceanothus velutinus* is co-dominant with *Prunus emarginata*. Other shrubs like *Symphoricarpos rotundifolius* and *Artemisia tridentata* (ssp. *vaseyana*) are often present.

*Ceanothus velutinus* – *Prunus emarginata* – *Artemisia tridentata*  
Association (n=5)

- (2) Tall shrubs or small trees of *Cercocarpus ledifolius* dominant to co-dominant in the mid/shrub layer. Other shrubs may include *Artemisia tridentata* (various subspecies), *Symphoricarpos rotundifolius*, *Prunus virginiana*, *Ribes velutinum* and/or *Purshia tridentata*. *Juniperus occidentalis* and *Pinus ponderosa* may be emergent in the tree layer but do not have enough cover to key to the *Juniperus occidentalis* Alliance or the *Pinus ponderosa* / Shrub Understory Alliance

***Cercocarpus ledifolius*<sup>5</sup> Alliance** (n=49)

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<sup>5</sup> *Cercocarpus ledifolius* is considered under separate tree and shrub Alliances in the NVCS. However, there is much overlap in California so we put it in one shrub Alliance following Sawyer et al. (2009).

- (a) *Artemisia tridentata* ssp. *vaseyana* is typically co-dominant in the shrub layer with *Cercocarpus ledifolius*, and no other shrub species are present with comparable cover.

*Cercocarpus ledifolius* – *Artemisia tridentata* ssp. *vaseyana*  
Association (n=16)

- (b) *Cercocarpus ledifolius* is strongly dominant with low cover of other shrubs such as *Ribes velutinum*, *Symphoricarpos rotundifolius*, and/or *Prunus virginiana*. *Artemisia tridentata* is typically present at low cover. Typically found on rocky, north facing slopes and/or where *Cercocarpus ledifolius* is dense with a closing canopy.

*Cercocarpus ledifolius* Association (n=25)

- (3) *Arctostaphylos patula* is strongly dominant to co-dominant in the shrub layer with *Ceanothus velutinus*, *Cercocarpus ledifolius*, and/or *Artemisia tridentata* ssp. *vaseyana*.

***Arctostaphylos patula* – *Arctostaphylos nevadensis* Alliance** (n=13)

- (a) *Arctostaphylos patula* is strongly dominant in the shrub layer though many other shrub species may be present at low cover including *Cercocarpus ledifolius*, *Purshia tridentata*, and/or *Ceanothus velutinus*. Herb layer is usually sparse and may include *Poa secunda*, *Achillea millefolium* or *Castilleja applegatei*.

*Arctostaphylos patula* Association (n=6)

- (b) *Arctostaphylos patula* and *Ceanothus velutinus* co-dominate in the shrub layer with *Cercocarpus ledifolius*, *Prunus emarginata*, and/or *Ceanothus prostratus*. Herb layer is sparse and variable in species composition but may include *Viola purpurea*, *Wyethia mollis*, or *Elymus elymoides*.

*Arctostaphylos patula* – *Ceanothus velutinus* Association (n=7)

- (4) *Chrysolepis sempervirens* is dominant in the shrub layer. Stands of this type are rare in this study area.

*Chrysolepis sempervirens* Association (n=1)  
of the *Chrysolepis sempervirens* Alliance (n=1)

- vi) Dominant or characteristic shrubs are soft-leaved members of the genus *Ericameria* or *Eriogonum*.

- (1) *Ericameria nauseosa* is typically strongly dominant in the shrub layer with or without *Artemisia arbuscula* or *Artemisia tridentata*.

***Ericameria nauseosa* Alliance (n=64)**

- (a) The understory herb layer is characteristically sparse (<10%) and has a decent native component that may include *Poa secunda*, *Epilobium brachycarpum*, and/or *Pseudoroegneria spicata*.

*Ericameria nauseosa* Association (n=45)

- (b) Evidence of disturbance from fire, grazing, or other clearing is present. Typically, the low diversity herbaceous layer is dominated by non-native annual herbs such as *Bromus tectorum*, *Sisymbrium altissimum*, and *Taeniatherum caput-medusae*.

*Ericameria nauseosa* / *Bromus tectorum* Association (n=18)

- (2) Dwarf shrub *Eriogonum* spp. (*E. vimineum*, *E. sphaerocephalum*, *E. prociduum*) are characteristically present even as low as <1% cover and usually no other shrubs are present with greater cover. Generally, on flats or exposed hilltops with significant volcanic cobble and/or gravel covering the soil surface. Total vegetation cover is usually <10% and often <5%. This type is related to the *Artemisia arbuscula* – *Eriogonum* (*microthecum*, *sphaerocephalum*) Association, but occurs on harsher sites where an evenly-distributed subshrub layer dominated by *Artemisia arbuscula* is unlikely.

***Eriogonum* spp. / *Poa secunda* Alliance (n=36)**

*Eriogonum sphaerocephalum* / *Poa secunda* Association (n=35)

- vii) Dominant or characteristic shrubs are associated with old playas or lakeshores occurring on semi-alkaline, sandy, or clayey soils. Stands are only known from the southern portion of the study area.

- (1) *Krascheninnikovia lanata* is dominant to co-dominant in the shrub layer.

***Krascheninnikovia lanata* Alliance (n=1)**

- (2) *Atriplex canescens* is dominant to co-dominant in the shrub layer with *Psoralea polydenia* and *Tetradymia glabrata*.

***Atriplex canescens* Alliance (n=1)**

- viii) Dominant or characteristic shrubs are winter-deciduous members of the genus *Prunus* or *Holodiscus*.

- (1) *Holodiscus discolor*, *Prunus emarginata* and/or *Ribes velutinum* dominate in the shrub layer. *Symphoricarpos rotundifolius*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and *Artemisia tridentata* may be



present as co-dominants or sub-dominants. Stands are found in forest openings or on rock outcrops.

***Prunus emarginata* – *Holodiscus discolor* Alliance (n=12)**

- (a) *Ribes velutinum* is dominant to co-dominant in the shrub layer with *Cercocarpus ledifolius* and/or *Prunus* spp.

*Ribes velutinum* Provisional Association (n=3)

- (b) *Holodiscus discolor* is dominant in the shrub layer with *Ericameria nauseosa*, *Chamaebatiaria millefolium*, *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus ledifolius*, and/or *Ribes velutinum*.

*Holodiscus discolor* Association (n=4)

- (c) *Prunus emarginata* is dominant in the shrub layer with *Symphoricarpos rotundifolius*, *Ribes velutinum*, and/or *Amelanchier utahensis*. *Holodiscus discolor* is absent.

*Prunus emarginata* Association (n=8)

- (2) *Prunus virginiana* or *Prunus subcordata* is dominant to co-dominant in the shrub layer. Typically found on rocky, moderately steep to steep (>10 degrees) north facing slopes.

***Prunus virginiana* Alliance (n=22)**

- (a) *Prunus virginiana* is dominant in the shrub layer with *Symphoricarpos rotundifolius*, *Ribes* spp., and/or *Cercocarpus ledifolius*. Herb layer is usually sparse and may include *Leymus cinereus*, *Lupinus argenteus*, *Agastache urticifolia*, and/or *Crepis acuminata*.

*Prunus virginiana* / *Symphoricarpos rotundifolius* Association (n=14)

- (b) *Prunus subcordata* is strongly dominant in the shrub layer with *Ericameria nauseosa*, *Prunus virginiana*, and/or *Ribes velutinum*.

*Prunus subcordata* Provisional Association (n=4)

b) Wetland shrub stands.

- i) Stands associated with larger playas or former Pleistocene lakebeds on fine, clayey soils often with a distinctly light color relative to adjacent upland substrates. *Sarcobatus vermiculatus* is dominant to sub-dominant in the shrub layer with *Artemisia tridentata*, *Atriplex confertifolia*, and/or *Chrysothamnus* spp. Herb layer is sparse, typically <10%. Stands are found on flats adjacent to playas.

***Sarcobatus vermiculatus* Alliance (n=26)**

- (1) *Sarcobatus vermiculatus* is dominant to sub-dominant with *Chrysothamnus viscidiflorus* and/or *Artemisia tridentata* in the shrub layer.  
*Sarcobatus vermiculatus* – *Artemisia tridentata* Association (n=15)
  - (2) *Sarcobatus vermiculatus* is dominant to sub-dominant with *Picrothamnus desertorum* and/or *Atriplex confertifolia*.  
*Sarcobatus vermiculatus* – *Atriplex confertifolia* – (*Picrothamnus desertorum*, *Suaeda moquinii*) Association (n=7)
- ii) Shrub stands associated with non-alkaline wetlands such as streams, lakes, sloughs, or ditches. The genus *Salix* is dominant.
- (1) *Salix exigua* is dominant or co-dominant in the shrub layer with *Salix lasiolepis*, *Rosa woodsii* and/or *Ribes cereum*.  
***Salix exigua* Alliance** (n=6)
  - (2) *Salix lasiolepis* is strongly dominant to co-dominant with *Cornus sericea* in the shrub layer. If *Salix exigua* is present, it is sub-dominant. *Salix lasiandra* var. *lasiandra* is absent.  
***Salix lasiolepis* Alliance** (n=9)
    - (a) *Rosa woodsii* may be present in the shrub layer. A variety of wetland species can be found in the herb layer including *Carex simulata*, *Artemisia douglasiana*, *Scirpus microcarpus*, or *Achillea millefolium*.  
*Salix lasiolepis* – *Rosa woodsii* / Mixed Herbs Association (n=9)
  - (3) Shrubby *Salix lasiandra* var. *lasiandra* or *S. lasiandra* var. *caudata* (*Salix lucida*, *Salix lasiandra* in some taxonomies) is characteristic of the large shrub layer. *Salix lasiolepis* may be dominant.  
***Salix boothii* – *Salix geyeriana* – *Salix lutea* Alliance** (n=10)
    - (a) *Poa pratensis* is often in the herb layer although it may have very low cover. Other herbaceous species may include *Epilobium ciliatum*, *Agrostis gigantea*, *Mimulus guttatus*, and/or *Equisetum arvense*.  
*Salix lucida* / *Poa pratensis* Association (n=9)
  - (4) *Betula occidentalis* is dominant in the shrub layer with *Salix lasiolepis* and *Rosa woodsii*.  
***Betula occidentalis* Alliance** (n=1)

- (5) *Cornus sericea* or *Rosa woodsii* is dominant or co-dominant in the shrub canopy.

***Cornus sericea* – *Rosa woodsii* – *Ribes spp.* Alliance** (n=5)

- (a) *Cornus sericea* is dominant to co-dominant in the shrub layer with *Prunus virginiana* or *Salix scouleriana*.

*Cornus sericea* Association (n=4)

- (b) *Rosa woodsii* is greater than 50% relative cover in the shrub layer.

*Rosa woodsii* Association (n=1)



### III. Herbaceous stands

1) Upland stands without any long-term accumulation of water. Stands may be on slopes, flats, or ridges, but are not typical of concave drainages or basins.

- a) Stands dominated and/or characterized by native perennial grasses such as *Elymus smithii*, *Pseudoroegneria spicata*, *Elymus elymoides*, *Poa secunda*, and/or *Festuca idahoensis*.

#### **Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group**

- i) *Elymus smithii* is present, with at least 20% relative cover, with other mesic herbs such as *Juncus balticus* and *Eleocharis* spp. The most extensive stands of this vegetation occur on the northern slopes of Shinn Mountain and adjacent areas to the north between 6000 and 7000 ft elevation. Stands range from concavities and swales to mesic middle slopes. Much of this area was affected by the 2012 Rush fire and the grasslands dominated or co-dominated by *E. smithii* as sampled 4-6 years after the fire appear successional to *Purshia tridentata*-*Artemisia tridentata*, or *A. tridentata* var. *vaseyana* Alliance stands.

*Elymus smithii* Stands (n=1)

- ii) Stands dominated and/or characterized by *Festuca idahoensis*, *Elymus spicatus*, and/or *Poa secunda*, without significant cover of *Elymus smithii*. Non-native annual grasses such as *Bromus tectorum* and *Taeniatherum caput-medusae* may exceed the cover of native grasses but total herbaceous nativity is usually >20% relative cover.

*Festuca idahoensis* – *Pseudoroegneria spicata* – *Poa secunda* Alliance (n=137)

- (1) Stands are characterized by *Pseudoroegneria spicata* and/or *Poa secunda*, usually on warmer aspects with rocky substrate. Non-native species such as *Bromus tectorum* or *Elymus caput-medusae* often co-dominate or dominate the herb layer but native cover is usually >20%. Other native herb species present include *Elymus elymoides*, *Epilobium brachycarpum*, *Blepharipappus scaber*, *Achnatherum thurberianum*, and/or *Lomatium* spp. *Festuca idahoensis* may be present but sub-dominant. Stands have typically burned within the past 10 years.

*Pseudoroegneria spicata* – *Poa secunda* Association (n=128)

- (2) Stands dominated or co-dominated by *Festuca idahoensis* with *Bromus tectorum*, *Elymus elymoides*, *Pseudoroegneria spicata*, and/or *Achnatherum thurberianum*. Compared to the *Pseudoroegneria spicata* – *Poa secunda* Grassland Association, stands are generally found on upper slopes on neutral to cooler aspects above 5500 ft.

*Festuca idahoensis* – *Pseudoroegneria spicata* Provisional Association (n=6)

- b) Upland stands dominated by non-native annual grasses and/or herbs.
  - i) Stands widespread and not solely associated with pastures or human habitation. Usually associated with recent fire or clearing and often formerly dominated by woody plants including *Artemisia arbuscula*, *Artemisia tridentata*, *Cercocarpus ledifolius*, or *Juniperus occidentalis* (evidence of charred stems or stumps is often found nearby).

**Intermountain Ruderal Steppe and Shrubland Group**

- (1) Stand with >75% relative cover of non-native herbs and grasses such as *Bromus tectorum*, *Elymus caput-medusae*, *Ventenata dubia*, *Poa bulbosa*, and *Sisymbrium altissimum*. *Elymus elymoides* may dominate or co-dominate although no single native species with significant cover is present. Signs of disturbance are typically present, such as fire, roads or trails, grazing, or *Juniperus occidentalis* removal.

***Bromus tectorum* – *Elymus caput-medusae* Alliance (n=109)**

- (a) *Bromus tectorum* is usually strongly dominant to co-dominant in the herb layer with *Elymus elymoides*, *Sisymbrium altissimum*, *Erodium cicutarium*, and/or *Descurainia sophia*. *Elymus caput-medusae* may be present but only as a sub-dominant. *Elymus elymoides* may be strongly dominant in areas with juniper removal. Low cover of shrubs such as *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, and/or *Tetradymia glabrata* may be present but usually patchy.

***Bromus tectorum* Association (n=53)**

- (b) *Elymus caput-medusae* is strongly dominant to co-dominant with *Bromus tectorum*, *Bromus arvensis*, *Erodium cicutarium*, and/or *Lactuca serriola*. If co-dominant with *Ventenata dubia* key to *Ventenata dubia* Provisional Association.

***Elymus caput-medusae* Provisional Association (n=33)**

- (c) *Ventenata dubia* is dominant to co-dominant with *Elymus caput-medusae*, *Bromus tectorum*, *Bromus arvensis*, and/or *Elymus caput-medusae*. Stands are in slightly more mesic sites compared to stands of *Elymus caput-medusae* Intermontane Provisional Association, including small swales and rocky flats with some water accumulation possible from spring to early summer.

***Ventenata dubia* Provisional Association (n=20)**

- ii) Stands strongly dominated by *Elymus elymoides* with all other herbaceous species with very little cover. Species diversity is very low and may have obvious signs of disturbance such as fire and/or Juniper removal.

**Intermountain Semi-Desert Grassland Group**

*Aristida purpurea* – *Elymus elymoides* – *Poa secunda* Alliance

*Elymus elymoides* Provisional Association (n=4)

- iii) Stands of moist or upland lower slopes locally associated with ranch buildings and maintained pastures.

- (1) Stands dominated by non-native *Festuca perennis* (*Lolium perenne*), with the bright-yellow flowered *Lotus corniculatus* conspicuous. Uncommon. Found in heavily grazed or disturbed lands adjacent to human modification.

**Californian Ruderal Grassland, Meadow & Scrub Group**

***Festuca perennis* Alliance** (n=1)

*Festuca perennis* – *Lotus corniculatus* Association (n=1)

- 2) Stands of marshes, bottomlands, basins, swales, meadows, vernal pools, or other areas that are moist, wet, or saturated for much of the growing season. Depending on the year some areas may be dry but have evidence of water flow or ponding.

- a) Stands composed largely of short to tall perennial grasses and/or graminoids associated with alkaline and/or heavy soils of large basins, playas, or flats.

**North American Desert Alkaline-Saline Marsh & Playa Group**

- i) Stands characterized by saltgrass, *Distichlis spicata*, though other herbaceous species may have higher cover. May have other halophytes (*Bassia*, *Nitrophila*, etc.). Found at Horse Lake and expected on other Pleistocene alkaline lakebeds/playas. If *Juncus balticus* co-dominates then key here.

***Distichlis spicata* Alliance** (n=4)

- ii) *Eleocharis rostellata* is dominant in the herb layer. Rare and local at mineralized springs, forming a raised peat fen strongly dominated by *E. rostellata*. This species is a strong indicator of basic pH wetlands and is only locally represented from a few known sites in California.

*Eleocharis rostellata* Association (n=1)

of the ***Eleocharis (palustris, rostellata)* Alliance** (n=1)

- iii) Grassland stands of relatively heavy soils (including clay mounds), not always in obvious alkaline basins, but often moist in early summer. *Elymus triticoides*



or *E. cinereus* are obvious and consistent throughout stand and are dominant to sub-dominant in the herbaceous layer with *Bromus tectorum*, *Poa secunda*, and/or *Descurainia sophia*. Stands are on lower slopes, often conspicuous following fires.

***Elymus cinereus* – *Elymus triticoides* Alliance** (n=19)

- (1) The large tufted perennial grass *Elymus* (*Leymus*) *cinereus* is dominant to co-dominant with *Poa secunda* and/or *Bromus tectorum*.

*Elymus cinereus* Association (n=14)

- (2) *Elymus triticoides* dominant to co-dominant with *Poa secunda*. *Poa secunda* may be absent.

*Elymus triticoides* – *Poa secunda* Association (n=3)

- b) Stands of persistent fresh-water wetlands (wet meadows and stream-sides) or stands of seasonal fresh or somewhat alkaline wetlands.

- i) Stands of seasonally drying edges of reservoirs, lakes, livestock ponds, or vernal pools and swales.

- (1) Stands, in peak phenology, contain several genera typical of California vernal pools, including: *Eleocharis* (especially *E. acicularis*, or *E. macrostachya*), *Psilocarphus*, *Downingia* spp., *Gratiola*, and/or *Epilobium* (subgenus *Boisduvalia*).

***Eleocharis macrostachya* Alliance** (n=17)  
of the **Californian Vernal Pool Group**

- (a) *Eleocharis macrostachya* is co-dominant with other vernal pool species including *Downingia bacigalupii*, *Marsilea vestita*, and *Trifolium cyathiferum*.

*Eleocharis macrostachya* Vernal Pool Provisional Association (n=12)

- (2) Stands, in peak phenology, contain several genera typical of seasonal or ephemeral wetlands of the Great Basin, from montane Eastern California, to E Oregon, and E Washington. Settings include vernal saturated or flooded flats and smaller vernal pools. The key species include *Navarretia*

*leucocephala*, *Muhlenbergia richardsonis*, *Polygonum aviculare*, and/or *Downingia bacigalupii*.

***Navarretia leucocephala* ssp. *minima* – *Plagiobothrys cusickii***

**Alliance (n=37)**

of the **Oregon-Washington-British Columbia Vernal Pool Group**

- (a) *Taraxia tanacetifolia* and/or *Iva axillaris* dominate to co-dominate with other Great Basin vernal pool species such as *Polygonum aviculare*, *Psilocarphus brevissimus* and/or *Muhlenbergia richardsonis*.

*Taraxia tanacetifolia* – *Iva axillaris* Provisional Association (n=24)

- (3) Stands without strong representatives from either the Californian or Eastern Oregon/Washington Vernal Pool Groups, but species more widespread and typical of slightly alkaline western interior seasonal wetlands such as *Muhlenbergia* spp., *Carex douglasii*, *Poa secunda* (moist meadow ecotypes), *Taraxia tanacetifolia*.

- (a) Stands characterized by the presence of *Carex douglasii*.

*Carex douglasii* Association (n=5)

of the ***Poa secunda* – *Muhlenbergia richardsonis* – *Carex douglasii***

**Alliance (n=6) of the Vancouverian – Rocky Mountain Montane Wet Meadow & Marsh Group**

- ii) Stands occurring in flooded, wet, moist, or saturated meadows, stream-sides, springs, or swales. Water is usually fresh and not strongly alkaline or salty. This is a large Group that encompasses stands that hold moisture in the soil until mid to late summer or stands that dry out before mid-summer. Dominated by wet meadow sedges, rushes, and grasses.

**Vancouverian – Rocky Mountain Montane Wet Meadow & Marsh Group**

- (1) Stands dominated by *Solidago canadensis*.

***Solidago canadensis* Alliance (n=1)**

- (2) Stands dominated or co-dominated by *Scirpus microcarpus*.

***Scirpus microcarpus* Alliance (n=1)**

- (3) Stands dominated or co-dominated by rushes (*Juncus* spp.) of several species. May be mixed with sedges or grasses, but rushes are most conspicuous.

- (a) *Juncus nevadensis* is dominant to co-dominant with *Juncus arcticus*.

*Juncus nevadensis* Association (n=3)

of the ***Juncus nevadensis* Alliance**

- (b) *Juncus* (*balticus*, *mexicanus*, *arcticus*) is dominant to co-dominant *Trifolium hybridum*, *Poa pratensis*, *Achillea millefolium* and other wetland herbs. If co-dominant with *Deschampsia cespitosa* then key to *Deschampsia cespitosa* Association in the *Deschampsia cespitosa* Alliance. If co-dominant with *Distichlis spicata* then key to *Distichlis spicata* Alliance.

*Juncus arcticus* var. *balticus* – (var. *mexicanus*) Association  
(n=27)

of the ***Juncus balticus* – *Juncus mexicanus* Alliance** (n=29)

- (4) Stands not clearly dominated by sedges or rushes. May be moist to relatively dry later in the growing season. Dominated by grasses or herbs of small to large stature.

- (a) Stands dominated by relatively short native grasses.

- (i) *Hordeum brachyantherum* dominant to co-dominant in herb layer with *Juncus arcticus*, *Poa secunda*, and/or *Phleum pratense*.

*Hordeum brachyantherum* Association (n=4)

of the ***Danthonia californica* – *Deschampsia cespitosa* –  
*Camassia quamash* Alliance** (n=4)

- (ii) Moist meadow stands with *Danthonia unispicata*, and/or broad-leaved bulbiferous monocots such as *Triteleia hyacinthina* or *Camassia* spp. conspicuous. *Poa secunda* is usually present to co-dominant. Other herbs may include *Lomatium bicolor*, *Blepharipappus scaber*, and *Epilobium minutum*.

*Danthonia unispicata* – *Poa secunda* Association (n=25)

of the ***Danthonia californica* – *Deschampsia cespitosa* – *Camassia quamash* Alliance** (n=32)

- (5) Stands dominated by wet meadow sedges or spike rushes.

- (a) *Carex aquatilis* and/or *Carex lenticularis* dominate the herb layer.

*Carex aquatilis* – *Carex lenticularis* Association (n=4)  
of the ***Carex (aquatilis, lenticularis)* Alliance** (n=4)



(b) *Carex simulata* present and conspicuous.

*Carex simulata* Association (n=3)  
of the ***Carex simulata* Alliance** (n=3)

(c) *Carex scopulorum* is dominant in the herb layer.

*Carex scopulorum* Association (n=1)  
of the ***Carex scopulorum* Alliance** (n=1)

(d) *Carex praegracilis* is dominant to co-dominant in the herb layer.

*Carex praegracilis* Association (n=2)  
of the ***Carex (pansa, praegracilis)* Alliance** (n=2)

(e) *Carex nebrascensis* is present and conspicuous and is evenly distributed. Stands may be dominated by other meadow species including *Juncus bufonius*.

*Carex nebrascensis* Association (n=5)  
of the ***Carex nebrascensis* Alliance** (n=5)

(f) *Eleocharis quinqueflora* is dominant in the herb layer, stands are small and often associated with fens.

***Eleocharis quinqueflora* Alliance** (n=1)

(6) Stands with co-dominant *Deschampsia cespitosa* with other wet meadow herbs including *Juncus balticus*, *Eleocharis macrostachya*, and *Juncus nevadensis*.

*Deschampsia cespitosa* Association (n=3)  
of the ***Danthonia californica* – *Deschampsia cespitosa* – *Camassia quamash* Alliance** (n=3)

iii) Stands dominated by larger non-native perennial pasture grasses (including *Phalaris arundinacea*, *Phleum pratense*, *Poa pratensis*, *Agrostis gigantea*).

**Western North American Ruderal Marsh, Wet Meadow & Shrubland Group**

(1) *Phalaris arundinacea* is dominant in the herb layer with *Juncus arcticus*, *Carex lenticularis*, and/or *Euthamia occidentalis*.

*Phalaris arundinacea* Association (n=2)  
of the ***Phalaris aquatica* – *Phalaris arundinacea* Alliance** (n=2)

(2) Stands dominated by *Agrostis gigantea*, *A. stolonifera*, *Alopecurus pratensis*, *Phleum pratense*, or *Poa pratensis*.

***Poa pratensis* – *Agrostis gigantea* – *Agrostis stolonifera* Alliance**  
(n=4)

(a) *Agrostis gigantea* is dominant in the herb layer.

*Agrostis (gigantea, stolonifera)* Association (n=1)

(b) *Phleum pratense* and/or *Poa pratense* dominate or co-dominate in the herb layer.

*Phleum pratense* – *Poa pratense* – *Bromus* spp. Association (n=3)

iv) Stands dominated by broad-leaved annual or perennial herbs. These often have a shorter early season saturation period than typically adjacent meadows of the *Juncus balticus* – *Juncus mexicanus* and the *Danthonia* spp. – *Camassia* spp. Wet Meadow Alliances.

(1) Small moist meadow stands dominated by the conspicuous trifoliate, hairy-leafed, pink-flowered, annual *Acmispon americanus* (*Lotus purshianus*).

**Californian Annual Grassland & Forb Meadow Group**  
***Acmispon americanus* Provisional Alliance** (n=4)

(2) Stands dominated by *Artemisia douglasiana*. Only known along an intermittent stream channel surrounded by coniferous forest on the western edge of the study area.

**Temperate Pacific Freshwater Wet Mudflat Group**  
***Bidens cernua* – *Euthamia occidentalis* – *Ludwigia palustris***  
**Alliance** (n=1)  
*Artemisia douglasiana* Provisional Association (n=1)

v) Stands perennially flooded or saturated during the summer. Plants either emergent or floating at peak phenology.

(1) Stands of plants with stems or leaves emergent out of water during peak growing season, but not supported by water.

**Arid West Interior Freshwater Marsh Group**

(a) Wetlands (ponds, ditches, lake margins) dominated by *Typha* species.

*Typha domingensis* Association (n=1)

of the ***Typha domingensis* – *Typha latifolia* – *Typha angustifolia* Alliance** (n=1)

- (2) Stands composed of anchored or unanchored floating-leafed hydrophytes on ponds, shallow lakes, or in slow moving streams or sloughs.

**Western North American Temperate Freshwater Aquatic Vegetation  
Group (n=2)**



## Terms and Concepts used throughout the key

**Stand:** The basic physical unit of plant communities in a landscape. It has no set size. Some vegetation stands are very small, such as certain wetland types, and some may be several square kilometers in size, such as certain forest types. A stand is defined by two main unifying characteristics:

1. It has compositional integrity. Throughout the stand, the combination of species is similar. The stand is differentiated from adjacent stands by a discernible boundary that may be abrupt or occur indistinctly along an ecological gradient.
2. It has structural integrity. It has a similar history or environmental setting that affords relatively similar horizontal and vertical spacing of plant species. For example, a hillside forest originally dominated by the same species that burned on the upper part of the slopes but not the lower would be divided into two stands. Likewise, a sparse woodland occupying a slope with very shallow rocky soils would be considered a different stand from an adjacent slope with deeper, moister soil and a denser woodland or forest of the same species.

The compositional and structural features of a stand are often combined into a term called homogeneity. For an area to meet the definition of a stand, it must be homogeneous at the scale being considered.

United States National Vegetation Classification (USNVC): A central organizing framework for how all vegetation in the United States is inventoried and studied, from broad scale formations (biomes) to fine-scale plant communities. The purpose of the NVC is to produce uniform statistics about vegetation resources across the nation, based on vegetation data gathered at local, regional, or national levels.

The hierarchy units in the USNVC from highest to lowest (i.e., broadest to finest) are:

1. Formation Class
2. Formation Subclass
3. Formation
4. Division
5. MacroGroup
6. Group
7. Alliance
8. Association

**Alliance:** Plant communities based on dominant/diagnostic species of the uppermost or dominant stratum. Accepted Alliances are part of the USNVC hierarchy. For the Modoc-

Lassen Vegetation Map, map classes for trees and shrubs are typically at the Alliance level of the USNVC hierarchy. Herbaceous stands are mapped at a higher level of the hierarchy.

**Association:** The most botanically detailed or finest-scale plant community designation based on dominant species and multiple co-dominant or sub-dominant indicator species from any stratum. Associations are also part of the USNVC hierarchy.

**Plant community nomenclature:** Species separated by "-" are within the same stratum; species separated by "/" are in different strata.

**Cover:** The primary metric used to quantify the importance/abundance of a particular species or a particular vegetation layer within a stand. It is measured by estimating the aerial extent of the living plants, or the bird's-eye view looking from above, for each category. Cover in this mapping project uses the concept of "porosity" or foliar cover rather than "opacity" or crown cover. Thus, field crews are trained to estimate the amount of light versus shade produced by the canopy of a plant or a stratum by taking into account the amount of shade it casts excluding the openings it may have in the interstitial spaces (e.g., between leaves or branches). This is assumed to provide a more realistic estimate of the actual amount of shade cast by the individual or stratum which, in turn, relates to the actual amount of light available to individual species or strata beneath it. However, as a result, cover estimates can vary substantially between leaf-on versus leaf-off conditions. Stands dominated by deciduous species (e.g., *Aesculus californica*, *Toxicodendron diversilobum*) should be sampled during leaf-on since they will have substantially less cover when leaves are absent and may key to another type.

**Absolute cover:** The actual percentage of the surface area of the survey that is covered by a species or physiognomic Group (trees, shrubs, herbaceous), as in "tan oak covers 10% of the area being surveyed." Absolute cover of all species or physiognomic Groups, when added together, may total greater than 100%, because this is not a proportional number and plants can overlap with each other. For example, a stand could have 25% tree cover in the upper layer, 40% shrub cover in the middle layer, and 50% herbaceous cover when surveyed on the ground. However, when aerial interpretation is being used, the maximum absolute value is 100%, since lower levels of vegetation cannot be seen through the overstory on aerial photographs.

**Relative cover:** The percentage of surface area within a survey area that is covered either by one species relative to other species within the same physiognomic stratum (tree, shrub, herbaceous) or one stratum relative to the total vegetation cover in a polygon. Thus, 50% relative cover of *Quercus douglasii* in the tree layer means that *Q. douglasii* comprises half the cover of all tree species within a stand, while 50% relative shrub cover means that shrubs make up half the cover of all vegetation within a stand. Relative cover values are proportional numbers that, when added together, total 100% for all the species within a stratum or each stratum within a stand of vegetation.

**Dominance:** Dominance refers to the preponderance of vegetation cover in a stand of uniform composition and site history. It may refer to cover of an individual species as in "dominated by tan oak," or it may refer to dominance by a physiognomic Group, as in "dominated by shrubs." When we use the term in the key, a species is dominant if it is in relatively high cover in each stand. See "dominance by layer," below, for further explanation.

**Strongly dominant:** A species in the dominant lifeform stratum has 60% or greater relative cover.

**Co-dominant:** Co-dominance refers to two or more species in a stand with similar cover. Specifically, each species has between 30% and 60% relative cover. For example, in a coastal scrub stand with 5% *Baccharis pilularis*, 4% *Frangula californica*, and 3% *Rubus ursinus* (total 13% shrub cover), technically only the *Baccharis* ( $5/13 = 39\%$  relative cover) and the *Frangula* ( $4/13 = 31\%$  relative cover) would be co-dominant because *Rubus* would only have 23% relative cover ( $3/13 = 23\%$ ).

**Characteristic/Diagnostic species:** Should be present in at least 80% of the stands of the type, with no restriction on cover. Relatively even spacing throughout the stand is important, particularly in vegetation with low total cover, since an even distribution of the diagnostic species is a much better indicator than overall cover. Characteristic species that are evenly distributed are better indicators of a type than species with higher cover and patchy distribution.

**Dominance by layer/stratum:** Tree, shrub, and herbaceous layers are considered physiognomically distinct. Alliances are usually named by the dominant and/or characteristic species of the tallest characteristic layer (see tree-characterized, shrub-characterized, and herb-characterized vegetation definitions below). Average covers within the dominant layer reflect the "modal" concept of the health/age/environment of a particular vegetation type. For example, a higher average cover of woody plants within a stand not recently affected by disturbance reflects a mode of general availability of water, nutrition, and equitable climate, while lower average cover under similar conditions would reflect lower availability of these things.

**Tree:** A one-stemmed woody plant that normally grows to be greater than 5 meters tall. In some cases, trees may be multi-stemmed (ramified due to fire or other disturbance) but the height of mature plants typically exceeds 5 meters. If less than 5 meters tall, undisturbed individuals of these species are usually single-stemmed. Certain species that sometimes resemble shrubs but may be trees in other areas (e.g., *Aesculus californica*) are, out of statewide tradition or by the USNVC, called trees. It behooves one to memorize which species are "traditionally" placed in one life-form or another. We use the accepted lifeforms in the USNVC or the PLANTS Database (USDA NRCS 2015) to do this.

**Forest:** In the USNVC, a forest is defined as a tree-dominated stand of vegetation with 60% or greater absolute cover of trees. Most forest Alliances tend to have average



cover of trees >60%, but individual stands under certain conditions may drop lower than 60%.

**Woodland:** In the USNVC, a woodland is defined as a tree-dominated stand of vegetation with between 25% and 60% absolute cover of trees. Most woodland Alliances tend to have average cover of trees with 25-60%, but individual stands under certain conditions may drop higher or lower than this range.

**Emergent:** A plant (or vegetation layer) is considered emergent if it has low cover and rises above a layer with more cover in the stand. For example, individual *Pseudotsuga menziesii* trees may comprise an emergent tree layer of 2% cover over dense *Gaultheria shallon* and *Rubus parviflorus* in the shrub understory; the stand would be considered within the *Gaultheria shallon* – *Rubus (ursinus)* Shrubland Alliance because the total tree cover is <10% and the shrub cover is >10%. Medium to tall shrubs are not considered emergent over shorter shrubs, but short trees are considered emergent over tall shrubs.

**Shrub:** A multi-stemmed woody plant that is usually 0.2-5 meters tall. Definitions are blurred at the low and high ends of the height scales. At the tall end, shrubs may approach tree-size based on disturbance frequencies (e.g., old-growth re-sprouting chaparral species such as *Cercocarpus montanus*, *Fremontodendron californicum*, *Prunus ilicifolia*, and so forth, may frequently attain "tree size", but are still typically multi-stemmed and are considered shrubs in this key). At the short end, woody perennial herbs or subshrubs of various species are often difficult to categorize into a consistent life-form (e.g., *Eriogonum latifolium*, *Lupinus chamissonis*); in such instances, we refer to the PLANTS Database or "pick a lane" based on best available definitions.

**Subshrub:** A multi-stemmed plant with noticeably woody stems less than 0.5 meter tall. May be easily confused with a perennial herb or small shrub. We lump them into the "shrub" category in stand tables and descriptions of vegetation types.

**Shrub-characterized vegetation:** Shrubs, including subshrubs, are evenly distributed throughout the stand, providing a consistent (even if sparse) structural component; the stand cannot be characterized as a tree stand; and one or both of the following criteria are met: 1) shrubs influence the distribution or population dynamics of other plant species; 2) shrubs play an important role in ecological processes within the stand. Shrub Alliances typically have at least 10% absolute shrub cover.

**Herbaceous plant:** Any species of plant that has no main woody stem development; includes grasses, forbs, and perennial species that die back each year.

**Herb-characterized vegetation:** Herbs are evenly distributed throughout the stand, providing a consistent (even if sparse) structural component and playing an important role in ecological processes within the stand. The stand cannot be characterized as a tree or shrub stand.